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The impact of COVID-19 on mental health service utilisation in England

Adrián Villaseñor *, James Gaughan, María José Montserrat Aragón Aragón, Nils Gutacker, Hugh Gravelle, Maria Goddard, Anne Mason, Adriana Castelli, Rowena Jacobs

Centre for Health Economics (CHE), University of York, United Kingdom

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ABSTRACT

The COVID-19 pandemic has had a significant impact on population mental health and the need for mental health services in many countries, while also disrupting critical mental health services and capacity, as a response to the pandemic. Mental health providers were asked to reconfigure wards to accommodate patients with COVID-19, thereby reducing capacity to provide mental health services. This is likely to have widened the existing mismatch between demand and supply of mental health care in the English NHS. We quantify the impact of these rapid service reconfigurations on activity levels for mental health providers in England during the first thirteen months (March 2020–March 2021) of the COVID-19 pandemic. We use monthly mental health service utilisation data for a large subset of mental health providers in England from January 1, 2015 to March 31, 2021. We use multivariate regression to estimate the difference between observed and expected utilisation from the start of the pandemic in March 2020. Expected utilisation levels (i.e. the counterfactual) are estimated from trends in utilisation observed during the pre-pandemic period January 1, 2015 to February 31, 2020. We measure utilisation as the monthly number of inpatient admissions, discharges, net admissions (admissions less discharges), length of stay, bed days, number of occupied beds, patients with outpatient appointments, and total outpatient appointments. We also calculate the accumulated difference in utilisation from the start of the pandemic period. There was a sharp reduction in total inpatient admissions and net admissions at the beginning of the pandemic, followed by a return to pre-pandemic levels from September 2020. Shorter inpatient stays are observed over the whole period and bed days and occupied bed counts had not recovered to pre-pandemic levels by March 2021. There is also evidence of greater use of outpatient appointments, potentially as a substitute for inpatient care.

1. Introduction

The COVID-19 pandemic has had a substantial impact on the demand for and supply of mental health care services. There is growing evidence that the pandemic reduced population mental health in many countries (US: Le and Nguyen, 2021; Sances and Campbell, 2021; Farkhad and Albarracín, 2021; European Countries: García-Prado et al., 2022; Brodeur et al., 2021; Norway: Hvide and Johnsen, 2022; UK: Proto and Quintana-Domeque, 2021; Turkey: Altindag et al., 2022; and a systematic review with 134 cohorts: Sun et al., 2023), with, consequently, greater need for care. There is also some evidence that this greater need translated into higher demand for mental health services, e.g., in England there was a surge in urgent referrals to crisis care for people in all ages during the pandemic months (Lavis, 2022).

At the same time, on the supply side, critical mental health services were disrupted and capacity reduced in response to the pandemic. Changes in care included shifting from face-to-face to virtual care, adopting additional protocols to restrict the spread of COVID-19 in care settings, as well as freeing up capacity for social distancing and the expectation of treating COVID-19 patients. This included expediting initial discharges and increasing the severity threshold for face-to-face treatment (NHS England and NHS Improvement, 2020b; Percudani et al., 2020; Rosenberg et al., 2020; Sutherland et al., 2020). Over and above the restrictions introduced, patients may also have chosen to reduce their contact or use of mental health services, due to heightened concerns about infection in a clinical setting or as an interpretation of stay at home instructions from national governments.

There is evidence that this combination of circumstances led to changes in clinical activity in mental health services, with substantial variation over time, between countries, and across services. Duncan

* Corresponding author.
E-mail address: adrian.villasenor-lopez@york.ac.uk (A. Villaseñor).

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et al. (2022) found that psychiatric emergency service encounters were 39% less than the same period in 2019 in Boston (US). Hvide and Johnsen (2022) found psychological cases in primary care in Norway initially increased in the spring of 2020, fell during the summer but were above pre-pandemic levels by the end of 2020. In the US, Ziedan et al. (2020) found that outpatient appointments fell initially before recovering partially by June of 2020. This pattern was found in both physical and mental health care, with physical care most strongly affected. In Australia, Sutherland et al. (2020) found reductions in all forms of care up to June of 2020, with substantial variation between services. The greatest reductions were observed in screening and elective care.

In the UK, after the first few months of the start of the first lockdown (March 2020), which showed a reduction in utilisation, patterns of mental health service activity changed, with bed occupancy levels seemingly returning to pre-pandemic levels (MIND, 2020). Studies on the impact of COVID-19 on mental health services in England have mainly focused on local areas and utilised relatively short pre-COVID trends, as well as examining limited sets of activity measures. Local and regional analyses have found a reduction in supply and demand for mental health services, for example in Cambridgeshire and Peterborough (Chen et al., 2020), reduced referrals and admissions in Leicestershire with admitted patients more likely to be detained (Abbas et al., 2021; Tromans et al., 2020), and a reduction in caseloads and total contacts for home treatment teams in South London and Maudsley (Stewart et al., 2020). Data from 10 UK provider sites covering part of the first lockdown period to May 2020, found reductions in referrals, reduced inpatient admissions and caseloads compared to a pre-lockdown period from January 2019. The period from May to July 2020, during which national restrictions were gradually eased, saw an increased number of referrals, inpatient admissions and caseloads compared to March and April of the same year (Bakolis et al., 2021).

In this paper, we examine whether there were changes in utilisation for mental health providers in England during the initial thirteen months of the COVID-19 pandemic (from March 2020 to March 2021) compared to what might be expected based on pre-pandemic activity patterns. We measure utilisation in terms of numbers of inpatient admissions, discharges, net admissions, length of stay, bed occupancy, bed days, occupied beds, patients with outpatient appointments within 30 days of discharge, and outpatient attendances within 30 days of discharge. Further, we look for evidence of whether there was a shift of utilisation from inpatient admissions to outpatient attendances. We estimate Ordinary Least Squares (OLS) models which control for pre-pandemic trends in activity and case-mix to construct a counterfactual pattern of activity in the absence of the COVID-19 pandemic and to quantify differences in inpatient and outpatient activity arising because of the pandemic. Our analysis is similar to that used to estimate excess mortality due to COVID-19 (Wang et al., 2022).

We make four main contributions to the literature. First, to the best of our knowledge, this is the first paper to use a rich patient-level administrative dataset in England covering the most comprehensive set of mental health providers available to investigate the impact of the COVID-19 pandemic on mental health inpatient activity. Our analysis includes 27 mental health providers, around half of all providers in England. Second, we include a substantial, five-year pre-COVID period to generate robust estimates of pre-COVID-19 trends in utilisation. Third, we estimate models that allow us to calculate a cumulative measure of the overall impact of COVID-19. Finally, we use a broad set of utilisation measures to examine the overall impact of the pandemic.

We observe an increase in discharges (leading to lower net admissions) in the first month of the UK lockdown (March). Yet net admission counts exceed pre-pandemic levels within two months and throughout the period of general restriction easing up to August 2020, when cumulative observed net admission levels return to levels expected from pre-COVID-19 trends. Total net admissions also continue to rise after this point. We also find that length of stay is consistently lower throughout the COVID-19 period, leading plausibly to bed occupancy rates not recovering to a pre-pandemic level. Finally, we find increasing cumulative excess outpatient appointments within 30 days from discharge from inpatient care, which combined with generally shorter inpatient stays, may be an indication of some substitution between inpatient and outpatient care.

2. Institutional setting

2.1. Provision of mental health inpatient care

The English National Health Service (NHS) is mostly funded by general taxation and care is predominantly free at the point of access. NHS mental health services differ from physical health services in organisation and delivery. Although some mental health services are provided in primary care, patients with more serious mental health problems are typically managed by publicly owned mental health providers (known as Mental Health Trusts) which provide care in both inpatient and community settings. Trusts are administrative units, which can be responsible for the running of one or more hospitals. Since we focus predominantly on inpatient mental health care in this paper, we shall use the term 'hospital' to refer to Trusts throughout this paper. A patient can be referred to inpatient mental health care through several channels including their General Practitioner (GP, family doctor), local authority services, their employer, community mental health services, emergency services, and the criminal justice system. Patients admitted for a mental health condition often experience substantially longer lengths of stay than patients admitted for physical health conditions (the median length of stay of a patient, for a mental health condition, admitted to a ward was 323 days in November 2017 (CQC, 2018)). Most hospitals serve the local population in their catchment areas, although some receive national referrals for more specialist services. Outpatient care takes the form of consultations with a range of clinicians and is generally accessed via GPs.

2.2. Response to COVID-19 pandemic

On the March 17, 2020, all hospitals in England were asked to reduce elective care and free up as much bed capacity as possible in the expectation of considerable demand from COVID-19 patients (NHS England and NHS Improvement, 2020a). While the deadline for carrying out this instruction was early April, it is likely that a considerable amount of work was completed in March and that the spread of COVID-19 may already have led to some reduction in hospital use by patients as well as initial preparations within hospitals, based on the observed experience of countries such as Italy and Spain. The first UK lockdown was announced on the March 23, 2020 (IFGA, 2021). While emergency departments remained open, the instruction to stay home, with the explicit expectation that this was to "protect the NHS", may have influenced patient decisions about seeking care.

Between June 2020 and August 2020 there was a gradual general easing of lockdown restrictions in England, though specific additional local restrictions were introduced. Between September 2020 and January 2021, national restrictions were gradually reintroduced, with the notable additional of "fire break" restrictions in November 2020. From the January 6, 2021, England returned to a national lockdown, which remained in place up to the end of our study period of March 2021 (IFGA, 2021).

Wards in mental health hospitals were also reconfigured to accommodate patients with COVID-19. However, a countervailing factor was that new wards were set up by mental health providers to take mental health patients out of acute hospitals and so free-up acute and general beds for treating patients with COVID-19 (NHS, 2020). For example, from April to June 2020, the overall bed occupancy rate in the English NHS across all acute and mental health hospitals fell to around 63% (Nuffield, 2020), whilst mental health hospitals both increased discharges and reduced avoidable admissions (NHS, 2020).

3. Data

3.1. Datasets

There are two national administrative datasets with information about inpatient mental health care provision in England: the Mental Health Services Dataset (MHSDS) and the Hospital Episode Statistics Admitted Patient Care dataset (HES APC). Mental health hospitals are mandated to submit data to MHSDS but from 2019 they were no longer required to submit patient care data for the HES APC dataset, making this a voluntary process. As a result, information in HES APC has become less consistent and complete, with some hospitals ceasing to submit any information to HES APC. However, NHS Digital, who administer both datasets on behalf of the Secretary of State, to the best of our knowledge did not grant access to the MHSDS dataset beyond March 2020 at the time this research was carried out, so we were unable to analyse the impact of COVID-19 using this dataset. We therefore employed the HES APC dataset as our primary data source, limiting our analysis to the 27 mental health hospitals (48% of the total providers in England) that consistently provided data to HES APC throughout our study period (Jan 2015 to March 2021). This facilitated analysis of a substantial proportion of mental health care provision in England.

HES APC is a patient level administrative dataset which includes a rich set of demographic and clinical variables. Each observation in the dataset, referred to as a finished consultant episode (FCE), represents a period of care received by a patient for which a specific consultant (senior doctor) is responsible. An FCE ends if a patient is discharged or transferred to the care of a different consultant. As we are concerned with a patient's entire period of care from admission to discharge within the same hospital, we combine FCEs where the same patient is transferred to the care of different consultants consecutively within the same hospital stay to form spells of care. From this dataset we use information about the timing of patient admission and discharge, patient demographics (age, sex, and ethnicity), diagnoses to identify mental health conditions.

We also use the HES Outpatient (HES OP) dataset. This is an appointment level administrative dataset with information about the timing of outpatient appointments which can be linked to admitted patient care captured in the HES APC through a pseudonymised patient identifier. We can therefore track the treatment of patients across these two settings and can identify outpatient appointments relating to mental health care which occur after a patient with a mental health condition is discharged from a mental health hospital.

We also link the English Index of Multiple Deprivation (measured in 2015) to our main dataset on the basis of the lower-layer super output area (LSOA) of residence recorded for each patient. LSOAs are small geographic areas designed to contain between 1000 and 3000 residents, based on the 2011 UK Census (ONS, 2022).

3.2. Sample selection

We consider a study period from January 2015 to March 2021. Hospital stays for mental health conditions can last several months. Therefore, in order to identify discharges and length of stay, we also consider the time period April 2021 to September 2021 when calculating these variables. Bed occupancy is made up of patients who are admitted during the study period and patients already in hospital before the study period begins and who have not yet been discharged. To incorporate this second element, we include the period April 2014 to December 2014 when calculating bed occupancy. In this way we minimise censoring of our data and retain a common study period which has a considerable pre-COVID time span.

We analyse activity for the set of twenty-seven hospitals which are: i) listed as mental health hospitals in the Organisation Patient Safety Incident Reports (NHS, 2021); ii) report data to HES APC in every year of our study period; and iii) do not undergo any mergers within our study period. We identify mental health admissions as those including a mental health primary diagnosis (ICD-10 codes F00–F99 (mental and behavioural disorders) (94% of identified admissions). An admission is also considered to be for a mental health problem if the consultant in charge of the care is primarily contracted within the mental health specialty (main specialty, *mainspef* = 700–715) or is working within a treatment specialty of mental health during the relevant period of care (*tretspef* = 700–727). A spell is allocated to the month in which the admission occurs. While hospitals were asked to discharge as many patients as possible from late March 2020, some patients with mental health conditions remained in hospital throughout the period from March 2020 to August 2020, the first lockdown. Retention of these patients in hospital during this time indicates that their conditions were severe, and it would have been clinically inappropriate to discharge them. This limits the impact of the pandemic on the treatment of these patients. We therefore exclude this patient group from our analysis, in order to consider a more homogenous sample with greater sensitivity to the changes in utilisation and treatment resulting from the pandemic. The number of patients excluded from our analysis is 1,469, which represents 0.24% of all patients with completed episodes in our initial dataset.

4. Methods

Our methodology closely follows the one used to estimate excess deaths in that we compare expected vs observed levels of activity (see for example Wang et al., 2022). We investigate the impact of the COVID-19 pandemic on inpatient and outpatient mental health care utilisation in the English NHS. Our data consists of a panel of monthly data measured at the hospital level. Specifically, we consider the following dependent variables: the number of admissions, the number of discharges, net admissions, length of stay at discharge, the number of occupied beds, the number of patients with a mental health outpatient appointment within 30 days of discharge, and the number of mental health outpatient appointments within 30 days of discharge, by month and hospital. The definition of all our dependent variables can be found in Table 1.

The impact of the pandemic on activity is likely to have varied over time due to a mix of different policies applied from March 2020 onwards. This limits the capacity of common before and after methods, such as standard Interrupted Time Series, which employs a single shift and single slope parameter, to characterise the COVID-19 period. We expand this approach by using shift parameters for every pandemic month to determine individual month and cumulative impacts from March 2020 to March 2021 inclusive. We first investigate the impact of COVID-19 on each activity measure, where changes might partly be driven by changes in case-mix. We do this by estimating the following Ordinary Least Squares (OLS) regression:

$$y_{imt} = \alpha + \beta_1 d_t + \sum_{m=1}^{11} \delta_m S_m + \sum_{p=1}^{13} \pi_p P_p + u_i + \varepsilon_{imt} \quad (1)$$

where: y_{imt} is the dependant variable (utilisation) considered for hospital i in month m of year t; α is a constant term; d is a continuous variable capturing the year time trend; S_m is a series of month-of-year dummy variables to control for seasonal effects; u_i is a set of hospital fixed effects to capture features of hospitals and their catchment area which remain constant over time; P_p is a series of thirteen post COVID-19 month dummy variables from March 2020 to March 2021 and where the base category is the months pre COVID-19. Our key coefficients are π_p, which capture the difference in our dependent variables between pandemic months and the expected level of activity based on pre-COVID-19 time trends.

We then regress measures of utilisation on the same set of covariates, plus a vector of case-mix variables as defined in Table 1. In this specification, we estimate the impact of the pandemic on utilisation, conditional on case-mix. We calculate the case-mix variables as percentages of

Table 1
Descriptive statistics and description of variables.

		Mean	S.D.	Minimum	Maximum
Dependent Variables					
Admissions	Number of admissions per calendar month per NHS hospital	176.21	101.17	1	768
Discharges	Number of discharges per calendar month per NHS hospital	177.32	104.04	0	836
Net Admissions	Admissions minus discharges per calendar month per NHS hospital	−1.51	29.05	−211	227
Length of Stay at Discharge	The number of days patients spent in hospital at the time of discharge per calendar month per NHS hospital	48.05	19.24	1	230
Bed Days	Bed Days are the count of occupied beds multiplied by the number of days they were occupied per calendar month per NHS hospital.	9336.04	5192.77	1	25,874
Occupied Beds	Mean daily count of patients in our sample occupying an inpatient hospital bed at any point during or throughout a day per calendar month per NHS hospital.	306.78	170.39	.033	834.64
Patients with Outpatient Appointments	Number of patients with an outpatient appointment within 30 days of discharge per calendar month per NHS hospital.	51.59	48.01	0	250
Total Outpatients Appointments	Number of outpatient appointments within 30 days of discharge per calendar month per NHS hospital.	507.16	1225.63	0	15,329
Case-Mix Variables					
% Female Admissions	Percentage of female admissions.	49.82	8.44	0	100
% 65+ Age Admissions	Percentage of Admissions of 65+ year olds	25.35	17.78	0	100
% Schizophrenia Admissions	Percentage of admissions of patients with schizophrenia	29.65	14.76	0	100
% Admissions with Comorbidities	Percentage of admissions of patients with at least one comorbidity	17.85	14.30	0	100
% Formally Detained Admissions	Percentage of Admissions for patients falling under Part II, sections 2 to 34 or Part III sections 35 to 55 or Part X, sections 131 to 149 of the 1983 Mental Health Act. It also includes patients on supervised discharge under the Mental Health Act 1995 and patients on Guardianship under the Mental Health Act of 1983	27.93	23.25	0	100
% Non-White Admissions	Percentage of admissions of non-white patients	16.37	13.78	0	100
% Admissions in Lowest Dep Decile	Percentage of patients resident in an LSOA (neighbourhood) in the decile of highest deprivation	13.91	11.72	0	55.77

total admissions; therefore, we do not estimate this model when total admissions is our dependent variable.

All models are estimated using clustered standard errors to account for the correlation between repeated measures. We also estimate linear joint tests of hypothesis for the month coefficients corresponding to the first lockdown (March 2020–August 2020) and for the full COVID-19 period analysed. All analyses are conducted using Stata version 17.

4.1. Robustness checks

We perform two robustness checks on our models. First, we estimate the models, including case-mix adjustment where applicable, using Poisson regressions for our count dependent variables, namely, admissions, discharges, length of stay at discharge, bed days, occupied beds, patients with one or more outpatient appointments, and total outpatient appointments.

Finally, for all our dependent variables we test whether our results are driven by specific heterogenous effects by estimating the following interaction models:

$$y_{imt} = \alpha + \gamma_1 d_t + \sum_{m=1}^{11} \theta_m S_m + \sum_{m=1}^{13} \pi_p P_p + \varsigma X_{imt} + \varphi \left(\sum_{p=1}^{13} P_p * HET_{imt} \right) + u_i + \varepsilon_{imt} \quad (2)$$

where our variables are as defined by equation (1) but we include the term X_{imt} which is a vector of case-mix variables described in Table 1 with its corresponding vector of estimated coefficients, ς, as in the second set of regressions, and the term $(\sum_{m=1}^{13} P_p) * (HET_{imt})$ which interacts our post pandemic dummy variables with a subset of our case-mix variables and which are either of the following: percentage of female admissions, percentage of admissions of patients aged 65+, percentage of patients from the most deprived neighbourhoods, and percentage of non-white patients. From these specifications, we test the joint hypothesis that there are heterogenous effects in either the first lockdown, or the whole COVID-19 period analysed.

5. Results

Table 1 presents descriptive statistics for our dependent and independent variables along with their definitions. Mean provider admissions and discharges over our study period are similar in magnitude, at around 176 per hospital-month, indicating roughly a one-for-one replacement. The average length of stay is 48 days. The mean occupied beds per month per hospital is 307 which amounts to an average of 9336 bed days. On average, around 52 patients per hospital-month have an outpatient appointment within 30 days of their discharge. There are, on average, around 507 such outpatient appointments per hospital-month.

When it comes to the demographic and case-mix of admissions, nearly 50% of admitted patients are female, and around 25% of admitted patients are aged 65 years or older. On average, around 18% of admissions have at least one comorbidity recorded, and almost 28% of admitted patients are detained. Finally, about 16% of admissions are for people of non-white ethnicity and nearly 14% come from the most deprived decile of LSOAs.

Table 2 presents the point estimates from our hospital-fixed effects OLS regression models and Table 3 additionally adjusts for case-mix variables (except for the Admissions model, which we still include for reference). Each column is labelled with the dependent variable of the estimated model and the highlighted rows represent the first lockdown. Each coefficient from March 2020 until March 2021 represents the difference in our measures of service utilisation between that month and the expected level of service utilisation based on pre-pandemic utilisation levels.

The statistical significance of the impact of each post-COVID-19 month varies by the dependent variable and point in time considered. Overall, there is an initial increase in discharges and net admissions at the time of first lockdown followed by a rapid return to pre-pandemic levels with cumulative net admissions at the end of the first lockdown of 7.49 higher than expected per hospital per month as indicated by our joint test of hypothesis. Although admissions and discharges do not show joint statistical significance either for the first lockdown or the whole COVID-19 period analysed, there is an indication that inpatient

Table 2
OLS Regressions Models with Hospital Fixed Effects and no case-mix controls.

	(1) Admissions	(2) Discharges	(3) Net Admissions	(4) Length of Stay at Discharge	(5) Bed Days	(6) Occupied Beds	(7) Patients with Outpatient Appt	(8) Total Outpatient Appointments
March 2020	−6.70	71.05***	−77.73***	−3.42	−766.67*	−23.16*	−5.06	−15.16
	(-30.08,16.68)	(37.67,104.42)	(-103.30,-52.16)	(-9.18,2.35)	(-1424.05,-109.29)	(-44.36,-1.96)	(-12.57,2.46)	(-59.88,29.55)
April	−18.55	−11.75	−6.77	13.64	−2708.19***	−90.80***	−3.98	744.33**
	(-45.70,8.61)	(-40.05,16.54)	(-17.24,3.70)	(-4.47,31.75)	(-3580.14,-1836.23)	(-119.82,-61.77)	(-11.52,3.56)	(275.52,1,213.13)
May	0.91	−29.97*	30.96***	−4.52	−2428.66***	−76.71***	2.30	952.10**
	(-25.92,27.74)	(-54.54,-5.41)	(20.42,41.49)	(-13.24,4.19)	(-3292.27,-1565.06)	(-104.65,-48.77)	(-5.10,9.70)	(406.15,1,498.06)
June	19.82	−3.54	23.16***	−6.69*	−1664.10***	−55.84***	9.62*	1467.72**
	(-9.80,49.45)	(-30.47,23.39)	(12.80,33.53)	(-11.79,-1.60)	(-2552.18,-776.02)	(-85.30,-26.39)	(1.03,18.21)	(409.80,2,525.63)
July	20.04	6.42	13.64*	−2.77	−1011.80*	−31.07*	11.61*	1549.48**
	(-10.41,50.49)	(-23.22,36.05)	(1.74,25.55)	(-9.38,3.84)	(-1969.52,-54.07)	(-62.04,-0.10)	(2.33,20.89)	(436.86,2,662.10)
August	12.67	−11.50	24.23***	−24.41***	−494.00	−14.32	7.34	1226.36**
	(-23.49,48.83)	(-45.91,22.91)	(11.99,36.47)	(-31.34,-17.48)	(-1505.45,517.45)	(-47.03,18.40)	(-4.65,19.33)	(426.46,2,026.27)
September	12.35	12.82	−0.45	−23.12***	−150.47	−5.54	6.70	998.23**
	(-29.11,53.81)	(-30.94,56.57)	(-7.81,6.92)	(-31.13,-15.11)	(-1199.48,898.54)	(-40.43,29.36)	(-7.00,20.40)	(269.48,1,726.97)
October	6.65	−0.57	7.30	−21.55***	−156.70	−3.44	4.68	1014.63***
	(-25.99,39.30)	(-35.48,34.34)	(-2.85,17.45)	(-29.65,-13.45)	(-1178.37,864.96)	(-36.52,29.65)	(-5.00,14.35)	(488.95,1,540.31)
November	−8.92	−20.86	11.95*	−21.10***	78.52	2.09	−0.46	815.62***
	(-35.79,17.94)	(-46.94,5.22)	(1.96,21.95)	(-28.09,-14.12)	(-982.94,1,139.98)	(-33.19,37.38)	(-7.45,6.52)	(379.74,1,251.50)
December	−0.06	−6.58	6.53	−16.94***	355.43	13.04	3.38	935.33**
	(-26.64,26.51)	(-35.16,22.00)	(-1.73,14.79)	(-24.03,-9.86)	(-698.26,1,409.13)	(-21.15,47.22)	(-3.24,10.00)	(389.58,1,481.08)
January 2021	−2.71	−12.87	10.18	−17.55***	517.05	18.51	8.32	978.15**
	(-40.69,35.28)	(-47.06,21.33)	(-3.72,24.08)	(-25.70,-9.39)	(-597.37,1,631.48)	(-17.66,54.69)	(-4.35,21.00)	(420.26,1,536.05)
February	16.22	1.55	14.69**	−15.69***	838.60	27.56	19.11*	1481.36***
	(-22.81,55.25)	(-39.07,42.18)	(5.76,23.61)	(-23.49,-7.89)	(-279.72,1,956.92)	(-11.44,66.55)	(1.33,36.90)	(710.28,2,252.45)
March	18.14	20.66	−2.50	−17.89***	1117.70	38.15	25.23**	2233.21**
	(-19.10,55.38)	(-27.26,68.59)	(-22.81,17.82)	(-26.26,-9.52)	(-182.47,2,417.88)	(-4.01,80.31)	(6.81,43.65)	(897.49,3,568.92)
Year Trend	−0.73	0.27	−1.01**	1.87**	−649.56***	−21.48***	−1.10	−6.96
	(-5.47,4.02)	(-4.37,4.92)	(-1.64,-0.38)	(0.51,3.24)	(-936.19,-362.92)	(-30.93,-12.03)	(-3.76,1.56)	(-23.98,10.05)
Jan FE	−2.12	1.27	−3.38	0.85	77.13	2.75	0.53	1.94
	(-11.25,7.02)	(-14.92,17.46)	(-14.16,7.40)	(-1.68,3.38)	(-100.66,254.92)	(-3.05,8.55)	(-2.57,3.63)	(-13.73,17.61)
Feb FE	−14.52***	−14.93*	0.41	−1.47	−865.90***	−0.28	−3.55**	−14.82*
	(-21.82,-7.23)	(-26.91,-2.96)	(-10.70,11.52)	(-4.07,1.14)	(-1081.52,-650.29)	(-3.78,3.22)	(-6.09,-1.02)	(-27.47,-2.18)
Apr FE	−7.19	−6.72	−0.47	2.53	−322.59***	0.18	−0.33	6.07
	(-17.37,2.99)	(-23.60,10.16)	(-11.03,10.08)	(-0.88,5.95)	(-470.37,-174.81)	(-5.18,5.53)	(-3.18,2.51)	(-5.32,17.46)
May FE	2.98	2.13	0.80	2.22	52.59	1.64	2.24	16.95
	(-8.08,14.05)	(-14.85,19.11)	(-8.30,9.89)	(-2.64,7.07)	(-176.25,281.42)	(-5.73,9.00)	(-1.87,6.35)	(-8.68,42.58)
Jun FE	1.05	3.07	−2.02	1.20	−267.72*	2.02	2.91	20.31
	(-9.83,11.92)	(-14.93,21.07)	(-11.12,7.08)	(-3.31,5.71)	(-497.24,-38.21)	(-5.84,9.87)	(-0.95,6.77)	(-1.52,42.15)
Jul FE	3.78	4.30	−0.52	−0.54	−24.10	−0.78	3.22	13.65
	(-8.06,15.62)	(-14.16,22.76)	(-10.74,9.70)	(-2.97,1.90)	(-262.09,213.90)	(-8.45,6.90)	(-0.44,6.88)	(-0.86,28.16)
Aug FE	−1.74	−0.04	−1.74	−1.45	−51.63	−1.71	2.64	6.58
	(-12.73,9.25)	(-17.42,17.33)	(-12.16,8.69)	(-4.60,1.69)	(-316.59,213.34)	(-10.26,6.83)	(-0.56,5.84)	(-7.88,21.05)
Sept FE	−6.01	−2.96	−3.06	1.29	−430.83**	−3.43	1.58	10.87
	(-17.52,5.49)	(-20.15,14.24)	(-12.92,6.80)	(-0.91,3.49)	(-705.97,-155.69)	(-12.41,5.55)	(-2.36,5.51)	(-5.00,26.73)
Oct FE	0.94	2.58	−1.70	2.45	−170.19	−5.54	3.64	17.02
	(-10.73,12.61)	(-14.22,19.37)	(-10.46,7.06)	(-0.45,5.36)	(-465.65,125.28)	(-15.06,3.99)	(-0.43,7.71)	(-4.81,38.86)
Nov FE	−6.85	−0.24	−6.61	3.46*	−581.19***	−8.44	0.15	5.66
	(-18.42,4.72)	(-19.37,18.88)	(-17.23,4.02)	(0.63,6.29)	(-850.47,-311.90)	(-17.05,0.16)	(-3.90,4.19)	(-9.96,21.28)
Dec FE	−10.90*	−6.64	−4.26	−0.70	−518.36***	−16.72***	−2.73	−7.20
	(-21.56,-0.24)	(-23.08,9.80)	(-14.35,5.83)	(-3.66,2.27)	(-735.55,-301.17)	(-23.73,-9.72)	(-6.16,0.69)	(-23.36,8.96)
Constant	1652.15	−372.79	2036.55**	−3725.95**	1320343.29***	43,648.65***	2268.54	14,213.67
	(-7919.52,11,223.83)	(-9741.30,8,995.72)	(769.83,3,303.27)	(-6475.93,-975.97)	(742,077.29,1898609.30)	(24,585.95,62,711.36)	(-3094.70,7,631.78)	(-20,121.20,48,548.54)

(*continued on next page*)

Table 2 (*continued*)

	(1) Admissions	(2) Discharges	(3) Net Admissions	(4) Length of Stay at Discharge	(5) Bed Days	(6) Occupied Beds	(7) Patients with Outpatient Appt	(8) Total Outpatient Appointments
Hospital FE	YES	YES	YES	YES	YES	YES	YES	YES
N	2019	2023	2019	1981	2019	2019	2019	2019
R^2 Adjusted	0.0135	0.0302	0.1543	0.1374	0.3528	0.3458	0.0243	0.2633
R^2 Within	0.0258	0.0422	0.1648	0.1483	0.3608	0.3539	0.0364	0.2724
R^2 Between	0.1366	0.0000	0.0000	0.0331	0.0957	0.1059	0.0670	0.0774
Joint Significance 1st Lockdown	28.19 (−120,177)	20.69 (−120,162)	7.49 (−32,47)	−28.17 (−63,7)	−9073.42*** (−13643,-4503)	−291.89*** (−441,-142)	21.83 (−21,65)	5924.83** (2,231,9,618)
Joint Significance Whole Period	69.86 (−293,432)	15.85 (−342,372)	55.19* (2, 108)	−162.01*** (−243,81)	−6473.28*** (−17588,4,642)	−201.51 (−567,163)	88.79 (−20,198)	14381.36*** (7,131,21,631)

***$p < 0.001$, **$p < 0.01$, *$p<0.05\%$.
95% Confidence intervals in parenthesis. Clustered standard errors. Greyed rows represent the first English lockdown.

stays were shorter and that there was an interplay between inpatient and outpatient care. This is evidenced by shorter length of stay over the whole period, and an overall reduction in bed days, and over the first lockdown for occupied beds as indicated by our joint test of hypothesis. Moreover, it is clear from our results that the total number of outpatient appointments significantly increased both during the first lockdown and continued increasing over the first year of the pandemic.

Additionally, Fig. 1 presents the key coefficients of Table 3 (our post pandemic dummies). The black markers indicate our point estimates for each COVID-19 month, with their corresponding confidence intervals. The shaded area over the x-axis is the cumulative excess service utilisation in terms of the dependent variable analysed. The rectangle in grey shade corresponds to the first lockdown period. Conditional on pre-COVID-19 time trends, hospital average monthly net admissions (graph (3)) first drop in March 2020 to a minimum of nearly −78 (95% CI [−103.30, −52.16]) per hospital below their expected level, slowly recovering and reaching their expected level by the end of the first lockdown 7.49 (95% CI [−32, 47]). Patients with outpatient appointments (graph (7)), and total hospital outpatient appointments (graph (8)) are consistently above what would have been predicted. By the end of the first year of the pandemic, there are around 14,313 (95% CI [7257, 21,370]) more outpatient appointments per hospital than expected. This result is consistent with a shift towards shorter inpatient stays, with total bed days reaching a minimum of around −9535 (95% CI [−14092, −4978]) fewer than the expected level at the end of the first lockdown and the point estimates for length of stay constantly below zero (−164 (95% CI [−231, −98]) at the end of the first year of the pandemic.

5.1. *Robustness checks*

The full results for our robustness check using Poisson models can be found in table A1. The Poisson model results confirm the qualitative conclusions from our main models, suggesting these are not driven by the underlying assumptions of OLS. Further, our interaction models show that our results are not driven by heterogenous effects. Table A2 presents the results from the linear joint hypothesis test of heterogenous effects from our interaction models. Except for the number of admissions of patients aged 65 and older, which is significant for some of our utilisation dependent variables, no other interacted variable shows joint significance for the first lockdown or for our whole study period. This suggests our results are not driven by a specific patient case-mix in our data.

6. Discussion

In this paper, we investigate the impact of the COVID-19 pandemic on provision of mental health inpatient and outpatient services in England. The introduction of a national lockdown in England in March 2020 had a major and potentially long-lasting impact on the provision of mental health services. Both the need to maximise bed capacity for potential COVID-19 patients, and explicit precautions to minimise the spread of the virus, limited hospitals' physical capacity to treat patients. The instruction to stay at home and minimise contacts may also have directly impacted on the propensity of patients to seek medical help. Between March 2020 and March 2021, the regulations in place to manage the spread of COVID-19 changed substantially, resulting in differential impacts on service provision over this period.

Our first key finding suggests a picture of *quicker and sicker*. We find, both in the first national lockdown and in the full pandemic period, that both admissions and discharges are substantially higher than would be predicted based on pre-COVID-19 trends. This finding, combined with persistently shorter length of stay in the COVID-19 period, suggests a more rapid turnover of patients in the inpatient mental health setting during the COVID-19 period.

This might have arisen through several mechanisms. First, demand

Table 3
OLS Regressions Models with Hospital Fixed Effects and case-mix controls.

	(1)Admissions	(2)Discharges	(3) Net Admissions	(4)Length of Stay at Discharge	(5)Bed Days	(6)Occupied Beds	(7)Patients with Outpatient Appt	(8)Total Outpatient Appointments
March 2020	−6.70	64.98***	−78.28***	−2.77	−823.63*	−24.92*	−7.33*	−49.81
	(-30.08,16.68)	(36.61,93.35)	(-103.77,-52.79)	(-8.52,2.99)	(-1485.02,-162.25)	(-46.35,-3.48)	(-13.58,-1.07)	(-100.99,1.37)
April	−18.55	−4.94	−9.47	10.60	−2812.32***	−94.07***	−4.25	726.97**
	(-45.70,8.61)	(-27.72,17.85)	(-19.53,0.58)	(-6.40,27.60)	(-3746.34,-1878.31)	(-125.14,-63.00)	(-11.58,3.08)	(217.81,1,236.13)
May	0.91	−24.31*	29.94***	−6.36	−2506.78***	−79.25***	2.26	965.54**
	(-25.92,27.74)	(-45.73,-2.90)	(20.18,39.70)	(-13.77,1.06)	(-3375.07,-1638.49)	(-107.42,-51.08)	(-4.69,9.21)	(398.43,1,532.65)
June	19.82	1.10	21.78***	−7.71**	−1719.38***	−57.67***	9.55*	1465.60**
	(-9.80,49.45)	(-23.77,25.97)	(11.73,31.82)	(-12.86,-2.56)	(-2518.56,-920.20)	(-84.30,-31.03)	(1.39,17.71)	(423.95,2,507.25)
July	20.04	6.86	13.61*	−3.26	−1093.89*	−33.82*	11.06*	1563.69**
	(-10.41,50.49)	(-20.42,34.14)	(2.07,25.15)	(-9.16,2.63)	(-2072.21,-115.58)	(-65.51,-2.14)	(1.89,20.23)	(435.86,2,691.52)
August	12.67	−15.19	22.91***	−23.97***	−579.39	−16.91	5.64	1203.37**
	(-23.49,48.83)	(-42.13,11.75)	(11.96,33.86)	(-30.38,-17.57)	(-1602.18,443.41)	(-50.11,16.28)	(-4.44,15.72)	(418.15,1,988.59)
September	12.35	14.45	−2.01	−24.11***	−204.46	−7.32	7.14	975.60**
	(-29.11,53.81)	(-21.61,50.51)	(-9.64,5.62)	(-30.30,-17.92)	(-1129.13,720.21)	(-38.07,23.43)	(-4.89,19.17)	(293.06,1,658.14)
October	6.65	−2.15	6.10	−21.15***	−172.76	−3.83	4.26	1013.80***
	(-25.99,39.30)	(-29.25,24.96)	(-4.50,16.69)	(-28.31,-13.99)	(-1179.22,833.70)	(-36.47,28.82)	(-3.66,12.18)	(474.51,1,553.09)
November	−8.92	−20.68	11.15*	−22.28***	7.66	−0.02	−0.53	809.12***
	(-35.79,17.94)	(-45.73,4.36)	(0.81,21.49)	(-28.18,-16.38)	(-976.04,991.37)	(-32.73,32.69)	(-6.57,5.50)	(361.46,1,256.78)
December	−0.06	−7.25	5.87	−17.41***	386.10	14.15	3.81	925.36**
	(-26.64,26.51)	(-35.76,21.26)	(-3.06,14.79)	(-23.64,-11.18)	(-683.02,1,455.22)	(-20.60,48.89)	(-3.32,10.94)	(374.43,1,476.28)
January 2021	−2.71	−15.63	8.52	−16.83***	398.19	14.69	7.88	966.56**
	(-40.69,35.28)	(-44.45,13.20)	(-5.47,22.52)	(-24.66,-9.00)	(-662.62,1,459.00)	(-19.83,49.20)	(-3.56,19.31)	(398.49,1,534.63)
February	16.22	−0.14	13.35**	−14.72***	771.95	25.34	19.50*	1486.88***
	(-22.81,55.25)	(-29.54,29.25)	(4.81,21.88)	(-21.75,-7.70)	(-370.65,1,914.55)	(-14.39,65.08)	(2.19,36.81)	(733.02,2,240.75)
March	18.14	19.55	−3.57	−14.54**	1260.14	42.88	28.43*	2260.94**
	(-19.10,55.38)	(-19.71,58.81)	(-24.33,17.19)	(-22.96,-6.12)	(-251.07,2,771.35)	(-6.32,92.08)	(5.22,51.65)	(987.25,3,534.64)
Year Trend	−0.73	1.14	−1.00*	1.51*	−660.96***	−21.87***	−0.99	−3.85
	(-5.47,4.02)	(-4.00,6.28)	(-1.80,-0.19)	(0.06,2.96)	(-941.90,-380.02)	(-31.14,-12.60)	(-3.94,1.97)	(-26.18,18.47)
% Female Admissions	−2.12	1.16	−2.92	1.04	102.43	3.54	0.78	6.60
	(-11.25,7.02)	(-13.38,15.71)	(-13.50,7.66)	(-1.69,3.77)	(-75.97,280.83)	(-2.27,9.36)	(-1.96,3.53)	(-18.04,31.25)
% 65+ Age Admissions	−14.52***	−17.74**	0.66	−0.74	−861.35***	−0.11	−4.05**	−25.77*
	(-21.82,-7.23)	(-29.99,-5.49)	(-10.33,11.64)	(-3.52,2.04)	(-1093.23,-629.47)	(-4.70,4.48)	(-6.71,-1.39)	(-47.76,-3.78)
% Schizophrenia Admissions	−7.19	2.71	−1.33	0.20	−289.08*	1.28	1.49	37.97
	(-17.37,2.99)	(-12.86,18.28)	(-12.01,9.35)	(-2.78,3.18)	(-535.60,-42.55)	(-7.24,9.79)	(-1.35,4.32)	(-13.71,89.65)
% Admissions with Comorbidities	2.98	9.48	0.45	0.08	134.01	4.32	3.96	38.16
	(-8.08,14.05)	(-6.46,25.43)	(-8.76,9.66)	(-4.57,4.73)	(-154.71,422.73)	(-5.04,13.68)	(-0.14,8.06)	(-1.87,78.19)
% Formally Detained Admissions	1.05	10.05	−2.53	−0.86	−236.20	3.06	4.14*	37.85
	(-9.83,11.92)	(-6.20,26.31)	(-11.59,6.53)	(-4.48,2.77)	(-527.43,55.04)	(-6.80,12.91)	(0.37,7.92)	(-0.83,76.53)
% Non-White Admissions	3.78	11.05	−0.87	−2.25	60.93	2.05	4.75**	31.42
	(-8.06,15.62)	(-5.49,27.59)	(-11.07,9.33)	(-4.64,0.14)	(-191.13,312.99)	(-6.08,10.18)	(1.72,7.79)	(-3.47,66.31)
% Admissions in Lowest Deprivation Decile	−1.74	4.96	−1.44	−2.76	−7.82	−0.35	3.87*	28.84*
	(-12.73,9.25)	(-9.84,19.75)	(-11.85,8.96)	(-5.99,0.46)	(-264.12,248.49)	(-8.64,7.95)	(0.82,6.93)	(2.65,55.03)
Jan FE	−6.01	2.03	−3.04	0.01	−381.09*	−1.80	2.79	32.44*
	(-17.52,5.49)	(-12.54,16.60)	(-12.69,6.62)	(-2.11,2.12)	(-666.23,-95.96)	(-11.12,7.52)	(-0.38,5.97)	(5.94,58.94)
Feb FE	0.94	6.99	−1.74	1.15	−181.44	−5.95	4.59**	31.76**
	(-10.73,12.61)	(-7.71,21.68)	(-10.43,6.95)	(-1.71,4.00)	(-460.65,97.77)	(-14.99,3.09)	(1.20,7.99)	(8.36,55.15)
Apr FE	−6.85	2.10	−6.36	2.85*	−573.71***	−8.23	0.82	25.84**
	(-18.42,4.72)	(-14.65,18.85)	(-16.80,4.09)	(0.04,5.66)	(-838.09,-309.33)	(-16.60,0.15)	(-2.48,4.12)	(7.52,44.17)
May FE	−10.90*	−5.06	−4.30	−1.57	−578.41***	−18.78***	−2.72	−1.20

(*continued on next page*)

Table 3 (*continued*)

	(1)Admissions	(2)Discharges	(3) Net Admissions	(4)Length of Stay at Discharge	(5)Bed Days	(6)Occupied Beds	(7)Patients with Outpatient Appt	(8)Total Outpatient Appointments
	(-21.56,-0.24)	(-20.07,9.94)	(-14.42,5.82)	(-4.60,1.47)	(-785.38,-371.45)	(-25.45,-12.11)	(-5.79,0.34)	(-26.79,24.39)
Jun FE		−0.07	−0.06	−0.04	−8.81	−0.29	−0.04	−2.42
		(-0.71,0.58)	(-0.18,0.06)	(-0.16,0.09)	(-25.92,8.30)	(-0.85,0.28)	(-0.15,0.08)	(-8.81,3.96)
Jul FE		0.53	0.29**	0.13	37.96	1.25	0.38	3.97
		(-0.44,1.51)	(0.09,0.49)	(-0.03,0.28)	(-9.36,85.28)	(-0.32,2.81)	(-0.06,0.83)	(-6.56,14.50)
Aug FE		−1.69***	0.39*	0.41**	−11.21	−0.39	−0.26	−2.34
		(-2.43,-0.94)	(0.09,0.70)	(0.15,0.66)	(-45.33,22.91)	(-1.52,0.74)	(-0.58,0.06)	(-16.97,12.29)
Sept FE		−0.22	−0.14*	0.01	7.03	0.25	−0.15	−5.82*
		(-0.63,0.19)	(-0.28,-0.01)	(-0.05,0.07)	(-7.99,22.05)	(-0.25,0.75)	(-0.36,0.06)	(-11.08,-0.56)
Oct FE		−0.31	−0.03	0.23*	4.48	0.14	0.10	1.35
		(-1.12,0.49)	(-0.18,0.12)	(0.03,0.42)	(-36.05,45.01)	(-1.19,1.48)	(-0.46,0.66)	(-7.01,9.70)
Nov FE		−0.75*	0.17	0.21	6.28	0.21	−0.22*	4.79
		(-1.48,-0.03)	(-0.06,0.41)	(-0.10,0.52)	(-30.17,42.74)	(-0.99,1.41)	(-0.42,-0.01)	(-12.63,22.22)
Dec FE		−0.15	−0.14	0.05	−7.80	−0.19	−0.08	1.05
		(-0.80,0.49)	(-0.49,0.21)	(-0.16,0.27)	(-33.75,18.14)	(-1.03,0.65)	(-0.32,0.16)	(-9.07,11.16)
Constant	1652.15 (-7,919, 11,223.)	−2056.34 (-12,413.78,8,301.11)	1997.09* (380.68,3,613.51)	−3027.33* (-5944.03,-110.63)	1342900.03*** (776,419,1909380.29)	44,419.59*** (25,733.37,63,105.80)	2047.12 (-3908.03,8,002.27)	7990.80 (-36,959.95,52,941.55)
N	2019	2017	2017	1976	2017	2017	2017	2017
R^2 Adjusted	0.0135	0.1666	0.1701	0.2324	0.3809	0.3745	0.0780	0.2688
R^2 Within	0.0258	0.1799	0.1833	0.2449	0.3908	0.3844	0.0927	0.2804
R^2 Between	0.1366	0.2197	0.0400	0.1891	0.1623	0.1696	0.0606	0.1266
Joint Significance 1st Lockdown	28.19 (−121,177)	28.50 (−92,149)	0.48 (−37,38)	−33.47* (−64,-3)	−9535.41*** (−14092,-4978)	−306.64*** (−456,-157)	16.93 (−22,56)	5875.36*** (2217,9536)
Joint Significance Whole Period	69.86 (−293,432)	16.65 (−274,308)	39.88 (−16,96)	−164.51*** (−231,-98)	−7088.58 (−17896,3719)	−220.75 (−576,134)	87.41 (−9184)	14313.62*** (7257,21,370)

***p < 0.001, **p < 0.01, *p<0.05%.

95% Confidence intervals in parenthesis. Clustered standard errors.Greyed rows represent the first English lockdown.Admissions model does not control for Case-Mix and it is included as reference. It is the same as in Table 2.

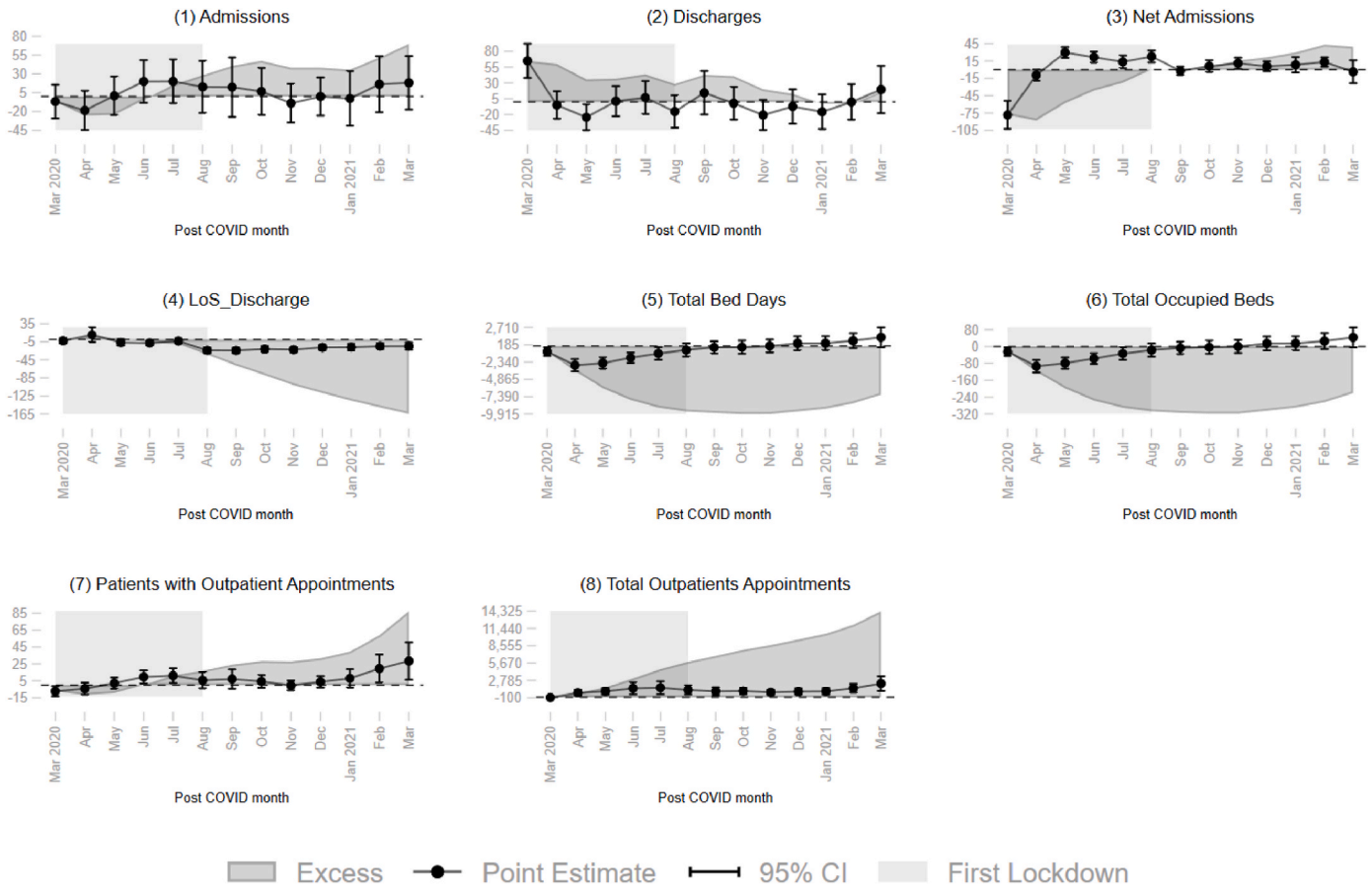

Fig. 1. Point estimates and cumulative excess.

factors such as patients needing a short period of inpatient care having been initially discharged pre-pandemic to clear beds, or requiring inpatient care for the first time partly due to the impact of lockdown on mental health. Second, supply is effectively reduced by the need to maintain bed capacity for potential COVID-19 patients, diverting staff to support the care of COVID-19 patients and measures taken to minimise the spread of the virus such as social distancing. These factors may have led to higher admission thresholds of more severe patients on average for shorter periods of time for stabilisation. Any of these mechanisms might be indicative of a mental health care system lacking spare capacity to deal with spikes in demand and potentially even normal levels of demand, resulting in exacerbated unmet need. A potential policy response would be to provide additional resources to increase total capacity or flexibility to respond to future shocks.

A second key finding suggests attempts to *catch-up* after initial reductions in activity. It is noteworthy that cumulative net admissions turn positive around the end of the first lockdown. This may indicate a trend towards returning to pre-pandemic care patterns, or even a need to catch-up with delayed care. The latter would imply important considerations for future need and capacity to meet it. For example, additional resources may be needed to treat patients who could not be treated during the study period and/or for whom mental health symptoms worsened due to or during the COVID-19 period.

A third key finding is of potential substitution between inpatient and outpatient care, reflected in a substantial *increase in the number of outpatient appointments, but not the number of outpatients*, following discharge from inpatient mental health care throughout the COVID-19 period. This may have arisen for several reasons: the potential to run more appointments virtually; a need to maintain contact with patients who would otherwise have been in inpatient care; and a desire among patients to minimise contact with inpatient hospital services in response to the threat of infection, these last two potential mechanism are also supported by observed shorter inpatient length of stay.

All of the above highlight important lessons in allocating resources to and within mental health services when pressure is high. On the one hand there is the potential to substitute between services, and there may be advantages in expanding provision in a targeted way to permit easier access to care. Substituting from inpatient to more outpatient care may require changes in organisation and investment (e.g. technology and skills), changes in care pathways and understanding of appropriate thresholds for admission. However, it is not clear from this study alone whether the shifts in care are themselves detrimental to patient outcomes, which would suggest a need for greater capacity to manage potential spikes in demand. Our work is consistent with the international literature finding and increase in population mental health problems during the COVID-19 pandemic (see Sun et al., 2023 for a systematic review and meta-analysis of 134 cohorts) and international evidence of changes in mental health services utilisation (see for example Hvide and Johnsen, 2022; Percudani et al., 2020; Rosenberg et al., 2020 among others).

This study has three main limitations. First, we are unable to include mental health hospitals that do not consistently report their activity to HES APC nor private providers. This limits the generalisability of our findings. However, we are able to observe activity in 27 hospitals, representing around half of inpatient NHS mental health providers in England.

Second, we evaluate the impact of COVID-19 purely in terms of national timing. As a result, we are not able to identify a clear causal link from policy to activity or distinguish the impact of a specific policy decision or individual drivers of impact, e.g. supply and demand factors. Instead, we present the overall impact of a bundle of policies with the common goal of minimising the effects of the COVID-19 pandemic.

Finally, we are unable to accurately examine acuity of patient presentation so cannot assess whether patients experiencing shorter stays or being discharged sooner were more/less severe, or whether those who were admitted when services started catching up to pre-pandemic activity levels, present as more severe.

Our analysis suggests a number of different routes for further research on this topic. Once available, the MHSDS dataset will be a valuable resource to build on this study. This would permit consideration of additional activity measures, such as healthcare professional contacts, referrals, and activity in the community. There would also be value in considering a longer COVID-19 period as mental health providers settle into the 'new normal'. This would permit insights into whether the reduction in mental health service activity during the pandemic has led to increased unmet need, which might manifest as additional demand at a later time.

A further important consideration is the heterogeneous impact of COVID-19 on mental health service activity across patients with different levels of acuity or deprivation as a result of COVID-19. Whilst we did explore in this study, the interaction between our independent variables and the COVID-19 pandemic period, we found limited impact. Other studies have, however, found that individuals with pre-existing mental health problems were more likely to experience disruptions to their care (di Gessa et al., 2022). The multifaceted impacts of COVID-19 and policies used in response may have individually or collectively impacted on the mental health care of specific patient groups differently.

7. Conclusion

This paper contributes to the understanding of how COVID-19 has impacted on activity of inpatient mental health services in England. The focus is on the contemporaneous impact during the first lockdown and over the first thirteen months of the pandemic in England. The work is part of a wider programme of research which includes qualitative case study research to understand how mental health providers have responded to changes in service provision (Mannion et al., 2022). Our study has potential to inform future resource planning as well as future pandemic preparedness.

CRediT authorship contribution statement

Adrián Villaseñor: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Visualization. **James Gaughan:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Visualization. **María José Montserrat Aragón Aragón:** Conceptualization, Methodology, Data curation. **Nils Gutacker:** Conceptualization, Methodology, Writing – review & editing, Visualization. **Hugh Gravelle:** Conceptualization, Methodology, Writing – review & editing. **Maria Goddard:** Conceptualization, Writing – review & editing. **Anne Mason:** Conceptualization, Writing – review & editing. **Adriana Castelli:** Conceptualization, Writing – review & editing. **Rowena Jacobs:** Conceptualization, Writing – original draft, Writing – review & editing, Supervision, Funding acquisition.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Rowena Jacobs reports financial support was provided by The Health Foundation.

A1 Poisson Models based on Table 3

	(1) Admissions	(2) Discharges	(4) Length of Stay at Discharge	(5) Bed Days	(6) Occupied Beds	(7) Patients with Outpatient Appt	(8) Total Outpatient Appointments
March 2020	−0.04	0.28***	−0.05	−0.12**	−0.12**	−0.19**	−0.10
	(-0.16,0.09)	(0.17,0.38)	(-0.15,0.06)	(-0.20,-0.05)	(-0.19,-0.05)	(-0.31,-0.07)	(-0.47,0.26)
April	−0.11	−0.07	0.13	−0.47***	−0.47***	−0.16*	1.79***
	(-0.27,0.04)	(-0.19,0.06)	(-0.08,0.35)	(-0.56,-0.37)	(-0.56,-0.37)	(-0.30,-0.02)	(1.01,2.57)
May	0.01	−0.18**	−0.13*	−0.38***	−0.37***	0.01	1.98***
	(-0.13,0.14)	(-0.29,-0.06)	(-0.26,-0.00)	(-0.46,-0.29)	(-0.46,-0.29)	(-0.12,0.15)	(1.33,2.64)
June	0.10	−0.02	−0.16**	−0.25***	−0.25***	0.15*	2.33***
	(-0.03,0.23)	(-0.14,0.11)	(-0.26,-0.06)	(-0.35,-0.16)	(-0.34,-0.16)	(0.01,0.30)	(1.51,3.14)
July	0.10	0.01	−0.07	−0.17**	−0.17**	0.15*	2.40***
	(-0.04,0.24)	(-0.12,0.14)	(-0.17,0.04)	(-0.27,-0.06)	(-0.27,-0.06)	(0.01,0.30)	(1.57,3.23)
August	0.07	−0.12	−0.59***	−0.11	−0.11	0.02	2.20***
	(-0.11,0.25)	(-0.26,0.02)	(-0.69,-0.50)	(-0.22,0.01)	(-0.22,0.01)	(-0.14,0.19)	(1.43,2.97)
September	0.07	0.02	−0.55***	−0.06	−0.06	0.06	2.01***
	(-0.14,0.28)	(-0.12,0.17)	(-0.65,-0.46)	(-0.18,0.05)	(-0.18,0.05)	(-0.12,0.24)	(1.22,2.80)
October	0.04	−0.05	−0.47***	−0.05	−0.05	0.04	2.02***
	(-0.13,0.20)	(-0.17,0.08)	(-0.59,-0.34)	(-0.16,0.07)	(-0.16,0.07)	(-0.10,0.18)	(1.34,2.70)
November	−0.05	−0.13	−0.48***	−0.02	−0.02	−0.04	1.84***
	(-0.20,0.10)	(-0.27,0.01)	(-0.57,-0.38)	(-0.13,0.09)	(-0.13,0.09)	(-0.18,0.10)	(1.13,2.55)
December	−0.00	−0.07	−0.39***	0.00	0.00	0.02	2.06***
	(-0.15,0.14)	(-0.24,0.10)	(-0.49,-0.28)	(-0.11,0.12)	(-0.11,0.12)	(-0.12,0.15)	(1.25,2.87)
January 2021	−0.02	−0.14	−0.36***	0.01	0.01	0.04	2.08***
	(-0.22,0.19)	(-0.31,0.03)	(-0.49,-0.22)	(-0.11,0.12)	(-0.11,0.12)	(-0.15,0.22)	(1.27,2.89)
February	0.09	−0.05	−0.32***	0.03	0.05	0.26*	2.61***
	(-0.11,0.29)	(-0.19,0.10)	(-0.44,-0.20)	(-0.10,0.17)	(-0.08,0.18)	(0.03,0.50)	(1.81,3.41)
March	0.10	0.05	−0.31***	0.10	0.10	0.39*	2.87***
	(-0.08,0.27)	(-0.13,0.23)	(-0.46,-0.16)	(-0.05,0.25)	(-0.04,0.25)	(0.08,0.71)	(1.98,3.75)
Year Trend	−0.00	0.01	0.03*	−0.06***	−0.06***	−0.02	−0.04
	(-0.03,0.02)	(-0.02,0.04)	(0.00,0.05)	(-0.09,-0.04)	(-0.09,-0.04)	(-0.07,0.03)	(-0.14,0.06)
% Female Admissions		−0.00	−0.00	−0.00	−0.00	−0.00	−0.02
		(-0.01,0.01)	(-0.00,0.00)	(-0.01,0.00)	(-0.01,0.00)	(-0.01,0.00)	(-0.04,0.00)
% 65+ Age Admissions		0.01*	0.00	0.01*	0.01*	0.01**	−0.01
		(0.00,0.01)	(-0.00,0.01)	(0.00,0.01)	(0.00,0.01)	(0.00,0.02)	(-0.03,0.02)
% Schizophrenia Admissions		−0.01***	0.01**	−0.00	−0.00	−0.01*	−0.01

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	(1) Admissions	(2) Discharges	(4) Length of Stay at Discharge	(5) Bed Days	(6) Occupied Beds	(7) Patients with Outpatient Appt	(8) Total Outpatient Appointments
		(-0.02,-0.01)	(0.00,0.01)	(-0.00,0.00)	(-0.00,0.00)	(-0.02,-0.00)	(-0.04,0.01)
% Admissions with Comorbidities		−0.00	0.00	−0.00	−0.00	−0.00	0.00
		(-0.00,0.00)	(-0.00,0.00)	(-0.00,0.00)	(-0.00,0.00)	(-0.01,0.00)	(-0.02,0.03)
% Formally Detained Admissions		−0.00	0.00*	0.00	0.00	0.00	0.00
		(-0.01,0.00)	(0.00,0.01)	(-0.00,0.00)	(-0.00,0.00)	(-0.01,0.01)	(-0.02,0.03)
% Non-White Admissions		−0.01*	0.00	0.00	0.00	−0.00	0.01
		(-0.01,-0.00)	(-0.00,0.01)	(-0.00,0.01)	(-0.00,0.01)	(-0.01,0.00)	(-0.01,0.03)
% Admissions in Lowest Deprivation Decile		−0.00	0.00	−0.00	−0.00	−0.01	−0.01
		(-0.01,0.00)	(-0.00,0.01)	(-0.00,0.00)	(-0.00,0.00)	(-0.02,0.00)	(-0.05,0.02)
Jan FE	−0.01	−0.00	0.02	0.01	0.01	−0.00	−0.01
	(-0.06,0.04)	(-0.07,0.06)	(-0.03,0.07)	(-0.01,0.03)	(-0.01,0.03)	(-0.05,0.04)	(-0.12,0.10)
Feb FE	−0.08***	−0.11***	−0.01	−0.09***	−0.00	−0.10***	−0.11*
	(-0.12,-0.05)	(-0.17,-0.04)	(-0.06,0.04)	(-0.11,-0.08)	(-0.02,0.01)	(-0.14,-0.06)	(-0.21,-0.01)
Apr FE	−0.04	0.02	0.00	−0.02*	0.01	0.04	0.04
	(-0.09,0.01)	(-0.06,0.09)	(-0.05,0.06)	(-0.04,-0.00)	(-0.00,0.03)	(-0.01,0.08)	(-0.07,0.16)
May FE	0.02	0.05	−0.00	0.02	0.02	0.07*	0.09
	(-0.04,0.07)	(-0.02,0.13)	(-0.09,0.08)	(-0.01,0.04)	(-0.01,0.04)	(0.00,0.13)	(-0.03,0.21)
Jun FE	0.01	0.06	−0.02	−0.02	0.02	0.08**	0.11*
	(-0.05,0.06)	(-0.02,0.13)	(-0.08,0.05)	(-0.04,0.01)	(-0.01,0.04)	(0.03,0.13)	(0.01,0.21)
Jul FE	0.02	0.06	−0.04	0.01	0.01	0.09***	0.10**
	(-0.04,0.08)	(-0.02,0.13)	(-0.09,0.00)	(-0.01,0.04)	(-0.01,0.04)	(0.04,0.13)	(0.03,0.17)
Aug FE	−0.01	0.03	−0.06	0.01	0.01	0.08**	0.05
	(-0.07,0.05)	(-0.04,0.10)	(-0.12,0.00)	(-0.01,0.03)	(-0.01,0.03)	(0.03,0.12)	(-0.03,0.14)
Sept FE	−0.03	0.01	−0.00	−0.03*	0.00	0.05*	0.07
	(-0.09,0.03)	(-0.05,0.08)	(-0.04,0.04)	(-0.05,-0.00)	(-0.02,0.03)	(0.00,0.10)	(-0.01,0.15)
Oct FE	0.01	0.04	0.02	−0.01	−0.01	0.08**	0.08
	(-0.05,0.06)	(-0.03,0.11)	(-0.03,0.07)	(-0.04,0.02)	(-0.04,0.02)	(0.03,0.13)	(-0.02,0.17)
Nov FE	−0.04	0.01	0.05*	−0.05***	−0.02	−0.00	0.04
	(-0.10,0.02)	(-0.07,0.08)	(0.00,0.11)	(-0.08,-0.03)	(-0.04,0.01)	(-0.05,0.05)	(-0.05,0.12)
Dec FE	−0.06*	−0.03	−0.03	−0.06***	−0.06***	−0.07*	−0.07
	(-0.12,-0.00)	(-0.10,0.04)	(-0.09,0.02)	(-0.07,-0.04)	(-0.07,-0.04)	(-0.12,-0.02)	(-0.18,0.05)
N	2019	2017	1976	2017	2017	2017	2017
Joint Significance 1st Lockdown	0.128 (0.385)	−0.090 (0.324)	−0.864*** (0.240)	−1.490*** (0.246)	−1.486*** (0.246)	−0.002 (0.337)	10.597*** (1.810)
Joint Significance Whole Period	0.354 (0.950)	−0.447 (0.774)	−3.740*** (0.536)	−1.485*** (0.631)	−1.462*** (0.630)	0.763 (0.780)	26.079*** (4.162)

***p < 0.001, **p < 0.01, *p < 0.05.

Standard errors in parenthesis. Robust standard errors. Hospital Fixed Effects.

A2. Linear Hypothesis Test on Heterogeneous Effects

		First Lockdown				Whole Study Period			
Dependent Variable	Interaction	Joint Estimate	P-value	Lower CI	Upper CI	Joint Estimate	P-value	Lower CI	Upper CI
Discharges	65+ Age	20.34	0.01	5.55	35.14	8.02	0.06	−0.26	16.30
Net Admissions	65+ Age	−0.83	0.56	−3.72	2.06	−0.63	0.61	−3.13	1.87
LoS	65+ Age	−1.85	0.05	−3.69	−0.01	−1.20	0.10	−2.65	0.26
Total Occupied Beds	65+ Age	635.87	0.01	165.08	1106.65	369.93	0.00	133.18	606.67
Total Bed Days	65+ Age	20.98	0.01	5.51	36.46	12.24	0.00	4.36	20.13
Patients with Outpatient Appointments	65+ Age	5.39	0.03	0.68	10.11	1.47	0.23	−0.96	3.90
Total Outpatients Appointments	65+ Age	−153.37	0.31	−454.82	148.09	−130.31	0.10	−289.31	28.68
Discharges	Female Admissions	4.59	0.56	−11.47	20.66	−5.96	0.22	−15.60	3.69
Net Admissions	Female Admissions	−1.06	0.76	−8.29	6.16	−1.31	0.62	−6.67	4.05
LoS	Female Admissions	−4.03	0.14	−9.47	1.41	−1.53	0.47	−5.81	2.76
Total Occupied Beds	Female Admissions	226.17	0.69	−923.02	1375.36	169.01	0.62	−515.46	853.48
Total Bed Days	Female Admissions	8.48	0.65	−29.13	46.10	5.96	0.59	−16.72	28.64
Patients with Outpatient Appointments	Female Admissions	2.14	0.66	−7.88	12.16	−1.98	0.51	−8.06	4.09
Total Outpatients Appointments	Female Admissions	−30.82	0.94	−827.88	766.23	−125.22	0.62	−643.94	393.50
Discharges	Most Deprived 10%	2.19	0.82	−17.33	21.72	−1.05	0.79	−9.20	7.10
Net Admissions	Most Deprived 10%	−0.95	0.49	−3.74	1.84	1.85	0.24	−1.28	4.97
LoS	Most Deprived 10%	−1.49	0.38	−4.95	1.96	−1.40	0.32	−4.26	1.46
Total Occupied Beds	Most Deprived 10%	−187.04	0.67	−1069.43	695.34	−71.05	0.75	−522.90	380.81
Total Bed Days	Most Deprived 10%	−6.30	0.66	−35.36	22.75	−2.45	0.74	−17.44	12.54
Patients with Outpatient Appointments	Most Deprived 10%	−3.24	0.39	−10.94	4.45	−1.15	0.53	−4.86	2.56
Total Outpatients Appointments	Most Deprived 10%	−155.75	0.44	−559.85	248.35	−87.47	0.43	−313.46	138.52

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		First Lockdown				Whole Study Period			
Discharges	Non White Admissions	7.51	0.33	−8.14	23.16	5.33	0.11	−1.29	11.95
Net Admissions	Non White Admissions	−0.56	0.78	−4.72	3.60	−0.23	0.88	−3.28	2.81
LoS	Non White Admissions	−0.31	0.74	−2.21	1.60	−0.20	0.72	−1.36	0.96
Total Occupied Beds	Non White Admissions	−311.72	0.44	−1120.73	497.30	−266.75	0.12	−606.32	72.82
Total Bed Days	Non White Admissions	−10.53	0.42	−37.17	16.10	−9.11	0.11	−20.37	2.14
Patients with Outpatient Appointments	Non White Admissions	−2.29	0.62	−11.64	7.05	−0.87	0.77	−6.89	5.15
Total Outpatients Appointments	Non White Admissions	296.19	0.25	−219.21	811.59	157.02	0.29	−139.58	453.61

***p < 0.001, **p < 0.01, *p < 0.05.
Models with Robust standard errors and Hospital Fixed Effects.

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