Inpatient treatment of people with schizophrenia: quantifying clinical change using the Health of the Nation Outcome Scales

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Abstract

Schizophrenia can require hospital inpatient care in crisis periods or times of severe symptoms, although the length of hospital stays has been considerably reduced in the last few decades. Evidence on individual outcomes under routine psychiatric practice conditions is sparse. This study aims to evaluate the outcomes of inpatient treatment in patients with schizophrenia using the reliable and clinically significant change approach. We used routinely collected Health of the Nation Outcome Scales (HoNOS) data to assess the extent to which and the areas where symptomatic and functional improvement was achieved. Data from 1783 schizophrenia patients admitted to a large psychiatric centre in Switzerland were examined.

Mean HoNOS total score dropped from 17.9 to 11.7 (effect size 0.8) during treatment; the greatest improvements were achieved regarding symptomatic problems and aggressive, agitated behaviour. According to the reliable change index formula, 24.5% of patients were to be considered improved, 73.3% unchanged and 2.2% deteriorated. In total, 56.6% were discharged from the hospital in a subclinical or mild functional state. The degree of individual improvement and time to achieve maximum symptom reduction varied considerably, depending on the patients' functional state at admission, as did the length of hospital stay (median 28 days). Rates of readmission within 28 days (17.8%) were significantly lower in patients with clinically significant improvement, discharged in better clinical condition. These findings support reconsidering (length of) inpatient treatment within the overall framework of meaningful clinical change and subsequent treatment needs in patients with schizophrenia.

Keywords  Schizophrenic disorder, inpatients, clinical outcome, functional impairment, length of stay, readmission
Introduction

Schizophrenia is a particularly severe disorder and one of the leading causes of disability worldwide. According to the Global Burden of Disease study 2016, schizophrenia was ranked as the 12th most disabling disorder globally. Long-term outcome studies report that a large number of schizophrenia patients have residual symptoms between episodes (13%–48%) or a chronic course of illness (10%–40%; 2,3). Moreover, schizophrenia is often associated with co-occurring mental or behavioural disorders and other medical conditions. Impairment in daily life is thus significant, with major implications for independence of residence, ability to work and social interactions. Life-long mental health care and support therefore remains vital for most individuals with schizophrenia.

Despite the development of drug treatments and of community-based alternatives to psychiatric hospital care in the last decades, readmissions to hospital due to clinical deterioration are still frequent in the treatment of schizophrenia. A recent meta-analysis reported that more than half (55%) of all first episode psychosis (FEP) patients required hospitalisation over an average follow-up of 7 years after FEP. Moreover, the proportion of people with FEP who were readmitted to a psychiatric hospital remained stable over time (1966-2017). Findings based on a number of longitudinal studies from German-speaking countries actually suggested that patients suffering from schizophrenia are more (or most) likely to be ‘high utilizers’ of inpatient psychiatric services. In Switzerland, treatment for an ICD-10 F2 main diagnosis currently accounts for about one fifth of all inpatient admissions (19.4% in 2019) according to national psychiatry statistics covering the 42 acute care psychiatric hospitals in Switzerland.

Hospital-based treatment, however, has been efficiently reduced in most high-income countries for many years. In the European Union, psychiatric care beds in hospitals decreased on average per 100’000 inhabitants from 74.9 in 2008 to 68.0 in 2018. For individuals with schizophrenia length of stay in the hospital (LOS) was considerably reduced. In Switzerland, e.g., LOS has decreased by half for patients with psychoses in the space of three decades and is now below the OECD average.
This development has been driven by several factors: concerns about the counter-productive effects of reduced autonomy, availability of alternative treatment options, service users’ preferences, and, not least, increasing pressure to cut public expenditure on health care, particularly in view of the fact that hospitalizations account for a large share of health care costs. 

Nevertheless, it is widely acknowledged that hospital admissions are unavoidable in people with an acute exacerbation of psychosis that cannot be managed safely in an outpatient setting. According to the German Association for Psychiatry, Psychotherapy and Psychosomatics (DGPPN) S3-guideline for schizophrenia, ‘inpatient psychiatric-psychotherapeutic treatment is offered if patients require particular diagnostic and therapeutic measures or need the special protection of the hospital because they pose an acute risk to themselves or others’ (17, p. 79), and it is recommended ‘that hospitalizations are short and planned, if possible’ (17, p. 78). A guideline cannot precisely specify ‘short’ (LOS) of course, i.e. how long it will take to reduce the risk of self-harm or harm to others, positive psychotic symptoms, aggression or agitation to a degree that allows safely discharging a patient into the community. In clinical practice, it is most often at the attending psychiatrist’s discretion, who, in coordination with a multi-professional team, performs this clinical evaluation, based on his/her own judgement and experience. Routine clinical data are rarely used as a standard for the evaluation process. This development has been driven by several factors: concerns about the counter-productive effects of reduced autonomy, availability of alternative treatment options, service users’ preferences, and, not least, increasing pressure to cut public expenditure on health care, particularly in view of the fact that hospitalizations account for a large share of health care costs. Despite the vital role hospital admission still plays in the treatment of schizophrenia, information on the magnitude of individual change (compared to initial symptoms, behaviour problems or functional disabilities) achieved in clinical inpatient settings is still scant. In particular, it is not fully understood how length of hospital care translates into symptomatic and functional improvement in patients with psychoses. Moreover, important questions regarding the effects of shortening LOS on clinical outcomes remain unanswered, e.g., questions regarding the necessary
and sufficient LOS to ensure clinically meaningful change, or the patient groups most likely to benefit from a shorter hospital stay. Therefore, the extent to which LOS may be further reduced whilst still resulting in clinically relevant outcomes and meeting the needs of the patients concerned is a matter of ongoing dispute.

With the adoption of quality control processes, routine outcome monitoring has been implemented nationwide in many countries, including Switzerland, to promote the evaluation of mental health services performance. Measuring clinically meaningful change during treatment is a key part of this. For the evaluation of such data, performance indicators have been proposed and statistically explored. On the basis of these methods several studies have been carried out recently in the Netherlands and Italy, yielding results for large patient samples treated in community mental health services, integrated mental health institutions, a medical psychiatric unit of a general hospital, and child mental health facilities. Such evaluations go far beyond the conventional use of statistical significance tests (to compare pre-post treatment group means), shifting the focus from ‘is there any difference’ to ‘how big is the difference’. These studies examined outcomes on a service level, however, thus covering a broad range of mental disorders, rather than focusing on people with psychoses.

In the present study we sought to apply these indicators of treatment outcome to an unselected sample of patients who received inpatient treatment for schizophrenia or related disorders. To determine clinical change during inpatient treatment we used HoNOS (Health of the Nation Outcome Scale) data collected in everyday clinical practice. Specifically, this study aimed:

- to assess the extent to which, and in what areas, symptomatic and functional improvement is achieved in this patient group in terms of categorical indicators of clinically meaningful change and pre-post treatment differences;
- to study how treatment outcomes relate to the length of inpatient stay,
- and how outcomes relate to the risk of hospital readmission shortly after discharge.
Ethical approval for this secondary analysis of health-related patient data was obtained from the Swiss Ethics Committees on research involving humans (EKNZ ID 2020-01804).

**Methods**

**Sample – data basis**

Between January 1, 2016 and December 31, 2019, a total of 11,876 people received inpatient treatment in the Department of Psychiatry and Psychotherapy of the Psychiatric Services Aargau (PDAG). The PDAG comprise all mental health services in the Swiss Canton of Aargau, a catchment area of around 690,000 inhabitants. The PDAG, within which the Department of Psychiatry and Psychotherapy covers the mental health care for adults, have a mandate to provide acute mental health care for the whole population. This study included all patients aged between 18 and 65 years who had been treated for schizophrenia or related disorders (main diagnosis ICD-10 F2). In total, 2249 inpatient admissions meeting the inclusion criteria during the index period were identified (basic sample).

**Inpatient treatment**

The treatment of schizophrenia in the PDAG includes pharmacological and non-pharmacological therapeutic interventions according to the DGPPN S3 guideline for schizophrenia. The non-pharmacological treatment particularly consists of psychoeducational and psychotherapeutic interventions, cognitive and social skills training, occupational and exercise therapy as well as family and community interventions, provided by a multi-professional treatment team. In the case of severely aggressive and agitated behaviour in combination with the high risk of self-harm or harm to others, de-escalating interventions including seclusion and/or parenteral medication may be required.
Data collection

The patients’ sociodemographic, diagnostic and treatment-related data were extracted from the electronic medical database of the PDAG. All psychiatric hospitals in Switzerland are obliged to report data on admissions, discharges, and treatment measures in a standardized form to the Federal Office of Statistics. The completeness of these documents is regularly monitored. The hospital doctors in charge of a given patient are responsible for diagnostic assessments and for completing the documentation.

Within the framework of the national quality assurance programme (ANQ), psychiatric hospitals are moreover committed to evaluating the inpatient treatment the patients received. The Health of the Nation Outcome Scale (HoNOS), an internationally established instrument for the assessment of clinical problems and social functioning of patients with mental illness, is used in this study to evaluate treatment outcomes. The Swiss ANQ provides an anchored version of the HoNOS, however the raters had no special training. The HoNOS ratings were made by the attending doctors within the first three days after admission to the hospital (t1) and within the last three days before leaving the hospital (t2).

HoNOS

The HoNOS comprises 12 items covering four key areas of functioning: behaviour, impairment, symptoms, and social functioning. Each of the 12 items is rated on a 0 - 4 scale of severity (0 = no problem; 1 = minor problem requiring no action; 2 = mild problem but definitely present; 3 = moderately severe problem; 4 = severe to very severe problem). Reference time period for the assessment are the previous 7 days.

The reliability of the HoNOS has been reported to be fair to good. Validity in terms of congruence with responses on conceptually similar instruments, like CGI, GAF, BPRS (convergent
validity) and sensitivity to change was found to be satisfactory \(^{25,26}\). Normative data from a functional population are lacking for this instrument \(^{22}\).

We excluded from the current analysis HoNOS ratings in which more than 3 rateable items were left uncompleted, because there were doubts about the adherence to assessment guidelines and clinical validity of such evaluations (t1: N=5; t2: N=3; 460 measures missing completely). Thus, HoNOS measures were available for N=2244 (99.8% of the basic sample) upon admission and for N=1786 (79.4%) upon discharge. In 1783 patients (79.3%) a HoNOS assessment had been made at admission and at discharge (study sample).

In cases in which a HoNOS evaluation had \(\leq 3\) missing items, we imputed the missing values using the \textit{Weighted mean approach} proposed by Gale and others. This approach is regarded as highly useful for predicting missing item scores accurately in routinely used depression scales \(^{27}\) and has been found to yield more accurate predictions for HoNOS data in modelling studies than other techniques of imputation \(^{28}\). Considering that these studies were based on patient samples with a wide range of mental health conditions within general psychiatry, we generated new HoNOS item weights from our database (confined to schizophrenia patients). HoNOS measures that contained a full set of valid scores (t1: N=1445; t2: N=1490) were used to establish the item weights for the 12 items. Missing item values were then replaced by the resultant weighted mean scores of all completed items.

\textbf{Dropout analysis}

A dropout analysis comparing clinical aspects of patients with (study sample) and without HoNOS discharge assessments (dropouts) revealed statistically significant group differences in several clinical aspects.

Most importantly, of the 463 dropouts, 431 (93.1%) had left the psychiatric hospital within 7 days after admission. According to the ANQ guidelines a second HoNOS assessment was not required for
these cases during the index period of this study, which is why second HoNOS assessments were not available.

Regarding relevant clinical aspects of patients without HoNOS t2 assessments, 61.2% of them had been in the hospital only for crisis intervention (vs. 20.7% of the study sample), and 45.4% had left the hospital against medical advice (vs. 17.7%). A higher percentage of the dropout group was male (66.1% vs. 60.5%). Moreover, the dropout group was on average 4.5 years younger (36.2y vs. 40.7y). Overall, almost one in four patients had a substance use disorder as a comorbid condition. In the dropout group, however, comorbidity with substance use disorders was, at 27.6%, more prevalent than in the study sample (20.4%).

Regarding the HoNOS ratings at admission, there were statistically significant, albeit small differences between the dropout and study sample on all HoNOS items except item 11 (living conditions). Therefore, the HoNOS t1 scores of the basic sample are presented in Table 2, in addition to those of the study sample.

**Indicators of treatment outcome**

(1) Mean difference $\Delta$t1-t2 and effects size (ES)

As a statistical indicator of change under treatment we computed the standardised mean difference between HoNOS scores at admission and at discharge (effect size; ES), which is the most commonly used effect indicator to denote within-group effect size in treatment outcome research. Positive values of $\Delta$t1-t2 indicate a lower level of severity in this study, while negative values indicate a higher level of severity at t2, compared with t1.

(2) Classification of severity

To analyse outcomes beyond conventional pre-post tests of differences on a group level we used further (clinical) criteria. The HoNOS were constructed to be as independent as possible, with each
item rating representing a clinical judgement of severity in itself. We therefore classified ‘severity’ based on the number of individual items with a certain severity score, instead of using cut-offs based on the total score. We used the criteria suggested by Parabiaghi\textsuperscript{20} to discriminate between four categories: a score of \(\geq 3\) on at least one HoNOS item was adopted to discriminate between ‘severe’ and ‘non-severe’ cases. Subjects with a score of \(\geq 3\) on at least two HoNOS items were classified as ‘very severe’. Non-severe subjects were regarded as ‘subclinical’ if they had scores < 2 on all items. Subjects were classified as ‘mild’ if they had a score of 2 on at least one item. Thus, the sample was stratified into four severity groups, both at admission and at discharge.

(3) Reliable change index (RCI)

The RCI, developed by Jacobson & Truax\textsuperscript{29}, is a psychometric criterion used to decide whether the change in an individual’s score is statistically significant or not, based on how reliable the measure is. For measures based on the Jacobson-Truax method, ecological validity has been established\textsuperscript{30} and they are widely used to determine meaningful individual improvement. In the present study we specified a 95% confidence level which equates to a RCI of \(\geq 1.96\). We estimated the standard error of measurement using the reliability statistic for the HoNOS total score (Cronbach’s \(\alpha = 0.713\)). On this basis we calculated the RCI adopting the formula of Jacobson & Truax. The resulting RCI of 10.5 means that an individual change score greater than this would occur in less than 5% of the cases through the fluctuations of imprecise measuring alone. Differences in HoNOS scores at admission and at discharge within the range of +11 and -11 were therefore classified as ‘no reliable change’, whereas change scores of +11 or above are regarded as significant improvement and change scores of -11 or below as significant deterioration.

Considering that some prior studies\textsuperscript{18,20,31} are based on a RCI change threshold of \(\geq 8\), we furthermore analysed our data using this less stringent cut-off. These results will be included in the tables to allow for comparability.
(4) Reliable and clinically significant change (RCSC)

To study statistical significance of change together with the symptomatic and functional state in which the patient had left the hospital, we combined the two criteria ‘level of severity’ (as described above) and ‘RCI’. Thus, we determined the proportion of patients whose HoNOS total score not only had improved significantly, but whose scores also had moved out of the category of ‘severe’ cases to a mild or subclinical level of severity at t2.

Similarly, the proportion of patients with significantly deteriorated change scores who had moved from a ‘non-severe’ to a ‘severe’ group was determined. This was the case in only a small minority of the sample (39; 2.2%). We therefore merged this group with the RCSC group ‘unchanged’ in the further analyses.

Statistical analysis

Effect size statistics in the present study are calculated within a repeated measures design. Therefore, we used the formula for correlated measures applying Psychometrica to compute ES with 95% confidence intervals. Test results are considered statistically significant at $P < 0.05$, two-tailed.

To compare patients with and without a HoNOS discharge assessment (dropout analysis) regarding clinical patient characteristics we used independent samples t-tests (HoNOS items; age) and chi$^2$-tests (categorical variables). To test changes in HoNOS measures during inpatient treatment (t2 compared to t1) we applied paired t-tests.

To operationalise ‘use of inpatient psychiatric treatment’ we specified two key parameters: ‘length of inpatient stay’ LOS and ‘time to inpatient re-admission’. LOS, which does not usually have a normal distribution and is extremely right-skewed in our data as well, was analysed using non-parametric tests (dropout comparisons: Mann-Whitney U tests; differences in LOS between HoNOS outcome categories: Mann-Whitney U tests, Kruskal-Wallis tests). In addition, we explored the kind
of association between HoNOS outcome measures and LOS by displaying $\Delta t_1-t_2$ and RCI change rates graphically. To this end the (ranked) LOS data were split up into 10 equally large subsections (deciles). Thus, each decile comprised 1/10 of the sample, corresponding to an increase in LOS of 10 percentage points.

For the analysis of ‘time to readmission’ we used a sub-sample, namely patients who had been discharged from the hospital before September 30, 2019 (N=1671). This selection was made (in this analysis only) to ensure a sufficiently long follow-up period after discharge in all cases. We assessed whether a patient had been readmitted to the psychiatric hospital within a 28-day period following discharge. Readmission to hospital within 28 days is considered to be related to outcome, and serves in some countries as an indicator of the quality of care. We examined the effect of the HoNOS-based indicators of outcome on the readmission risk using logistic regression analysis. Statistical analyses were performed using SPSS version 26.0 (IBM 2019).

Results

Sample characteristics

The descriptive statistics for the basic sample of 2249 patients are displayed in Table 1. The majority of patients included in this study were admitted for a schizophrenic disorder (ICD-10 F20). In 31% of this sample the admission had been compulsory, 23% left the psychiatric hospital against medical advice. Regarding their sociodemographic background, the sample (mainly men; mean age: 40 years) is characterised by a high rate of people dependent on social welfare payments (46%) and living alone (73%).

--- Table 1. Sample characteristics ---
Change in HoNOS scores before and after inpatient treatment

A comparison of mean HoNOS scores at admission (t1) with those at discharge (t2) is shown in Table 2. Between the two time points there was a statistically significant decrease in levels of severity across the 12 HoNOS scales; the HoNOS total score declined from 17.9 to 11.7 ($P < 0.001$). In terms of effect size (ES), the magnitude of change, however, was only small in 8 of the 12 HoNOS scales, whereas in 3 scales (‘aggression/overactivity’, ‘depressive symptoms’, ‘other mental health problems’) the ES value exceeded 0.5, which means that the sample moved half of the standard deviation in the asymptomatic direction on these scales. With an ES of 0.8, changes in the HoNOS scale ‘problems associated with hallucinations and delusions’ and in the HoNOS total score, overall, were most pronounced.

--- Table 2. Comparison of HoNOS scores at admission (t1) and at discharge (t2) ---

Assessing the extent to which symptomatic or functional improvement is achieved we found marked differences in some of the HoNOS scales, depending on the level of severity at admission (Figure 1). Whereas patients who had been classified as ‘severe’ or ‘very severe’ at admission showed greatest improvement during treatment regarding the item ‘hallucinations and delusions’, there were only minor effects in the mild severity group. In the ‘very severe’ group, improvement regarding ‘other mental health problems’ ranged second. In the ‘mild severity’ group the most pronounced improvement was found in ‘aggression/overactivity’ and ‘depressive symptoms’. Across all levels of severity, ‘aggressive, overactive’ behaviour problems had improved at discharge. However, in the ‘mild’ and ‘severe group’ results also suggest that ‘problems with occupation and activities’ had deteriorated at discharge rather than improved.

--- Figure 1 ---

Table 3 shows the proportion of patients moving (at t2) into another severity group according to the severity criteria defined above (left columns), who showed reliable change according to the RCI
(centre columns), or reliable and clinically significant change according to the RCSC (right columns), broken down by severity grouping at t1.

**Categorical shift.** The clinical condition at admission had been classified as very severe in 1167 subjects (65.5%), as severe in 369 (20.7%), and as mild in 247 (13.9% including 1% subclinical states).

The comparison of t1 and t2 rates shows that, in total, the rate of 86.2% admitted with ‘severe or very severe’ functional impairment (score of ≥ 3 in at least one HoNOS item) has been reduced by half at discharge (43.4%). Within the 247 ‘non-severe’ cases at admission, 72.9% had remained in this category at t2, whereas a categorical shift to a ‘severe’ condition was found in 27.1%. Within the group of 1536 ‘severe’ cases at admission, 46.0 % were still classified as ‘severe’ at discharge, whereas a categorical shift to a ‘non-severe’ condition was found in 54.0 %.

**Reliable change.** The relationship between the pairwise individual HoNOS total scores at t1 and t2 is depicted in Figure 1S. According to the RCI determined for this sample, no reliable change (i.e. change beyond what could be attributed to measurement error or chance) was observed in 73.3% of the sample (dots within the 95% confidence limits). In a small number of patients, 2.2% of the sample, HoNOS total scores had significantly deteriorated by t2, whereas in 24.5% a significant improvement was found (RCI ≥ 11). If the less stringent threshold ‘change of at least 8 points’ were to be applied, this would have resulted in a rate of 52.1% being classified as ‘unchanged’, whereas 4.6% would be classified as worsened and 43.3% as improved.

When RCI rates are stratified according to the ‘severity of the clinical condition at admission’, significant deterioration is found in a small minority of cases across all categories of severity at t1. Rates of significantly improved patients (RCI ≥ 11) clearly increased with a higher severity level at t1: whereas in the ‘mild severity’ group the HoNOS total score significantly decreased in 4.0%, we found 8.9% in the ‘severe’ group and 33.7% in the ‘very severe’ group. It is obvious, however, that in mild or subclinical conditions a major decrease in HoNOS scores is basically impossible.
Reliable and clinically significant change. Not all who underwent a reliable significant change between t1 and t2, were fully recovered in the sense that they no longer were classified as ‘severe’ cases according to the above classification of severity. We found reliable and clinically significant change in 17.9% of this sample. The RCSC rate was at 24.2% highest in the ‘very severe’ group at t1.

This means that for almost one in four patients in this group the HoNOS total score had been reduced by 11 points or more and severity of symptoms had reached a mild or subclinical level. (At a cut-off of 8 points, the corresponding RCSC recovery rates are 30.5% in the total sample, and 36.7% in the ‘very severe’ group).

--- Table 3. Categorical shift t1-t2 and clinical change indices of HONOS outcome scores ---

Treatment outcome and length of inpatient stay (LOS)

The average length of stay in hospital in the study sample was 28.0 days (median; mean 36.9; SD 30.4). In 10% of the sample inpatient treatment took longer than 76 days, and in some cases more than 200 days. A higher level of severity at admission was found to be associated with a longer hospital stay: whereas the LOS in patients who had been classified as ‘subclinical/mild’ was 24.0 days (median), it was 26.0 days in the ‘severe’ and 29.0 days in the ‘very severe’ group (LOS differences statistically significant; \( P = 0.013 \)).

Regarding the outcome criterion RCI the group comparison showed that time in hospital was, at 26.0 days (median), shortest in the ‘no reliable change’ group. ‘Reliably improved’ patients stayed 5.5 days longer, i.e. on average 31.5 days, in inpatient treatment. In the small group of ‘reliably deteriorated’ patients, the LOS was 34.0 days (\( P < 0.001 \)).

This corresponds, by and large, to the LOS ascertained for the RCSC groups: Patients with reliable and clinically significant change were in the hospital for 31.0 days on average, whereas in the ‘unchanged or deteriorated’ group LOS was 27.0 days (\( P = 0.001 \)).
To further explore how change in HoNOS scores varies with LOS, we compared outcomes across the 10 decile subsections according to the LOS distribution. Figure 2S gives the extent of improvement ($\Delta t_1-t_2$ HoNOS total score) achieved within each decile group, in total (red line), and stratified by level of severity at $t_1$. The mean $\Delta t_1-t_2$ scores averaged at 1.9 in the ‘subclinical/mild’, 3.4 in the ‘severe’ and 7.9 in the ‘very severe’ group.

As to the total sample, results suggest that improvement was highest in patients who had spent 22-27 days in the psychiatric hospital. Up to this point, HoNOS scores increasingly improved with longer LOS. Marked improvement was also achieved with longer hospital stays, but no greater improvement was found in these patients.

A closer look at the three severity groups shows that the improvement ‘curve’ closely follows this pattern in the ‘very severe’ group. This is not unexpected, considering that this group accounts for 65.5% of the total sample. HoNOS improvements in the ‘very severe’ group were considerably higher throughout all LOS deciles than those of the lower severity groups, peaking at 10.3 points ($\Delta t_1-t_2$) in patients who spent 22-27 days in the hospital. Regarding the ‘severe’ group, the findings suggest that a maximum improvement is already reached after 18-21 days. After 35 days of inpatient stay only small improvements (< 2.9 points) are found (apart from the outlier at LOS ‘77+’). In the ‘subclinical mild’ group, which showed the least pronounced changes throughout, the maximum improvement of 4.1 points occurs even earlier, after 10-13 days. Longer inpatient stay in this severity group was associated with only very small improvement and, after 77 days, even deterioration in clinical problems.

In the same way, outcome in terms of RCI rates was compared across LOS deciles. Figure 3S gives the rate of patients whose HoNOS scores had been classified as reliably improved, unchanged, or worsened within in each time section. This comparison reveals that rates of ‘reliably improved’ patients increased steadily up to 31.2% at LOS 22-27 days and varied between 24.9% and 32.0% after that. Regarding the ‘unchanged’ group which represent a majority (73.3%) of the whole
sample, rates run counter to the above, decreasing from 85.6% to 67.3% up to a LOS of 22–27 days. ‘Reliably deteriorated’ patients were found to be almost evenly distributed across any LOS time (rates between 1.5% and 3.8%).

**Treatment outcome and hospital readmission**

Readmission to hospital soon after discharge is an undesirable course of treatment, in general suggesting that the patient did not remain stable, thus being widely used as a proxy of ‘relapse’. We therefore sought to examine how the HoNOS-based clinical change indices are related to readmission within 28 days of discharge. In total 17.6% were readmitted within 28 days. Results suggest that this rate is directly related to the level of severity at discharge (Table 1S): for those who had been discharged in a clinical condition that had been classified as ‘very severe’, this readmission rate was (at 26.0%) three times that of patients discharged in a ‘subclinical’ level of severity (7.8%).

All clinical change indices were significantly linked to the likelihood of early readmission as well. Regarding the RCI, results suggest that there was an almost 50% decrease in the odds of being readmitted within 28 days given reliable clinical improvement at discharge (OR 0.52; compared to RCI ‘unchanged’). For the RCSC group ‘reliable and clinically significant change’ this risk had decreased even further (OR 0.33). The regression coefficients of all clinical change indices suggest that the risk of being readmitted within 28 days after discharge is significantly lower in ‘improved’, compared to ‘unchanged’ clinical conditions, whereas no such statistical differences were found between ‘unchanged’ and ‘deteriorated’ clinical conditions.

**Discussion**

The present study examines the outcome of inpatient psychiatric treatment of people with schizophrenia and related disorders. We analysed a data-set of 2249 inpatient admissions to a large Swiss psychiatric service to determine the magnitude of individual clinical change and its relationship to LOS.
Symptomatic and functional status at admission

Most of these patients had been admitted to the psychiatric hospital in a severely impaired functional status; adopting the criteria suggested by Parabiaghi\textsuperscript{20}, 86.1\% were classified as severe or very severe. By comparison, the overall level of severity at admission was, with a mean HoNOS total score of 17.9, similar to that reported from Medical Psychiatric Units in the Netherlands (16.2; \textsuperscript{21}). In patients admitted to community mental health services presenting with psychosis, less severe clinical problems were found at initial assessment in a large observational study from the UK (HoNOS total score 11.1; \textsuperscript{33}) as well as in large-scale studies on 'mixed' samples attending community mental health services in Italy and the Netherlands (11.6 \textsuperscript{31}; 12.4 \textsuperscript{18}). Initial scores in these studies are quite close to the mean HoNOS score of our study sample at discharge, or even lower (8.9 \textsuperscript{34}). A comparatively higher level of severity (22.9), however, was reported by a Swiss psychiatric hospital specialized in treating 'heavy-users' for patients with an ICD-10 F2 main diagnosis \textsuperscript{35}. Even if comparisons between patient populations should be made with due caution, these initial scores seem to suggest that opting for inpatient treatment reflects a higher overall level of clinical problems. The current analysis shows that symptomatic problems (hallucinations, delusions) were of primary importance for admission to hospital treatment.

Clinically meaningful change

To examine mental health outcome, pre-post differences are usually analysed relying on statistical significance alone, which does not allow us to draw conclusions on the relevance of clinical outcomes. Measures based on the Jacobson-Truax method therefore have been recommended to evaluate the extent of individual change. In the present study a reliable change was achieved in 24.5\% of the sample during treatment.

There are only few studies in psychiatry that have examined treatment effects using HoNOS measures in this way. A recent study on the functional status and healthcare needs of 50 patients
with complex medical and psychiatric morbidity reported reliable improvement in 8% of this sample. The results of a modelling study based on data from Australian mental health services indicated a rate of 38.0% significantly improved (and 60.8% without significant change) in adults in acute inpatient settings. In a large-scale study evaluating community mental health services in Italy, rates of 14.4% improved, 82.5% stable, and 3.2% worsened have been reported at RCI_{95\%} for the subgroup of patients who had been classified as 'severe'. In all these studies samples of mixed cases were analysed. This suggests that the relatively large proportion of patients who did not show meaningful change during treatment in our study (73.3%) is not a result that specifically characterises the treatment outcome of patients with psychosis. Considering that in community mental health settings 'stabilization' of a patient alone can be regarded as a favourable outcome, whereas in inpatient treatment the efficient reduction of acute symptoms has priority, a higher rate of reliably improved patients, however, is to be expected in inpatient treatment.

Some methodological aspects should also be borne in mind. The proportion of 'improved' (unchanged, worsened) patients immediately depends on the stringency of the criterion for RCI that is applied. As is the case in all statistical hypothesis testing, where the significance level for a test is chosen by the researcher, there is no universal 'reference value'. We used a 95% confidence level because it is most commonly used, but it is clear that a lower threshold would produce a higher proportion of patients who can be considered 'improved'. Moreover, it has been argued that the RCI is a conservative measure, quickly resulting in a large proportion of 'unchanged' patients. It is an asset of the RCI, however, that it explicitly addresses the issue of measurement error, so that we can be reasonably confident that the observed changes are statistically reliable and reflect real improvement, rather than spurious differences. The baseline level of symptom severity is a further factor affecting the likelihood of achieving 'improvement'. In the present sample a large minority of 15.1% had an initial HoNOS score of < 11 and were thus factually unable to pass the threshold of reliable change. On the basis of the data available, it is uncertain whether in these mild forms of symptom or functional severity inpatient admission could have been prevented.
The majority of this sample showed most pronounced improvements regarding problems with hallucinations and delusions. Also, with regard to other mental health problems, depressed mood and aggressive behaviour, substantial changes were identified. This suggests that inpatient treatment was effective in reducing particularly symptomatic and behavioural problems, i.e. those domains in which these patients had scored highest at admission and upon which inpatient treatment of individuals with schizophrenia often primarily concentrates. An evaluation of the effectiveness of routine NHS care in the UK recently showed an outcome profile across the 12 HoNOS scales that is very similar to the one found in the current study, with most notable improvements in the 'hallucinations' and 'other mental and behaviour problems' scales for patients with psychotic mental illnesses. Greatest improvement in symptom domains in which pretest severity was highest is a finding, however, that has been repeatedly reported in the literature. Regarding the further HoNOS scales we found only small effects. As to self-injury and physical illness this could possibly be explained by low prevalence at admission. As to cognitive problems as well as social problems, we can only speculate: difficulties in social and occupational functioning might have been not so much in focus as targets in acute admissions; but it could also mean that these are problem areas that are particularly difficult to change during short inpatient treatment, or that are particularly difficult to change in individuals with psychosis.

The small group of patients (2.2%) whose mental health status significantly deteriorated during inpatient treatment demands our special attention. Further research efforts will be required to understand the key factors behind such worsening and to better address their treatment needs.

Treatment outcome and LOS

Overall, the HoNOS total score improved on average by 6.2 points (ES 0.79). This reduction is within the range other studies (of mostly 'mixed' samples with only few or no psychotic patients) have found, which reported reduction in HoNOS scores ranging between 4.6 and 7.9 (ES 0.6 - 1.58) after inpatient treatment.
Results of this analysis suggest that routine inpatient treatment was effective. Nevertheless, one might ask whether equivalent outcomes would also have been achieved with shorter inpatient stays.

The current study cannot conclusively answer this question, as a well-controlled trial would be necessary, but it may provide a more differentiated picture than the usual analyses of LOS predictors do, in which clinical change during treatment is typically not addressed.

According to the present data hospital stay was on average 4 days longer in patients who achieved reliable and clinically significant change, but the time at which the improvement peak is reached strongly depends on initial symptom severity: Patients with schizophrenia admitted in a very severe clinical condition reached the point of optimal improvement in health and social functioning on average 12 days later than those admitted with only mild clinical problems. In previous research factors related to clinical severity and poor social functioning were usually associated with longer LOS \(^{38,39}\); this is corroborated by the present findings.

The relation between patient outcome and LOS raises the question of the role and the contribution of the tarification system being applied. Reimbursement of in-hospital treatments in Switzerland is regulated by a payment system based on diagnosis-related groups which provides incentives for early discharge of patients in the form of declining daily reimbursements with longer LOS. The impact of this reimbursement system on the quality of care and patient outcomes has not yet been fully understood \(^{39-41}\). Especially with regard to severe mental illness it is still unclear whether it is associated with reduced LOS or improved efficacy of inpatient treatment.

There is evidence from large-scale evaluations of community mental health services in the UK that the severity of initial presenting symptoms in people with psychosis has significantly worsened over the last decade \(^{33,42}\). This effect has been associated with declining continuity of care \(^{42}\) and it has been hypothesized that it might reflect an increased pressure on these services due to increased demand \(^{33}\). The present cross-sectional study does not allow to analyse such time trends. It is plausible, however, to deduce from this data that if hospitals are committed to the imperative to
discharge patients 'as early as possible', this affects schizophrenia patients with the most serious clinical problems particularly, who are then discharged into the community with a higher level of mental health problems.

The present findings furthermore suggest that the relationship between reliable clinical change and observed LOS follows an inverted u-shaped curve rather than a steady increase. This means that after some time in hospital no further increment in functional improvement is achieved, or (in initially mild conditions) improvements are diminishing. A recent study from China analysing optimal length of hospitalization in schizophrenia patients with regard to recovery of daily living functions reported a similar curve-shaped relationship, suggesting improvement up to a minimum LOS of 20 days, but decreasing benefit after 50 days.\textsuperscript{5} LOS must of course be understood within an overall health care system and specific figures may not apply universally. However, what these analyses clearly show is that reasoning about LOS in terms of 'the shorter the better' falls short. Reaching an individual patient's optimal treatment outcome takes time. Likewise, reasoning in terms of 'the longer the better' would not be appropriate either, since functional improvement during inpatient treatment does not follow a linear trend.

**Treatment outcome and inpatient readmission**

Readmission to a psychiatric hospital soon after discharge is a commonly used indicator of quality of care.\textsuperscript{30} It is considered incompatible with functional recovery. Therefore, it might be expected that clinically significant change should translate into readmission rates. The results of this study show that patients with reliable change were significantly less likely (OR 0.52) to be readmitted shortly after their discharge and that for patients discharged with non-severe clinical problems this risk decreased even further.

Of course, readmission risk cannot be explained by the effects of inpatient treatment alone. Stressors the patient experiences in the context of readjusting to daily life after leaving the clinic,
discontinuation of antipsychotic treatment, non-adherence to aftercare, lack of social support or social conflicts may contribute to rapid deterioration and lead to hospital readmission. Such factors might have triggered an early readmission particularly in those who had left the hospital in a good state of mental health.

In Switzerland, a dense network of community-based treatment options is available, and patients are (ordinarily) not discharged without aftercare planning and referral to treatment in a psychiatric day clinic, outpatient treatment by a psychiatrist or to a primary care physician. Considering that psychiatric treatment in Switzerland is covered by mandatory health insurance, the level of income of mentally ill seeking treatment is not a major barrier to health care utilization. The high rate of early readmissions therefore cannot be attributed to a lack of resources or availability of outpatient treatment alternatives to standard inpatient-wards. Rather, the present findings suggest that severely ill patients with schizophrenia do not sufficiently benefit from these services. A reason for this might be that these community-based treatment options require some degree of initiative and activity on the part of the individual to manage to get help, what poses an obstacle in particular for those patients who are discharged at a higher level of severity. Seeing that the outcome of inpatient treatment (in terms of clinical change indices as well as level of severity at discharge) was consistently and significantly linked to the readmission rate within 28 days, however, this strongly suggests that relevant improvement during treatment may have prevented early hospital readmission in many patients in this sample.

The present study only covered a period of 28 days after discharge. Therefore, we cannot draw any conclusions concerning the predictive validity of these outcome indices on the longer run. The impact of clinically significant change during inpatient treatment on the further clinical course and mental health care utilization clearly needs to be addressed in a longitudinal analysis over a longer follow-up period.
Limitations

The data presented in this study are derived from an electronic medical data base. Legal regulations require checking the completeness and plausibility of the medical data so that it is safe to assume that the present study covers all inpatient treatments of people with schizophrenia in the catchment area. Since this analysis is based on routinely collected patient data, however, the findings are limited by the scope and the kind of patient characteristics which could be taken into account in this study. A further limitation is the number of patients in which the HoNOS assessment at discharge was missing. The rate of patients thereby excluded (21%) is nevertheless within expectations (evaluation studies using HoNOS data usually report far higher attrition rates). We must assume, however, that missingness is not random, since it is mainly attributable to the fact that a HoNOS discharge assessment was not made in hospital stays shorter than 7 days. Because it is most unlikely that in these cases the threshold of reliable change had been exceeded, the change rates found in our study sample might overestimate the reliable improvement rate. Accordingly, the results of this analysis might cast too favourable a light on the effects of inpatient treatment on patients with schizophrenia overall; they are representative only of those schizophrenia patients who had received inpatient treatment for at least a short period of time. Considering that a large proportion of patients admitted to the hospital for short crisis intervention only were discharged without a second HoNOS assessment, crisis intervention patients are clearly underrepresented in the HoNOS results of this study sample.

A further methodological problem is that the reliability of the clinical ratings was not established, and ratings were made by those who were also responsible for the treatment. Indeed, the assessments we used in this retrospective analysis do not derive from a controlled research environment. The HoNOS, however, is designed as an instrument for routine use by keyworkers and across services. It is the probably most widely used assessment tool to generate an outcome measure based on real-world assessments in severe mental illness, which we believe is indicative of
its utility also in the framework in which the assessments of this study were made. Because test-retest reliability was not available, we used (as did previous studies \(^{19-21,31}\)) Cronbach’s \(\alpha\) for the Jacobson-Truax formula, which should be considered only the second-best option for estimating the standard error of measurement.

Moreover, findings on symptomatic and functional improvement are based solely on the HoNOS. It is obvious that for a comprehensive picture of the outcome of inpatient treatment a broader information base is needed. Although the HoNOS scales cover a broad spectrum of behavioural, symptomatic and social problems, we suggest implementing further clinical measures in future studies, notably the use of psychosis-specific medical scales alongside the HoNOS scales, which would also provide an opportunity to validate HoNOS-based measures of change in health status against an external criterion.

**Conclusions**

This analysis of HoNOS data shows that improvement during inpatient treatment varies widely with level of severity, and that roughly only one in two patients with schizophrenia leaves the hospital with merely subclinical or mild mental health problems. There were substantial differences also in the time needed to achieve the individual optimum of clinical improvement. This emphasizes the importance of closely monitoring the patient’s individual progress and apply this in individual treatment and discharge planning. Moreover, it may be concluded from this data that attempts to discharge a patient as soon as possible into the community affect schizophrenia patients quite differently. Those with relatively mild disorders could actually benefit, because longer inpatient stay is unlikely to increase symptomatic or functional improvement (or might even have detrimental effects, as previous research has shown). But those who are admitted with severe, complex behavioural and symptomatic problems clearly benefit from a longer inpatient stay. Categorically reducing the length of hospital stay to brief psychiatric admissions will thus adversely affect those patients at the more severe end of the disorder who can most benefit from inpatient treatment.
Seeing that a considerable proportion of patients were readmitted soon after discharge and that the risk of early readmission was linked to reliable and clinically significant change during inpatient treatment, this adds to the concern about 'revolving-door' effects. Such effects are hardly desirable from the therapeutic perspective and in terms of cost-effectiveness indeterminate at best. Future studies should therefore evaluate the effects of inpatient treatment by focusing on the role of 'meaningful clinical change' and its impact on the further clinical course of illness as well as the patients' further treatment needs.

Conflict of interest

The authors declare that they have no competing interests.

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Figure legends

Main text:

Figure 1. Mean change in HoNOS scores (Δ t1-t2), by severity level at admission (t1)

Supplement:
Table 1. Characteristics of the basic sample (N=2249)

| Characteristic                                           | Mean±SD / Median | N   | %   |
|----------------------------------------------------------|------------------|-----|-----|
| Age (years) 1)                                           | 39.8 ± 12.3      |     |     |
| Sex: male                                                |                  | 1386| 61.6|
| Highest educational level                                |                  |     |     |
| No or primary education (≤ 11 years)                     |                  | 664 | 29.5|
| Secondary education or higher                            |                  | 624 | 27.7|
| Not known                                                |                  | 961 | 42.7|
| Marital status                                           |                  |     |     |
| Single                                                   |                  | 1357| 60.3|
| Married                                                  |                  | 342 | 15.2|
| Divorced, widowed                                        |                  | 278 | 12.4|
| Not known                                                |                  | 272 | 12.1|
| Means of subsistence                                     |                  |     |     |
| Social welfare, invalidity or other pension              |                  | 1029| 45.8|
| Nationality: foreign national                            |                  | 238 | 10.6|
| Primary clinical diagnosis (ICD-10)                      |                  |     |     |
| Schizophrenia (F20)                                      |                  | 1476| 65.6|
| Brief psychotic disorder (F23)                            |                  | 360 | 16.0|
| Schizoaffective disorders (F25)                           |                  | 318 | 14.1|
| Other psychotic disorders (F2x)                           |                  | 95  | 4.2 |
| Comorbid mental disorders                                |                  |     |     |
| Substance use disorder                                   |                  | 492 | 21.9|
| Other                                                    |                  | 220 | 9.8 |
| Compulsory admission                                     |                  | 698 | 31.0|
| Length of inpatient stay (days)                           | 21.0             |     |     |
| Length of stay ≤ 7 days                                   |                  | 520 | 23.1|
| Discharge                                                |                  |     |     |
| Regular                                                  |                  | 1722| 76.6|
| Self-discharge against medical advice                     |                  | 527 | 23.4|

1) Age range: 18 - 65 years
Table 2. Comparison of HoNOS scores at admission (t1) and at discharge (t2)

| HoNOS item                        | Admission Basic sample N=2244 | Admission Study sample N=1783 | Discharge Study sample N=1783 | Δ t1 – t2 |
|-----------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------|
|                                   | Mean  SD                        | Mean  SD                      | Mean  SD                      | ES  95% CI |
| Aggression, overactivity          | 1.51 1.25                       | 1.56 1.26                     | 0.75 0.97                     | 0.81 1.34 0.61 0.47 - 0.61 |
| Self-injury                       | 0.48 0.88                       | 0.51 0.90                     | 0.13 0.47                     | 0.37 0.92 0.41 0.26 - 0.40 |
| Substance use                     | 1.07 1.30                       | 1.02 1.27                     | 0.63 1.07                     | 0.39 1.11 0.36 0.26 - 0.40 |
| Cognition                         | 1.20 1.09                       | 1.23 1.11                     | 1.01 1.01                     | 0.22 1.15 0.19 0.11 - 0.25 |
| Physical illness                  | 0.66 1.03                       | 0.71 1.05                     | 0.56 0.92                     | 0.16 1.02 0.15 0.08 - 0.21 |
| Hallucinations, delusions         | 2.53 1.20                       | 2.57 1.20                     | 1.44 1.11                     | 1.13 1.49 0.76 0.66 - 0.80 |
| Depressive symptoms               | 1.72 1.12                       | 1.75 1.14                     | 1.01 0.93                     | 0.73 1.26 0.58 0.47 - 0.60 |
| Other mental health problems      | 1.82 1.33                       | 1.87 1.33                     | 1.02 1.10                     | 0.85 1.51 0.56 0.45 - 0.58 |
| Social relationships              | 1.68 1.17                       | 1.72 1.17                     | 1.25 1.08                     | 0.47 1.30 0.36 0.28 - 0.41 |
| Activities of daily living        | 1.77 1.15                       | 1.83 1.14                     | 1.33 1.12                     | 0.50 1.31 0.38 0.31 - 0.45 |
| Living conditions                 | 1.38 1.29                       | 1.41 1.29                     | 1.07 1.18                     | 0.34 1.36 0.25 0.17 - 0.31 |
| Occupation, activities            | 1.63 1.23                       | 1.67 1.23                     | 1.47 1.24                     | 0.20 1.42 0.14 0.08 - 0.21 |
| Total score 1-12                  | 17.47 6.93                      | 17.86 6.93                    | 11.68 7.06                    | 6.17 7.82 0.79 0.73 - 0.87 |

SD Standard deviation
ES Effect size (d repeated measures); 95% confidence interval
Δ t1 – t2 Differences t1 – t2 (positive values indicate lower=improved t2 scores)
Table 3. Categorical shift t1–t2 and clinical change indices of HoNOS scores (N=1783)

| Severity t1     | Severity t2          | Reliable change | Reliable clinically significant change |
|-----------------|----------------------|-----------------|---------------------------------------|
|                 | N   | %     | RCI <sub>95%</sub> threshold 11 | N   | %     | N   | %     | 95% threshold 11 | N   | %     | N   | %     |
|                 |     |       | RCI threshold 8 |     |       | RCI threshold 8 |     |       |                      |     |       |                      |
| Subclinical, mild |     |       |                 |     |       |                      |     |       |                      |
| Subclinical     | 75  | 30.4  | Improved        | 10  | 4.0   | 46  | 18.6  | Improved, non-severe |
| Mild            | 105 | 42.5  | Improved        | 2  | 0.8   | 2  | 0.8   | Improved, non-severe |
| Severe          | 35  | 14.2  | Improved        | 16 | 6.5   | 29  | 11.7  | Improved, non-severe |
| Very severe     | 32  | 13.0  | Improved        | 16 | 6.5   | 29  | 11.7  | Improved, non-severe |
| Total           | 247 | 100.0 | Improved        | 100.0 | 100.0 | Improved, non-severe |
| Severe          |     |       |                 |     |       |                      |     |       |                      |
| Subclinical     | 65  | 17.6  | Improved        | 33  | 8.9   | 96  | 26.0  | Improved, non-severe |
| Mild            | 176 | 47.7  | Improved        | 327 | 88.6  | 252 | 68.3  | Improved, non-severe |
| Severe          | 62  | 16.8  | Improved        | 9  | 2.4   | 21  | 5.7   | Improved, non-severe |
| Very severe     | 66  | 17.9  | Improved        | 9  | 2.4   | 21  | 5.7   | Improved, non-severe |
| Total           | 369 | 100.0 | Improved        | 100.0 | 100.0 | Improved, non-severe |
| Very severe     |     |       |                 |     |       |                      |     |       |                      |
| Subclinical     | 110 | 9.4   | Improved        | 393 | 33.7  | 630 | 54.0  | Improved, non-severe |
| Mild            | 478 | 41.0  | Improved        | 759 | 65.0  | 505 | 43.3  | Improved, non-severe |
| Severe          | 224 | 19.2  | Improved        | 15  | 1.3   | 32  | 2.7   | Improved, non-severe |
| Very severe     | 355 | 30.4  | Improved        | 15  | 1.3   | 32  | 2.7   | Improved, non-severe |
| Total           | 1167| 100.0 | Improved        | 100.0 | 100.0 | Improved, non-severe |
| Total           |     |       |                 |     |       |                      |     |       |                      |
| Subclinical     | 250 | 14.0  | Improved        | 436 | 24.5  | 772 | 43.3  | Improved, non-severe |
| Mild            | 759 | 42.6  | Improved        | 1307| 73.3  | 929 | 52.1  | Improved, non-severe |
| Severe          | 321 | 18.0  | Improved        | 40  | 2.2   | 82  | 4.6   | Improved, non-severe |
| Very severe     | 453 | 25.4  | Improved        | 40  | 2.2   | 82  | 4.6   | Improved, non-severe |
| Total           | 1783| 100.0 | Improved        | 1783| 100.0 | 1783| 100.0 | Improved, non-severe |

RCI <sub>95%</sub> Reliable change index, 95% confidence level
RCISC <sub>95%</sub> Reliable clinically significant change, 95% confidence level
Figure 1. Mean change in HoNOS scores ($\Delta t_1 - t_2$), by severity level at admission ($t_1$)

| HoNOS item | H1  | H2  | H3  | H4  | H5  | H6  | H7  | H8  | H9  | H10 | H11  | H12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
|             | Aggression, overactivity | Self-injury | Substance use | Cognition | Physical illness | Hallucinations, delusions | Depressive symptoms | Other mental health problems | Social relationships | Activities of daily living | Living conditions | Occupation, activities |

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