Inpatient service use before and after a mental health inpatient rehabilitation admission

This research was completed as part of the corresponding author's PhD thesis (https://discovery.ucl.ac.uk/id/eprint/10162689).

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Abstract

Background

Inpatient mental health rehabilitation services provide specialist treatment to people with complex psychosis. On average, rehabilitation admissions last around one year and usually follow several years of recurrent and often lengthy psychiatric hospital admissions.

Aim

To compare inpatient service use before and after an inpatient rehabilitation admission using electronic patient healthcare records in one NHS Trust in London.

Method

We carried out a retrospective cohort study comprised of individuals with an inpatient rehabilitation admission lasting ≥84 days between 1st January 2010 and 30th April 2019 with ≥365 days of records available before and after their rehabilitation admission. We used negative binomial regression models to compare the number of inpatient days before and after the rehabilitation admission.

Results

A total of 172 individuals met our eligibility criteria. The median percentage of days spent as an inpatient prior to the rehabilitation admission was 29% (IQR 18% to 52%) and was 8% (IQR 0% to 31%) after. The regression model adjusted for potential confounder variables produced an incident rate ratio of 0.520 (95% CI 0.367 to 0.737).

Conclusion

The rate of inpatient service use was halved in the period after an inpatient rehabilitation admission compared to the period before. This suggests that inpatient rehabilitation is a clinical and cost effective intervention in the treatment and support of people with complex psychosis.

Keywords

Background

It is estimated that around 20% of individuals who have an episode of psychosis will develop severe and complex longer term mental health problems (1-3). Most have a primary diagnosis of schizophrenia, bipolar affective disorder, or schizoaffective disorder, with cognitive impairments that negatively impact on their motivation and organisational skills. Many will have additional problems that complicate recovery, such as pre-existing neurodevelopmental disorders (e.g., autism spectrum disorder, attention deficit hyperactivity disorder), co-existing mental health problems (e.g., anxiety, depression, substance misuse), and/or physical health problems (e.g., cardiovascular disease, pulmonary conditions). These complex problems severely affect the individual's ability to manage everyday tasks such as self-care, housework, shopping, cooking, budgeting, and interpersonal skills, and result in high support needs.

In recent literature, people who develop these complex and longer term mental health problems have been described as having 'complex psychosis'. This literature includes the healthcare guideline published by the National Institute for Health and Care Excellence (NICE) specifically for this population which recommends that all local mental healthcare systems should have a specialist rehabilitation care pathway for people with complex psychosis (3). This pathway should be comprised of inpatient rehabilitation units, supported accommodation services, and community rehabilitation teams. Around 80% of people admitted to inpatient rehabilitation units are referred from acute inpatient units with the remainder arriving from forensic inpatient settings (4, 5). In England, most people admitted to an inpatient rehabilitation unit will have been in contact with mental health services for over a decade (median 13 years, interquartile range (IQR) 6 to 22) and have experienced recurrent inpatient admissions (median 4 admissions, IQR 2 to 9) (4, 5). These units are staffed by a multidisciplinary team, including psychiatrists, psychologists, occupational therapists, nurses, and support workers. They support people to gain or regain the skills and confidence to manage the everyday tasks needed for a successful community discharge, through a personalised biopsychosocial approach. The specific treatments offered may include optimisation of medication and management of associated side effects, including where appropriate, a trial of clozapine (6); management of physical health conditions; a range of activities that promote specific skills (e.g. cooking) and develop the person's interests and social networks (e.g. music, arts, sports); and psychological interventions including Cognitive

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Behavioural Therapy for psychosis and family work. This specialist approach takes time; the median length of admission in an inpatient rehabilitation unit in England is eight months (IQR 4 to 19 (4, 5)), and thus inpatient rehabilitation is an expensive component of the mental healthcare system. Nevertheless, cohort studies suggest that around two-thirds of the people they treat achieve and sustain successful community discharge (7, 8).

The gold standard for testing the effectiveness of an intervention is a randomised controlled trial (RCT). However, since inpatient rehabilitation is recommended by national healthcare guidelines, it would be unethical to withhold this from a control group of people with complex psychosis. The studies which have investigated the effectiveness of inpatient rehabilitation have therefore been observational cohort studies, comparing inpatient service use before and after an inpatient rehabilitation admission. Such studies have been conducted in the UK (5, 9), Canada (10), and Australia (11) and have consistently reported a reduction in inpatient service use after the rehabilitation admission compared to before. However, these studies are limited by small sample sizes (9), relatively short before and after periods (10, 11), and unique characteristics of the service studied as one of the studies evaluated a tertiary inpatient rehabilitation unit (5). This study aimed to address these limitations by using routinely reported electronic healthcare records to compare inpatient service use before and after admission to a standard inpatient rehabilitation unit. We also aimed to investigate the characteristics of individuals who were and were not discharged successfully from the inpatient rehabilitation unit to inform whether these services may be more effective for sub-groups of patients. This study was completed as part of the lead author's doctoral thesis (12).

Method

Design and setting

This study used deidentified electronic healthcare records from the Camden and Islington NHS Foundation Trust (C&I) Clinical Records Interactive Search (CRIS) Database. C&I provides a range of inpatient and community adult mental health services to residents of two inner city London boroughs. It has well-established rehabilitation services, comprising inpatient rehabilitation units, supported accommodation services, and community rehabilitation teams. CRIS is a tool which deidentifies electronic healthcare records providing approved researchers with a searchable database of structured and unstructured records (13-15).

Structured records are any record that was created using a pre-determined drop-down options menu (e.g., for ethnicity) or a specific format (e.g., date for date of birth). Unstructured records are created using free text (e.g., a clinical note describing a healthcare contact or a GP letter).

The cohort in this study was defined as any individual with a recorded admission to one of the Trust's two high dependency inpatient rehabilitation units (as defined by the Royal College of Psychiatrists' typology of inpatient rehabilitation services (16)), where the admission started between 1st January 2010 and 30th April 2019 and lasted for a minimum of 84 days (what was considered a reasonable balance between individuals receiving an adequate dose of inpatient rehabilitation and having an adequate cohort size), and the individual had at least 365 days of records available before and after the admission. Therefore, the study utilised records pertaining to the period between 1st January 2009 and 30th April 2020.

Data extraction

Study data were extracted from structured records, with structured inpatient service use data validated using free text records (see 'Data validation' below for further detail). Primary diagnosis in this study was defined as the ICD-10 diagnosis which had a record date closest to the start date of the inpatient rehabilitation admission. Secondary, or comorbid, diagnoses were defined as any other diagnosis recorded during the study period.

For each inpatient admission, the start date, end date, and admission type (acute, psychiatric intensive care, forensic, or rehabilitation) were extracted from the structured records. Transfers between inpatient services (instances where an admission end date was contiguous with the admission start date of the next recorded admission) of the same type were coded as a continuous admission, whereas transfers to a different type of inpatient service were coded as a new admission.

Data validation

Significant changes in an individual's healthcare, such as an admission or discharge from an inpatient service, are recorded as a free text record in the 'progress notes' section of the patient's records. Free text documents relating to inpatient admissions, such as discharge

summaries, are also uploaded to the healthcare record system. The recording of inpatient admission start and end dates in free text records provides a means of validating the admission start and end dates recorded in structured records that were extracted for this study.

We carried out two validations. One of the validations identified instances where the structured records indicated that the individual was admitted to the inpatient rehabilitation unit directly from the community rather than from another inpatient service (i.e., the start date of the inpatient rehabilitation admission did not match the end date of another inpatient admission). This validation was carried out because most referrals to inpatient rehabilitation units are from another type of inpatient service. To do this, unstructured records recorded around the start date of the inpatient rehabilitation admission were reviewed by the researcher to clarify where they were before they were admitted to the rehabilitation unit.

The other validation comprised a check of start and end dates of all inpatient admissions of a randomly selected 10% of the study cohort by reviewing the relevant unstructured records. This validation was to provide a general check on the accuracy of the structure records for inpatient admission start and end dates used in this study. It was agreed that if more than 5% of the dates checked mismatched by more than one day, the admission dates of the whole cohort would be validated.

Health of the Nation Outcome Scale (HoNOS) data

Data from clinical assessments using the Health of the Nation Outcome Scale (HoNOS; (17)) were also extracted. The HoNOS is a clinician rated clinical and social functioning assessment scale with good psychometric properties which is used nationally and internationally (18-20). It consists of 12 items (1. aggression and overactivity, 2. self-harm, 3. problem drinking and drugs, 4. cognitive impairment, 5. physical impairment, 6. hallucinations and delusions, 7. depressed mood, 8. other mental health problem, 9. relationship problems, 10. daily living skills, 11. living conditions, and 12. occupation/activities), each rated from 0 to 4, with a score of 0 indicating that there is no problem in this area affecting health or functioning and a score of 4 indicating a very severe problem. The HoNOS is recorded routinely by NHS staff at admission and discharge from inpatient and community care. HoNOS assessments were

extracted at two time-points: within three months of the start date and within three months of the end date of the rehabilitation admission.

Analysis plan

Data analyses were carried out using Stata 16.0 (21). The main analysis compared the number of inpatient days before and after the rehabilitation admission using paired t-tests and negative binomial regression models.

The first t-test compared the number of inpatient days one-year before the rehabilitation admission with one-year after the rehabilitation admission. Further paired t-tests were conducted using longer before and after periods at yearly intervals until there were an insufficient number of individuals for the comparison to be made.

Unlike the t-tests, all the available before and after data were used in the negative binomial regression models. To account for the variance within and between individuals in the period of records before and after the rehabilitation admission, inpatient days were entered as the response variable and the period before and after the rehabilitation admission was entered as the exposure variable, with a binary time variable added to the model (pre-rehabilitation admission or post-rehabilitation admission) (22).

Two negative binomial regression models were planned: an unadjusted model and a model adjusted for potential confounder variables. Sociodemographic and clinical variables available in the CRIS Database which, based on previous research (8) and the authors' clinical knowledge may affect inpatient service use, were added as potential confounder variables to the adjusted model. These were: age at start of the rehabilitation admission; sex; ethnicity (White/ minoritised ethnicity); any recorded mental or physical health comorbidity; length of the rehabilitation admission (days); year the rehabilitation admission started (as a proxy for any change in the mental health system over time); whether admitted from a forensic unit (yes/no); whether discharged under a Community Treatment Order (CTO) (yes/no); and HoNOS ratings at the end of the rehabilitation admission for domains 6 (psychotic symptoms), 9 (relationships), and 10 (activities of daily living).

An estimate of the cost of inpatient service use one, two, three and four years before and after the inpatient rehabilitation admission was calculated by multiplying the number of inpatient days during each period by the NHS reference costs for the daily cost of an NHS mental health bed in 2021 (i.e., £428) (23). A similar pre- and post-rehabilitation cost comparison was conducted by Bunyan et al. (9). We also estimated inpatient service use costs one, two, three and four years before and after the rehabilitation admission, accounting for the cost of the rehabilitation admission. The 'before' periods included an estimate of what each individual's inpatient service use and associated costs would have been during the period of their rehabilitation admission if they had not been admitted to the rehabilitation unit, based on the rate of their inpatient service use before the rehabilitation admission and the length of their rehabilitation admission. For example, if someone had 250 inpatient days over a period of 500 days before their rehabilitation admission (an inpatient service use rate of 0.5) and their rehabilitation admission lasted 200 days, their inpatient service use would be estimated as 100 days for the period of the rehabilitation. This assumes that their rate of inpatient service use before the rehabilitation admission would have remained stable if they had not had a rehabilitation admission. The 'after' costs included the cost of their actual rehabilitation admission. For these estimates, we used the local C&I acute and rehabilitation inpatient bed day costs provided by the Trust's Finance Team for 2021 (£547 and £498, respectively) as there are no standard NHS costs specifically for acute or rehabilitation inpatient bed days.

Further analyses were conducted to investigate the sociodemographic and clinical characteristics of people who were and were not successfully discharged. Successful discharge was defined as discharge from the inpatient rehabilitation unit to the community without any readmission within 12 months of discharge. The sociodemographic and clinical characters of the successfully discharged group were compared to those that were not successfully discharged using chi-squared tests and t-tests.

Ethics and Consent Statement

The C&I CRIS Database has been granted ethical approval to be used in epidemiological research and service improvement (National Research Ethics Service (NRES) Committee East of England—Cambridge Central: reference number 19/EE/0210), without the need to obtain

informed consent of individuals given that the database contains only healthcare records of de-identified individuals. Approval for this project was granted by the C&I CRIS Database Oversight Committee on 28th February 2020.

Results

Sociodemographic and clinical characteristics

A total of 271 individuals were admitted to one of the two inpatient rehabilitation units during the study period (1st January 2010 and 30th April 2019). However, 99 of these individuals did not meet the eligibility criteria, most commonly (95/99), due to having fewer than 365 days of records available before and/or after their rehabilitation admission. A further four individuals were excluded as their inpatient rehabilitation admission lasted less than 84 days (seven of the 99 excluded individuals failed to meet both criteria). Therefore, 172 individuals were included in the study. Table 1 shows their sociodemographic and clinical characteristics. They had a mean age of 44 years (SD 14), the majority were male (n=101, 59%), White (n=98, 57%), and single (n=155, 91%). Almost three-quarters had a primary mental health ICD-10 diagnosis of schizophrenia (n=126, 73%), around half had at least one mental or physical health comorbidity (n=97, 56%) and around a third (n=55, 32%) had multiple comorbidities. Sixteen individuals (9%) died during the study period, at a mean age of 65 years (SD 12).

Table 1: Sociodemographic and clinical characteristics (N=172)

	n	%
Age at the start date of the inpatient rehabilitation admission, n=172 (mean, SD)	44.2	13.8
Male, n=172	101	59
Ethnicity, n=172	-	-
White - British/Irish/Other	98	57
Asian	9	5
Black	51	30
Mixed or Other ethnicity	14	8
Marital status, n=171	-	-
Single (unmarried or without a civil partner)	155	91
Divorced/Separated/Widowed	10	6
Married/Civil partner	6	4
Primary mental health ICD-10 diagnosis, n=172*	-	-
Schizophrenia disorder (F20-F24 & F26-F29)	126	73
Schizoaffective disorder (F25)	28	16
Manic episode (F30) or bipolar affective disorder (F31)	11	6
Other mental health disorder	7	4
Comorbid mental health diagnosis, n=172†	-	-

Substance misuse disorders (F10-F19)	44	26
Depression and anxiety disorders (F32-F48)	10	6
Disorders of adult personality and behaviour (F60-F69)	15	9
Comorbid physical health diagnosis, n=172†	-	-
Endocrine, nutritional and metabolic diseases (E00-E90)	41	24
Diseases of the nervous system (G00-G99)	8	5
Diseases of the circulatory system (I00-I99)	21	12
Diseases of the respiratory system (J00-J99)	10	6
Any mental or physical health comorbidity, n=172§	97	56
Multiple comorbidities, n=172	55	32

*The ICD-10 primary mental health diagnosis recorded closest to the rehabilitation admission start date.
†Whether this ICD-10 diagnosis has ever been recorded during the study period (01 January 2009 to 30 April 2020) for this individual, in addition to the 'Primary mental health ICD-10 diagnosis'.

Data validation

Of the 172 individuals in the cohort, 50 (29%) did not have an admission recorded immediately prior to their rehabilitation admission in their structured records, suggesting they were referred to the inpatient rehabilitation unit from the community. However, the free text records for these individuals showed that 39 of the 50 (78%) had actually been transferred from another inpatient unit. Most of these transfers (23 [59%]) were from another healthcare provider which may explain why their admission data was missing from the structured records in the C&I Database.

Validation of start and end dates of inpatient admissions recorded in the structured fields was conducted for 18 individuals (10% of the total individuals included in this study) for whom 211 admissions were recorded. Of the 422 start and end dates that were validated, 351 (83%) matched exactly and 409 (97%) matched within one day.

Referral source and discharge destination

Supplementary table 1 shows where individuals were before and after their rehabilitation admission (i.e., the referral source and discharge destination). The vast majority were transferred from another inpatient unit (n=161, 94%). Three-quarters were discharged to the community (n=130, 76%), and the remainder were transferred to another inpatient unit. Just over half (56%) were made subject to a CTO at discharge from the rehabilitation admission (n=96, 74% of those discharged to the community).

HoNOS scores

Supplementary table 2 shows the HoNOS scores for each HoNOS item at the start and end of the rehabilitation admission. There was a high rate of missing data at both the start and end of the rehabilitation admission, with total HoNOS scores missing for 75 (44%) and 71 (41%) individuals, respectively. The total score was higher at the start of the admission (mean 33.1, SD 14.8) compared to the end of the admission (mean 27.5, SD 13.2). The three HoNOS items selected as confounder variables for the regression model (6, 9, and 10), scored as 3 or 4 more often than the other HoNOS items across both time points, providing corroboration for our decision to include these three items in our regression model.

Inpatient service use before and after the rehabilitation admission

The median length of the rehabilitation admission was 318 days (IQR 191 to 455). Supplementary table 3 shows the calendar year in which the rehabilitation admission started. Table 2 shows the period of records available before and after the rehabilitation admission, and inpatient service use during these periods. The median period that records were available before and after the rehabilitation admission was 4.1 years (IQR 2.6 to 6.2) and 5.4 years (IQR 3.1 to 7.0), respectively. The median percentage of days spent as an inpatient prior to the rehabilitation admission was 29% (IQR 18% to 52%), and after rehabilitation it was 8% (IQR 0% to 31%). Fewer than five individuals had no inpatient service use before their rehabilitation admission (<3%, exact number supressed to prevent the identification of individuals), whereas over one third had no inpatient service use after their rehabilitation admission (n=64, 37%).

Table 2: Inpatient service use before and after the rehabilitation admission (N=172)

-	Pre-rehabilitation admission		Post-rehabilitation admission	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Duration of records, in years, n=172*	4.4 (2.2)	4.1 (2.6 to 6.2)	5.2 (2.4)	5.4 (3.1 to 7.0)
Inpatient days, n=172	519 (400)	420 (262 to 653)	411 (595)	153 (0 to 583)
Number of admissions, n=172	3.8 (3.0)	3 (1.5 to 5)	1.9 (2.4)	1 (0 to 3)
Percentage of days spent as an inpatient, n=172	40% (31%)	29% (18% to 52%)	20% (26%)	8% (0% to 31%)

SD = standard deviation, IQR = interquartile range.
*The start date used to calculate the pre-rehabilitation admission period was the date their first progress note is recorded or on the start date of their first recorded admission, whichever comes first within the study period (1 January 2009 to 30 April 2020). The end date used to calculate the post-rehabilitation admission period was the date records are available up until (30 April 2020) or their date of death if one is recorded.

Table 3 shows the results comparing the number of inpatient days during the one-year, two-year, three-year, and four-year periods before and after the inpatient rehabilitation admission. The five-year comparison was not carried out as too few individuals in the cohort had this length of records before and after the rehabilitation admission. Although the cohort size decreased substantially with each additional year used in the comparison, each comparison consistently showed a statistically significant reduction in the number of inpatient days after the rehabilitation admission compared to before.

Table 3: Inpatient days before and after the rehabilitation admission, by number of years of pre-post rehabilitation (N=172)

Pre- and post-rehabilitation period	Inpatient days pre-rehabilitation admission		Inpatient days post-rehabilitation admission		Mean difference (95% CI)
	Mean	SD	Mean	SD	
One year, n=172	223.3	115.5	103.7	137.6	119.6 (95.8 to 143.4)
Two years, n=123	354.6	203.4	185.5	248.6	169.1 (114.4 to 223.9)
Three years, n=82	424.3	307.7	253.5	332.1	170.7 (64.9 to 276.6)
Four years, n=36	561.4	447.5	305.6	420.2	255.8 (32.0 to 479.5)

In the unadjusted negative binomial regression model, the incident rate ratio (IRR) comparing the period after the rehabilitation admission with the period before it was 0.504 (95% CI 0.358 to 0.710). This shows that inpatient service use reduced by 50% after an inpatient rehabilitation admission compared to the period before.

The IRR increased slightly to 0.555 (95% CI 0.351 to 0.877) when adjusted for potential confounding variables. However, due to missing HoNOS scores, the adjusted model did not include the full cohort (n=100). Therefore, a post-hoc regression analysis was conducted that included the full cohort (N=172), which adjusted for the same potential confounding variables except for the three HoNOS items and this produced an IRR of 0.520 (95% CI 0.367 to 0.737).

Cost of inpatient service use before and after the rehabilitation admission

The mean estimated cost of inpatient service use for the one-year period before the rehabilitation admission was £95,585.84 (SD £49,417.89) and £44,392.56 (SD £58,894.49) for the one-year period after the rehabilitation admission.

Table 4 shows the estimated costs of inpatient service use for the two, three, and four years before and after the rehabilitation admission which all showed a similar pattern of reduced costs in the after rehabilitation period compared to the before rehabilitation period.

Table 4: Inpatient service use costs (£) before and after the inpatient rehabilitation admission (N=172)

Pre- and post-rehabilitation period	Inpatient costs pre-rehabilitation admission		Inpatient costs post-rehabilitation admission	
	Mean	SD	Mean	SD
One year, n=172	95,585.84	49,417.89	44,392.56	58,894.49
Two years, n=123	151,786.90	87,054.23	79,402.70	106,402.50
Three years, n=82	181,581.60	131,683.20	108,508.40	142,141.50
Four years, n=36	240,262.60	191,514.00	130,801.60	179,861.70

NHS reference costs for the daily cost of an NHS mental health bed in 2021 (i.e., £428) (23)

Table 5 shows the before and after estimated inpatient service use costs for the same periods as reported in Table 4, but where the cost of the rehabilitation admission has been included as described earlier in the methods. These analyses showed the mean inpatient service use cost for the one-year period before the rehabilitation admission was £205,477.60 (SD £144,431.40) and the mean inpatient costs for the one-year period after the rehabilitation admission was slightly higher at £233,070.80 (SD £129,115.50). The estimated inpatient costs for the two-year and three-year before and after periods were similar. However, the inpatient cost estimate in the four years after a rehabilitation admission was lower than the four years before (£316,168.10, SD £227,626.20 vs £378,478.80, SD £322,519.10).

Table 5: Inpatient service use costs (£) before and after the inpatient rehabilitation admission, including the cost of the rehabilitation admission (N=172)

Pre- and post-rehabilitation period	Inpatient costs pre-rehabilitation admission, including estimated cost of inpatient service use during the rehabilitation admission*		Inpatient costs post-rehabilitation admission, including cost of the rehabilitation admission itself**	
	Mean	SD	Mean	SD
One year, n=172	205,447.60	144,431.40	233,070.80	129,115.50
Two years, n=123	264,714.20	176,887.60	269,010.10	158,205.70
Three years, n=82	292,162.80	226,632.80	289,656.90	190,968.30
Four years, n=36	378,478.80	322,519.10	316,168.10	227,626.20

*Includes an estimation of the cost of inpatient service use during the rehabilitation admission if there was not a rehabilitation admission. This cost is calculated using the individual's proportion of days spent in an inpatient service before the rehabilitation admission and the length of their inpatient rehabilitation admission, and the cost per day for an acute mental health bed at Camden and Islington NHS Foundation Trust (£547).
**Includes the cost of the inpatient rehabilitation admissions itself. This cost is calculated using the length of the inpatient rehabilitation admission, and the cost per day for a mental health rehabilitation bed at Camden and Islington NHS Foundation Trust (£498).

Sociodemographic and clinical characteristics of individuals with and without successful discharge

Overall, 89 (52%) individuals had a successful discharge which meant that they were discharged from the inpatient rehabilitation unit to the community and were not readmitted within 12 months. The remaining 83 (48%) individuals without a successful discharge were discharged from the rehabilitation unit to another type of inpatient service (n=42, of whom 26 were discharged to an acute or psychiatric intensive care unit, and 16 were discharged to a longer term rehabilitation unit or other type of ward), or they were discharged to the community and readmitted within 12 months (n=41). Those who were not successfully discharged were more likely to be Black than any other ethnicity (37% vs 22%; p=0.033), and more likely to have a comorbid health condition (67% vs 46%; p=0.005). **Error! Reference source not found.**They also had a larger proportion of days as an inpatient before (mean 46%, SD 31% vs mean 34%, SD 30%; p=0.011) and after the rehabilitation admission compared to the successfully discharged group (mean 38%, SD 27% vs mean 3%, SD 8%; p<0.001). Amongst those who were successfully discharged, 64 (72%) individuals had no further recorded inpatient service use after their inpatient rehabilitation admission.

Discussion

This study found that following admission to an inpatient rehabilitation unit, the rate of subsequent inpatient service use was halved compared to the period before the rehabilitation admission. Adjusting for potential confounding variables had minimal impact on this estimate. Whilst this finding is consistent with those of other 'before and after' studies of inpatient rehabilitation services (5, 9-11), this study has a number of strengths that suggest it provides more robust evidence for the effectiveness of these services.

Bunyan et al. (9) compared inpatient service use two years before and after an inpatient rehabilitation admission in South London but included only 22 individuals. Awara et al. (10) in Canada, compared inpatient service use six months before and after a rehabilitation admission for 53 individuals. In Australia, Parker et al. (11) compared inpatient service use for a large cohort (N=501) of patients one year before and after admission to a community rehabilitation unit. Casetta et al. (5) compared inpatient service use for 147 individuals two-years before and after admission to the National Psychosis Unit. All these studies showed

statistically significant reductions in inpatient service use following the rehabilitation admission. The current study included a relatively large cohort of individuals (N=172) who were studied over a longer period before (mean 4.4 years, SD 2.2 years) and after (mean 5.2 years, SD 2.4 years) the rehabilitation admission than previous studies. Our analysis also took account of potential confounders, unlike previous studies. In addition, Casetta et al.'s study (5) focused on a specialist national service whereas the rehabilitation units included in the current study only accept referrals from the catchment area of the local mental health Trust within which they operate. This difference is of clinical relevance as inpatient rehabilitation units form part of a local rehabilitation pathway (3) and developing partnerships with local organisations (such as supported accommodation services, and educational and employment services) are key in enabling recovery and community engagement for the individuals with whom they work.

Our finding that inpatient service use is halved after a rehabilitation admission suggests that inpatient rehabilitation facilitates long term stability, significantly reducing the chance of relapse and readmission. Over three quarters of the cohort were discharged to the community at the end of their rehabilitation admission and over a third had no subsequent admissions. These positive outcomes (being discharged to the community and not being readmitted) were associated with having spent less time as an inpatient prior to the rehabilitation admission. This supports NICE's recommendation (3) that people with complex psychosis experiencing recurrent or lengthy admissions should be referred for rehabilitation much sooner, and after fewer acute inpatient admissions.

The extent of the reduction in inpatient service use after an inpatient rehabilitation admission is striking given the very high level of inpatient service use for the present cohort. Out of all the days in the pre-rehabilitation admission period, the present cohort spent a median of 29% (IQR 18% to 52%) as an inpatient, the equivalent of three-and-a-half months in one-year. This is very high compared to the general level of inpatient service use for people with psychosis. For comparison, a study which looked at inpatient service use for 2,147 people who presented with psychosis to a South London NHS Trust between 2007 and 2010, had a median of six (IQR 0 to 69 days) psychiatric inpatient days during the five years following their presentation (24). This comparison adds even greater weight to NICE's recommendation that people with

complex psychosis should be identified and referred to rehabilitation much sooner than what is currently happening.

We also found patients who were Black or had a comorbid health condition were less likely to be successfully discharged from their rehabilitation admission. These findings are helpful in identifying those who may benefit most from inpatient rehabilitation currently and raise questions as to how rehabilitation services can tailor their interventions to support all patients more effectively. The issue of racial disparity in healthcare outcomes is not confined to rehabilitation services. In England, Black people with psychosis are three times more likely to be detained involuntarily in hospital compared to White people with psychosis (25). A meta-analysis using international data found that Black African and Black Caribbean patients were twice as likely to have a compulsory mental health admission and twice as likely to be readmitted than White patients (26).

Whilst having a comorbid health condition does understandably complicate treatment, this constitutes the majority of people admitted to inpatient rehabilitation units. The urgent need to improve outcomes for people with multiple health conditions is recognised in national and international guidelines which recommend addressing this need through greater integration and collaboration between mental and physical healthcare systems (3, 27, 28), including the NICE guideline for rehabilitation (3).

Although this study indicates there is a substantial reduction in inpatient service use after an inpatient rehabilitation admission, there was considerable variation between individuals. As well as the characteristics discussed above, further work is needed to identify whether other characteristics (not examined in this study) predict the risk of relapse and readmission (e.g., psychiatric symptoms, social functioning, substance misuse, risk behaviours). This would assist in the development of individualised relapse prevention plans and may help reduce readmissions.

Unsurprisingly as they are based on the same data, our cost estimate of inpatient service use before and after the rehabilitation admission is consistent with our comparison for inpatient days; inpatient service use costs were lower after the rehabilitation admission compared to

the period before. However, when the cost of the rehabilitation admission itself is also considered, this difference only appears in the four-year comparison. This result should be interpreted with caution as the size of the cohort is much smaller for the four-year comparison than it is for the other shorter before and after comparisons. The standard deviation for each of the mean estimates across all the comparison are also quite large.

Furthermore, the cost estimates were limited to inpatient service use and other health and social care costs, such as supported accommodation and community rehabilitation team input, were not included. Whilst more rigorous cost-effective analyses are required, these analyses nevertheless suggest that inpatient rehabilitation may provide a worthwhile investment but, from a purely financial perspective, the return on the investment is likely to be achieved in the longer rather than the shorter term.

However, the value of inpatient rehabilitation should, of course, not only be viewed in terms of the financial benefits for the system but also in terms of its clinical effectiveness for the individual. By the time a patient is admitted to an inpatient rehabilitation unit, they are likely to have been unwell for over a decade and to have had multiple admissions. At this stage, their confidence in being able to lead a meaningful life and participate in society is likely to be at a very low ebb. Our finding that inpatient rehabilitation is associated with reduced subsequent inpatient service use strongly suggests that these services enable people's recovery. The benefits of having adequate local inpatient rehabilitation are not limited to the people that directly use these services. Reducing ineffective and often extended acute inpatient admissions for this group frees these high in demand acute beds for others who are more likely to benefit from them.

Limitations

We acknowledge limitations to our study. We used data from a single inner-city NHS Trust in London with a well-established local rehabilitation pathway and findings may differ to areas with less well-established rehabilitation pathways. We did not include evaluation of how other components in the rehabilitation pathway, such as the availability and effectiveness of specialist supported accommodation services and community rehabilitation team input, may affect the effectiveness of inpatient rehabilitation services. A well-established pathway

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providing good community support is likely to help to reduce the need for subsequent readmission.

The study was also limited by the use of healthcare data from a single NHS Trust that were not collected for the purpose of research. We did carry out validations of the inpatient service use data used in this study but there may still be inaccuracies in this data and the other data used in this study. This is perhaps demonstrated by the high level of missing data for HoNOS assessments in the present study. It is standard practice for a HoNOS assessment to be completed at the start and end of a treatment, including an inpatient rehabilitation admission (29). However almost half of the individuals in this study did not have a HoNOS assessment recorded within three months of the start date of their rehabilitation admission, nor did they have a HoNOS assessment recorded within three months of their rehabilitation admission discharge date. It is unclear why there were so many individuals in this study without a recorded HoNOS assessment when such an assessment should have taken place, but it is illustrative of the potential issues in using routine healthcare data in research. In relation to this limitation regarding the available data for this study, inpatient service use as an outcome is a very narrow outcome for inpatient rehabilitation. Other important outcomes such as measures of personal recovery, autonomy, and social inclusion, should be considered in future research.

Almost everyone in our cohort had a primary diagnosis of schizophrenia, schizoaffective disorder, or bipolar affective disorder, which is consistent with the other before and after studies (5, 9-11). That more than half of our cohort had at least one comorbid mental or physical health condition was also to be expected given what is known about this population (3). However, what was unexpected was the lack of autism spectrum disorder as a comorbid health condition as the association between the two conditions is well evidenced (30). This may indicate that some diagnoses are under reported in the dataset used for this study, at least in the structured fields that were used in this study. Other studies using similar datasets have used natural language processing approaches to extract diagnoses from free text records (24). Free text records could have been used more than they were in the present study to improve data quality and data availability.

Finally, due to the difficulties of randomisation and identification of a suitable comparison group, as with previous studies of inpatient rehabilitation (5, 9-11) , this study was observational in design. Causality cannot therefore be inferred and 'regression to the mean' may explain the reduction in inpatient service use (31). However, this seems unlikely to be the full explanation given the magnitude of the reduction in inpatient service use that we observed.

Conclusion

Inpatient mental health rehabilitation services are designed to support people with complex psychosis to gain and regain skills which are essential to living in the community. These services are an important component of the rehabilitation pathway and should be available locally as per NICE guidelines (3). Although inpatient rehabilitation services are an expensive component of the mental healthcare system, there has been a lack of research investigating their effectiveness. Our study partially addressed this and found that inpatient service use was reduced by half in the period after the rehabilitation admission compared to the period before the rehabilitation admission. The lack of a control group means causality cannot be inferred and further studies investigating other outcomes are needed.

List of abbreviations

Camden and Islington NHS Foundation Trust (C&I);

Clinical Records Interactive Search (CRIS);

Community Treatment Order (CTO);

Confidence interval (CI);

Health of the Nation Outcome Scale (HoNOS);

Incident rate ratio (IRR);

International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10);

Interquartile range (IQR);

National Institute of Health and Care Excellence (NICE);

National Health Service (NHS);

Standard deviation (SD);

United Kingdom (UK)

Declarations

Declaration of Interest

None.

Funding

Acknowledgements

Authors' contributions

CDL designed the study, and cleaned, validated, and analysed the data. CDL also wrote the first draft of the manuscript. CDL completed this study as part of his PhD. HK contributed to the design of the study and LM contributed to the analysis plan as CDL's PhD supervisors. JY and DO contributed with their expertise and support in their roles as Camden and Islington NHS Foundation Trust (C&I) CRIS Research Database Manager and C&I CRIS Academic Lead, respectively. All authors provided feedback on the first draft of the manuscript and approved the final version for submission.

Data Availability

The data that support the findings of this study are available to approved researchers through Camden & Islington NHS Foundation Trust. The data are not publicly available due to restrictions on data access by the Data Controller in the interest of patient confidentiality.

Ethics and Consent Statement

The C&I CRIS Database has been granted ethical approval to be used in epidemiological research and service improvement (National Research Ethics Service (NRES) Committee East of England—Cambridge Central: reference number 19/EE/0210), without the need to obtain informed consent of individuals given that the database contains only healthcare records of

de-identified individuals. Approval for this project was granted by the C&I CRIS Database Oversight Committee on 28th February 2020.

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