Observational study of mental health presentations across healthcare setting during the first 9 months of the COVID-19 pandemic in England.

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Abstract

Background: The COVID-19 pandemic has resulted in unprecedented impact on the day to day lives of people, with several features potentially adversely affecting mental health. There is growing evidence of the size of the impact of COVID-19 on mental health, but much of this is from ongoing population surveys using validated mental health scores.

Objective: This study investigated the impact of the pandemic and control measures on mental health conditions presenting to a spectrum of national healthcare services monitored using real-time syndromic surveillance in England.

Methods: We conducted a retrospective observational descriptive study of mental health presentations (those calling the national medical helpline, NHS 111, consulting general practitioners in and out-of-hours, calling ambulance services and attending emergency departments) between 1 January 2019 to 30 September 2020. Estimates for the impact of lockdown measures were provided using an interrupted time series analysis.

Results: Mental health presentations showed a marked decrease during the early stages of the pandemic. Post-lockdown, attendances for mental health conditions reached higher than pre-pandemic levels across most systems; a rise of 10% compared to expected for NHS 111 and 21% for GP out-of-hours whilst the number of consultations to in-hours GPs was 13% lower compared to the same time last year. Increases were observed in calls to NHS 111 for sleep problems.

Conclusions: These analyses showed marked changes in the healthcare attendances and prescribing for common mental health issues, across a spectrum of healthcare provision, with some of these changes persisting. The reasons for such changes are likely to be complex and multifactorial. The impact of the pandemic on mental health may not be fully understood for some time, and therefore these syndromic indicators should continue to be monitored.

Introduction

Previous infectious disease outbreaks have been shown to worsen mental health [1]. For example, the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003 resulted in increased incidence of Post-Traumatic Stress Disorder and depressive illness in healthcare workers [2].

The COVID-19 pandemic has resulted in unprecedented impact on peoples' day to day lives with several features potentially adversely affecting mental health. Features include the direct effects of the disease; impact on employment and income; and the prolonged time of restrictions to activities and normal life for the majority of the population.

There is growing research on the size of the impact of COVID-19 on mental health [3, 4, 5, 6, 7, 8], much of this from ongoing population surveys using validated mental health scores demonstrating significant impact, and that the effect varies across population groups. Young women have been particularly impacted [3]. The impacts on health and social care workers are additionally described [2]. A systematic review of available longitudinal cohort studies concluded a small rise in mental health symptoms immediately after the onset of the pandemic which dropped to pre-pandemic levels by mid-2020. However, there is little evidence about how the current pandemic has affected the presentation of mental health issues to a spectrum of healthcare settings.

We are not aware of work examining the impact of COVID-19 on mental healthcare usage across multiple health care settings and using routinely available healthcare data. We hypothesise that consultations for common mental health conditions, including depression, anxiety and sleep disorders, would have been impacted by the first nine months of the COVID-19 pandemic.

Here we investigate the impact of the COVID-19 pandemic on mental health conditions presenting to a variety of healthcare services monitored using syndromic surveillance in England. Based on these findings we propose a surveillance package of indicators to

monitor trends in mental health conditions in real-time to provide timely information for action for future events.

Methods

Syndromic surveillance systems aim to detect outbreaks; to provide situational awareness on the impact of events on the population and to provide reassurance about lack of impact of events such as mass gatherings. Real-time syndromic surveillance (using data on patients' symptoms) is a helpful adjunct to laboratory surveillance and is being used to monitor the impact of COVID-19 on healthcare seeking behaviour for respiratory illness [9]. Public Health England (PHE) coordinate a suite of national syndromic surveillance systems which are able to monitor attendances to healthcare settings in England in near real-time [10]. These syndromic surveillance systems are used mainly to monitor the impact of infections (such as COVID-19 and seasonal influenza) [11, 12], and impact of environmental hazards such as heatwaves and flooding. However, the utility of syndromic surveillance systems to monitor changes in the presentation of other diseases or conditions (such as mental health) in the event of a major incident is being explored.

The primary care database held by the Oxford-Royal College of General Practitioners (RCGP) Clinical Informatics Digital Hub (ORCHID) is a database from one of the longest established primary care sentinel networks globally [13, 14]. The Oxford RCGP network is able to monitor a wide range of diagnoses in addition to notifiable diseases and other infections. We used a subset of ORCHID, the Oxford-RCGP Research and Surveillance Centre (RSC) PHE COVID-19 VE cohort with good data quality (which was developed to support COVID-19 surveillance [15, 17]) to explore recent trends in GP in-hours consultations for common mental health conditions.

Study design

We conducted a retrospective observational descriptive study using PHE Real-time Syndromic Surveillance Systems covering the population of England [12] and the ORCHID GP in-hours dataset [15]. We estimated the impact of national lockdown measures using an interrupted time series approach and generalised linear modelling.

Study period

We extracted data for the period 1 January 2019 to 30 September 2020.

Surveillance data

NHS 111 calls were extracted from the PHE Remote Health Advice syndromic surveillance system. The data extracted included the number of daily calls which were triaged by the NHS 111 call handlers for mental health problems and sleep difficulties and the total number of daily calls in the PHE dataset. NHS 111 use 'Pathways' to triage calls [16]. The Pathways included in the dataset for this study are the first Pathway selected by the call handler during the triage process (**Supplementary Table 1**).

GP in-hours consultations were based upon a total of 504 practices, which included 7,057,447 registered patients during the time period of this study. We extracted daily counts of consultations and prescriptions for commonly occurring mental health conditions including depression and anxiety. Prescriptions included antidepressants, anxiolytics and hypnotics extracted using lists generated based on the British National Formulary (BNF, bnf.org). We used a case definition of common mental health problems (CMHP) developed for the evaluation of community psychology services [18, 19], which we subsequently updated from Read code to the Systematised Nomenclature of Medicine (SNOMED) Clinical Terms [20]. The SNOMED clinical terms are listed in **Supplementary Table 2**.

Daily GP out-of-hours (OOH) consultations were extracted from the PHE GP Out-of-Hours (GP OOH) syndromic surveillance system [10, 21] for the following: total consultations; all

consultations with a clinical (Read) code; consultations with a mental health diagnosis (based on Read code chapter E Mental disorders; **Supplementary Table 2**); consultations for anxiety; consultations for depression.

The PHE National Ambulance Surveillance System (NASS) syndromic dataset includes data on specified syndromes and does not represent all callouts. We extracted the daily number of ambulance callouts for overdoses/ingestion/poisoning, based on the chief complaint codes used by the ambulance services (**Supplementary Table 2**; we assumed that these were all deliberate overdoses/poisonings but acknowledge that some may have been accidental).

Emergency department (ED) attendances were extracted from the PHE Emergency Department Syndromic Surveillance System (EDSSS) for all mental health attendances (as identified in the Emergency Care Data Set diagnosis coding list) [22], acute alcohol intoxication and drug overdoses (**Supplementary Table 2**). Ninety-four Type 1 EDs were eligible for inclusion as they had provided data to the PHE EDSSS every day for the period of the study.

For each surveillance system included in the study, counts of calls/consultations/ attendances were extracted by day and by gender.

Statistical analysis

Data were visualised graphically as daily counts and seven day moving averages (adjusted for public (bank) holidays) for each of the mental health conditions and surveillance systems for 1 January to 30 September 2019 compared to the equivalent dates in 2020. Data were presented graphically by ISO (International Organisation for Standardisation) week (ISO weeks 1 to 40).

Data were sub-divided into three periods, pre-lockdown (before the 23 March 2020), lockdown (23 March 2020 to 31 May 2020; ISO week 13 to 22 inclusive) and post-lockdown (1 June 2020 to 30 September 2020; ISO week 23 to 40). Generalised linear models (glm)

were used to model the data and an interrupted time series approach to estimate the impact of national lockdown measures and the changes in healthcare seeking behaviour since pre- and post-lockdown compared to 2019. Count data were modelled using a negative binomial distribution to account for over-dispersion, which is common in health data. Systematic differences in the daily data caused by weekends and public holidays were accounted for by including a binary variable for working days versus weekends and public holidays. Annual seasonality was modelled by including a harmonic term using Fourier transforms. For each of the three periods, pre, during and post lockdown, variables were included to model step-changes and trends separately. The resulting models were compared with the actual data and the residuals for signs of bias were checked.

To estimate the impact of lockdown and changes post-lockdown glm models were used to create counterfactual models of what would have been expected if the pandemic and lockdown had not occurred. The lockdown period was characterised by a sudden sharp decrease in healthcare seeking activity followed by an increasing trend, therefore the estimate for the impact of lockdown was based on a single date (23 March 2020) to show the full extent of the impact. Post-lockdown trends were more stable so comparing average activity across the whole period provided an estimate for the longer-term impacts. Firstly, the actual data on 23 March 2020 were compared with the counterfactual model for 23 March 2020, setting the variables for the step-change and trend during lockdown, to lockdown not having occurred. Secondly, to estimate how activity has changed post-lockdown compared to what we would expect at this time of year, actual activity post-lockdown was compared with the counterfactual model.

The advantage of using an interrupted time series approach over simply comparing with the previous year's data is that we could account for any long-term trends and lessen the impact of any short fluctuations in data that would make 2019 incomparable with 2020, thus providing less-biased estimates for the direct effects of lockdown.

In order to provide 95% confidence intervals around our estimates for the change in post-lockdown activity a boot-strap method was used to calculate the bias-corrected and accelerated bootstrap interval.

All statistical analyses were completed in R using packages, MASS, tsModel and boot [23-27].

Ethical considerations:

All data used in this study were anonymised. PHE has access to a range of data sources under Regulation 3 (Health Protection) of The Health Service (Control of Patient Information) Regulations 2002. The use of ORCHID data was specifically approved by the PHE Caldicott Guardian as an addendum to the Data Sharing agreement with the University of Oxford.

Patient and Public Involvement:

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Results

Calls/consultations/attendances:

Between 1 January 2019 and 30 September 2020 the syndromic data included 25,718,106 total calls to NHS 111 (an average of 40,247 daily calls); 1,427,507 GP in-hours mental health consultations (including telephone consultations) in the sentinel network (an average of 2,199 daily consultations); 16,090,272 total GP OOH consultations (an average of 25,180 daily consultations) of which 39.2% had a clinical code; 9,284,990 total ambulance callouts (an average of 14,531 daily callouts); and 13,821,306 total ED attendances (an average of 21,630 daily attendances). These figures represent the data routinely available through the syndromic surveillance systems, though coverage of England for each of the systems varies (**Supplementary Table 1**).

All mental health presentations and GP prescriptions for mental health medications

Calls to NHS 111 triaged using the mental health problems Pathways occurred at a slightly increased level at the beginning of 2020 compared to the same time in 2019 and showed an initial peak in mid-February 2020 (ISO week 8) (**Figure 1A**). Call numbers thereafter decreased to the lowest level on 19 March 2020 (ISO week 12) just before the lockdown commenced (on 23 March 2020) and then increased, throughout lockdown and remained elevated throughout the post lockdown period (**Figure 1A**). Call levels as estimated by the interrupted time series model during the post lockdown period were approximately 10% above expected levels of the counterfactual model (additional daily mean of 62 calls; 95% confidence interval 51 to 73) (**Figure 2; Table 1**).

Figure 1: Calls, consultations and attendances for mental health conditions presenting to NHS 111, GP in-hours and GP out-of-hours and emergency departments and GP in-hours mental health medications in comparison to selected key dates in the pandemic. A) NHS 111 calls for mental health problems; B) GP in-hours consultations for mental health conditions; C) GP in-hours medications for mental health conditions; D) GP OOH consultations for all mental health conditions; E) attendances at emergency departments for mental health conditions. Daily calls/consultations/attendances/medications presented as 7 day moving averages (7dma) adjusted for bank holidays (BH) and by gender.

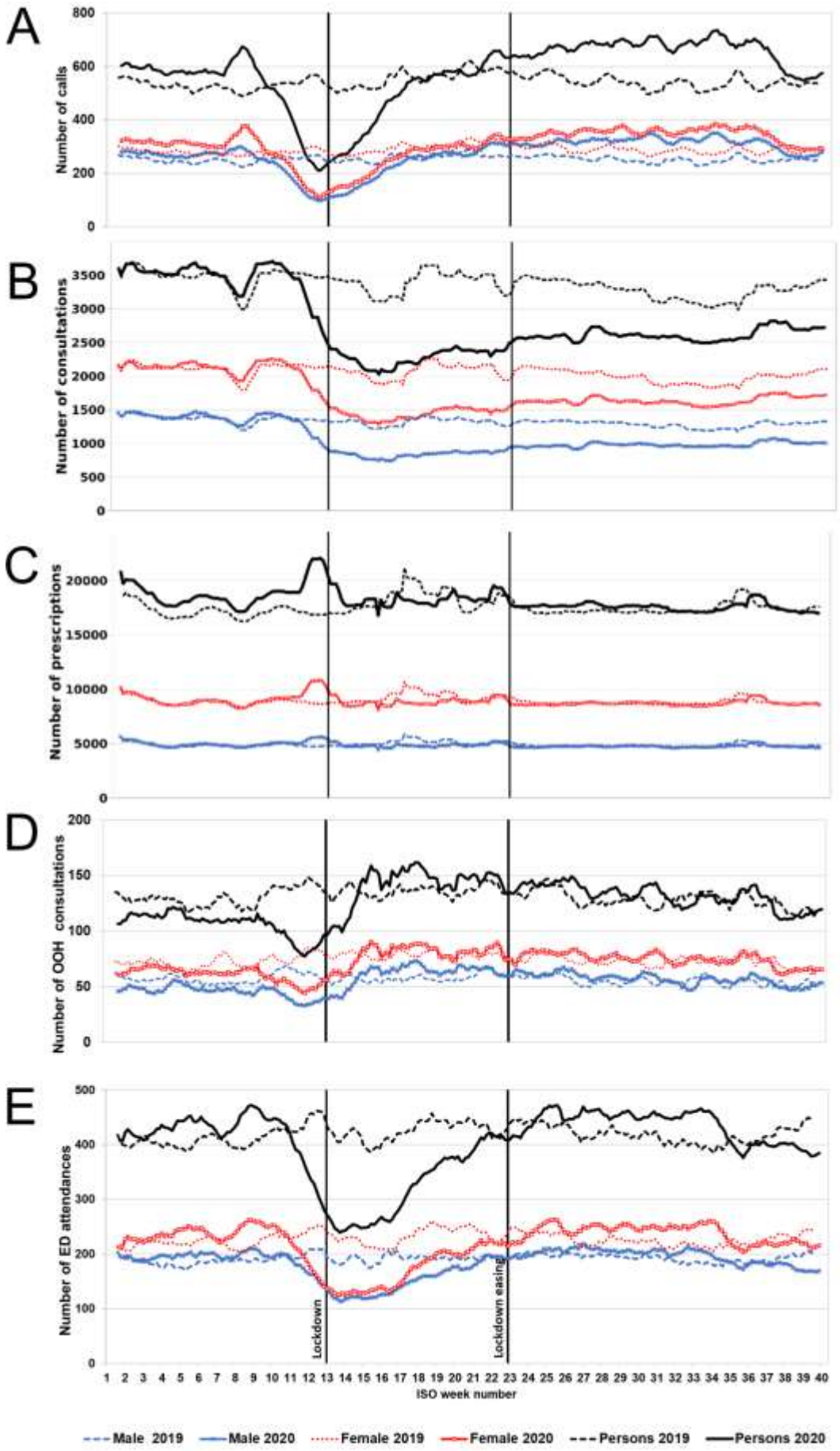

A
Number of calls
800
600
400
200
0
B
Number of consultations
3500
3000
2500
2000
1500
1000
500
0
C
Number of prescriptions
20000
15000
10000
5000
0
D
Number of OOH consultations
200
150
100
50
0
E
Number of ED attendances
500
400
300
200
100
0
Lockdown
Lockdown easing
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
ISO week number
Male 2019
Male 2020
Female 2019
Female 2020
Persons 2019
Persons 2020

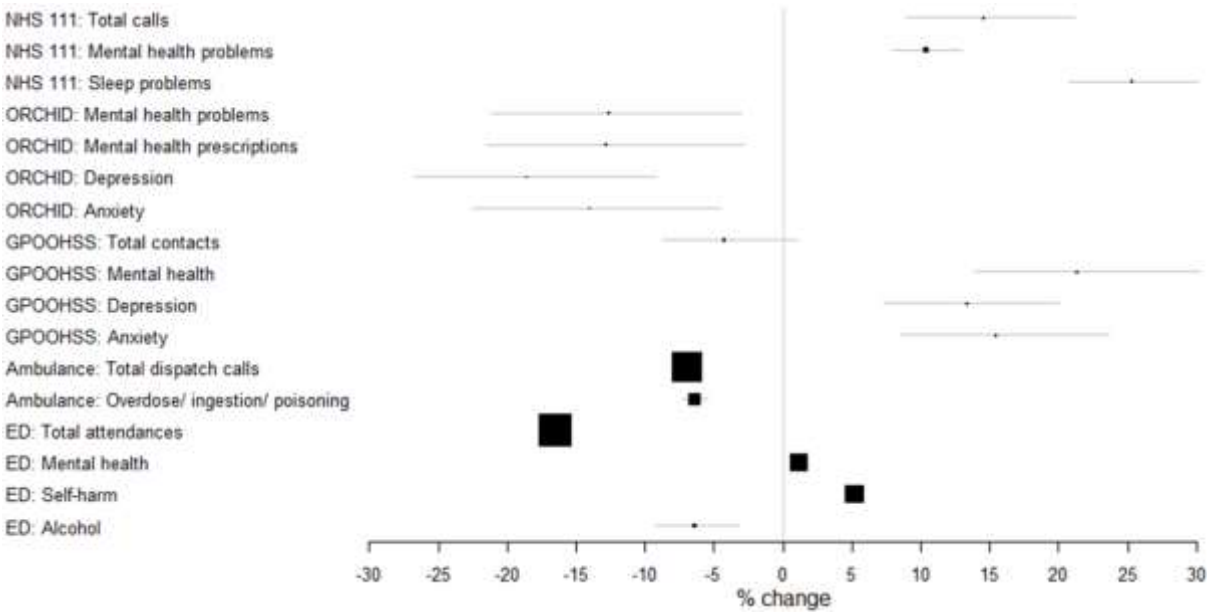
Table 1: Interrupted time series analysis illustrating a comparison of modelled versus measured call, consultation, attendance and prescription counts on 23 March 2020 and post first lockdown (1 June 2020 to 30 September 2020) presenting to a number of healthcare systems: NHS111, in-hours and out-of-hours General Practice, ambulance services and emergency departments.

System	Syndrome	Modelled*	Actual†	Estimated change‡	% change	Modelled daily mean** Estimate [LCI to UCI]	Actual daily mean††	Estimated difference‡‡ Estimate [LCI to UCI]	% change
NHS 111 calls	**Total**	**33,104**	**37,572**	**4,468**	**13%**	**37,606 [35,553 to 39,532]**	**43,071**	**5465 [4653 to 6295]**	**15%**
	Mental health problems	550	214	336	-61%	599 [585 to 613]	661	62 [51 to 73]	10%
	Sleep difficulties	24	12	12	-49%	27 [26 to 28]	34	7 [5 to 8]	25%
GP in-hours consultations or prescriptions	Mental health problems	3155	2859	296	-9%	2178 [1963 to 2414]	1903	-275 [-317 to -232]	-13%
	Mental health prescriptions	20639	26137	5496	27%	14592 [13093 to 16197]	12722	-1870 [-2342 to -1392]	-13%
	Depression	1560	1421	139	-9%	1090 [978 to 1210]	887	-202 [-229 to -176]	-19%
	Anxiety	1428	1420	-8	-1%	1022 [920 to 1134]	878	-144 [-166 to -122]	-14%
GP OOH consultations	**Total**	**20,861**	**20,628**	**- 233**	**-1%**	**24,444 [23,149 to 25,634]**	**23,391**	**-1,053 [-1,562 to -512]**	**-4%**
	Mental health	87	76	- 11	-12%	109 [101 to 116]	132	23 [19 to 27]	21%

	Depression	18	7	-11	-60%	20 [18 to 21]	22	3 [2 to 4]	13%
	Anxiety	49	51	2	4%	62 [58 to 66]	71	10 [7 to 12]	15%
Ambulance dispatch calls	**Total**	**14,705**	**17,156**	**2,451**	**17%**	**14883 [14,827 to 14,938]**	**13,842**	**-1041 [-1194 to -889]**	**-7%**
	Overdose/ ingestion/ poisoning	509	362	-147	-29%	571 [566 to 577]	535	-37 [-45 to -28]	-6%
ED attendances	**Total**	**23,758**	**13,191**	**- 10,567**	**-44%**	**23,865 [23,776 to 23,959]**	**19,925**	**-3,940 [-4,201 to -3,681]**	**-17%**
	Mental health	434	269	- 165	-38%	428 [426 to 431]	433	5 [-1 to 11]	1%
	Overdose	182	97	-85	-47%	179 [178 to180]	188	9 [6 to 12]	5%
	Excess alcohol use	162	86	- 76	-47%	198 [192 to 205]	186	-13 [-17 to -8]	-6%

*modelled number on 23/03/2020 (ie. if pandemic had not happened); † actual number on 23/03/2020; ‡estimated change on 23/03/2020 (first day of lockdown); **modelled daily mean number 01/06/2020 to 30/09/2020 – post-lockdown period (ie. if pandemic had not happened); ††actual daily mean number 01/06/2020 to 30/09/2020 – post-lockdown period; ‡‡estimated difference due to pandemic in daily mean 01/06/2020 to 30/09/2020 (post lockdown period).

Figure 2: Summary of changes in syndromic indicators for the post lockdown period across systems compared with that expected.



GP in-hours consultations for all mental health began to drop sharply in week commencing 2 March 2020 (ISO week 10) and continued to fall until week commencing 6 April 2020 (ISO week 15) when consultations started to rise again, though remained at reduced levels (**Figure 1B**). Mean daily levels of all mental health GP in-hours consultations were reduced by 13% in the period post-lockdown (1 June 2020 to 30 September 2020) compared to that modelled if the pandemic had not occurred (**Table 1**). Consultations during the whole period were higher in females compared to males (**Figure 1B**). GP in-hours prescriptions for mental health medications showed a sharp spike just prior to lockdown (**Figure 1C**), being raised by 27% on 23 March 2020 compared with that expected if the pandemic had not occurred and were 13% reduced compared with that expected for the post-lockdown period (**Table 1**).

Mean daily consultations for all GP OOH mental health conditions occurred at a slightly reduced level at the beginning of 2020 compared with 2019, and then started to decrease from late February 2020 (ISO week 9) to levels on 23 March 2020 approximately 12% below that expected from the model. Levels subsequently started to increase, and post-lockdown

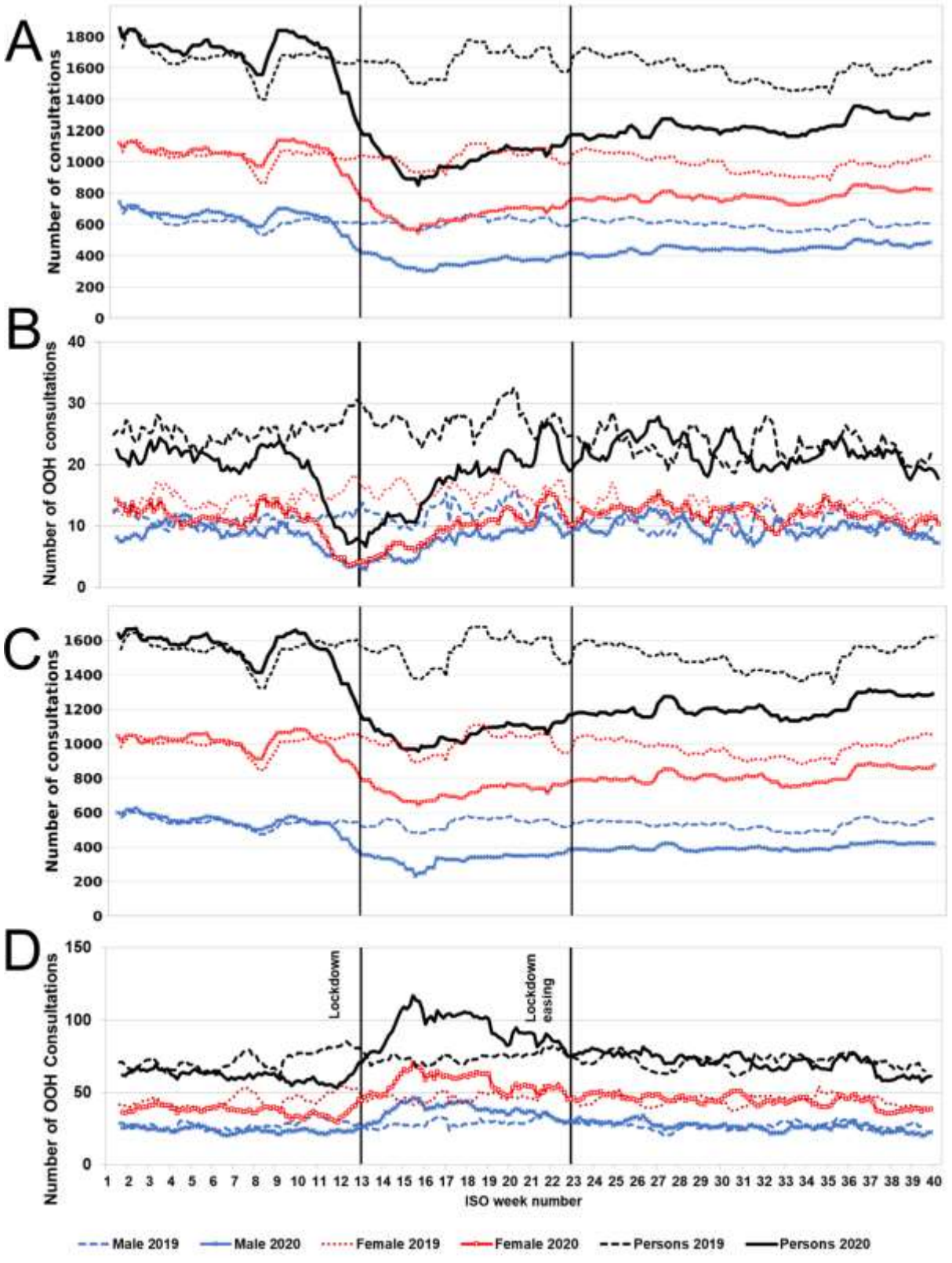
remained elevated until early June (ISO week 23) after which levels were similar to 2019 (**Figure 1D**). Mean daily levels of all mental health GP OOH consultations were elevated by 21% compared to that expected in the post-lockdown period to 30 September (additional daily mean of 23 consultations; 95% confidence interval 19 to 27) (**Table 1**).

ED attendances for all mental health diagnoses occurred at slightly higher levels during the first part of 2020 compared to 2019 (**Figure 1E**) and, as for other systems, decreased during March and remained low for the first half of the lockdown period (**Figure 1E**). The number of attendances on 23 March 2020 was 38% below that expected from the counterfactual model (**Table 1**). Following the period of lockdown levels returned to those similar to those expected (**Figure 2; Table 1**) whilst total ED attendances reduced by 17%.

Depression

GP in-hours consultations for depression showed a similar pattern to the all mental health conditions (**Figure 3A**). Mean daily levels for depression presenting to in-hours GPs showed a decrease of 19% in the post-lockdown period compared to that expected had the pandemic not occurred (**Table 1**). Consultations for depression for GP OOH showed a similar pattern to the all mental health conditions (**Figure 3B**). Mean daily levels for depression presenting to GP OOH showed an increase of 13% in the post lockdown period (although daily numbers were small) (**Figure 2; Table 1**).

Figure 3: Consultations for depression and anxiety presenting to GP in-hours and GP OOH in comparison to selected key dates in the pandemic. A) GP in-hours consultations for depression; B) GP OOH consultations for depression; C) GP in-hours consultations for anxiety; D) GP OOH consultations for anxiety. Shown as daily consultations presented as 7 day moving averages (7dma) adjusted for bank holidays (BH) and by gender.


A
Number of consultations
1800
1600
1400
1200
1000
800
600
400
200
0
B
Number of OOH consultations
40
30
20
10
0
C
Number of consultations
1600
1400
1200
1000
800
600
400
200
0
D
Number of OOH Consultations
150
100
50
0
Lockdown
Lockdown easing
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
ISO week number
Male 2019
Male 2020
Female 2019
Female 2020
Persons 2019
Persons 2020

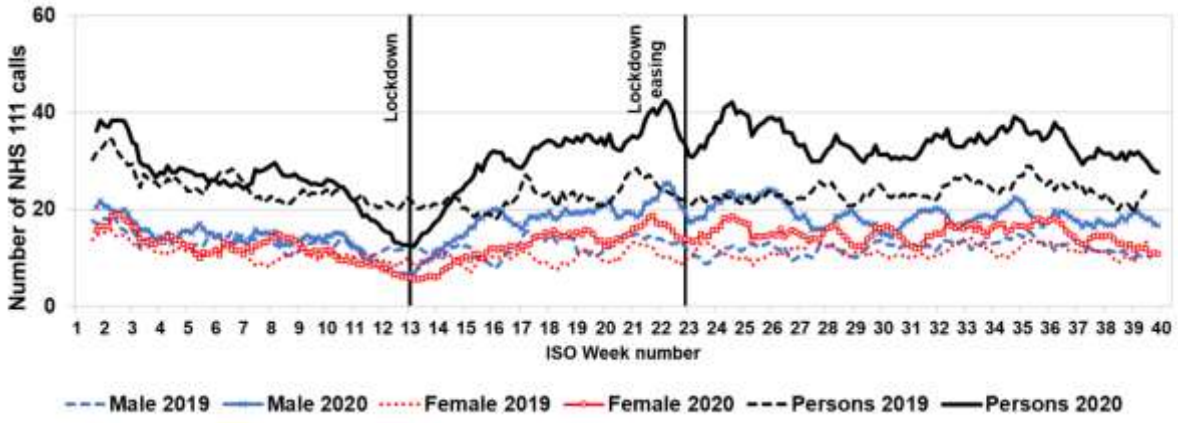
Anxiety

Consultations to in-hours GPs for anxiety reduced as lockdown approached with the introduction of social distancing measures and remained below 2019 levels for the remainder of the study period (**Figure 3C**). In the post-lockdown period total consultations for anxiety were 14% below modelled expected levels if the pandemic had not occurred **(Figure 2; Table 1)**. Consultations for anxiety to GP OOH services were below levels seen in 2019 but relatively stable until mid-March (ISO week 11) after which levels rose until a peak on 9 April 2020 (ISO week 15) (**Figure 3D**). Overall anxiety consultations remained 15% above expected levels (had the pandemic not occurred) during the post- lockdown period (**Figure 2; Table 1**). GP consultations (in-hours/OOH) for anxiety were higher in females than males in both 2019 and 2020 (**Figures 3C and 3D**).

Sleep Difficulties

Calls to NHS 111 triaged for sleep difficulties fell sharply in January 2020, a trend also seen in January 2019. Calls to NHS 111 for sleep difficulties rose slightly in mid-February 2020 (week 8) (**Figure 4**) then reduced to a low of approximately 50% of expected levels at the start of the first lockdown on 23 March 2020 (**Table 1**). Thereafter calls for sleep difficulties increased to 25% above modelled expected levels in the post lockdown period (**Table 1**). Calls for sleep difficulties for males were higher than those for females but calls in both genders peaked just before lockdown easing commenced at the beginning of June 2020 (ISO week 23) (**Figure 4**).

Figure 4: Calls to NHS 111 for sleep difficulties in comparison to selected key dates in the pandemic. Shown as daily numbers of calls presented as bank holiday (BH) adjusted 7 day moving averages (7dma) and by gender.

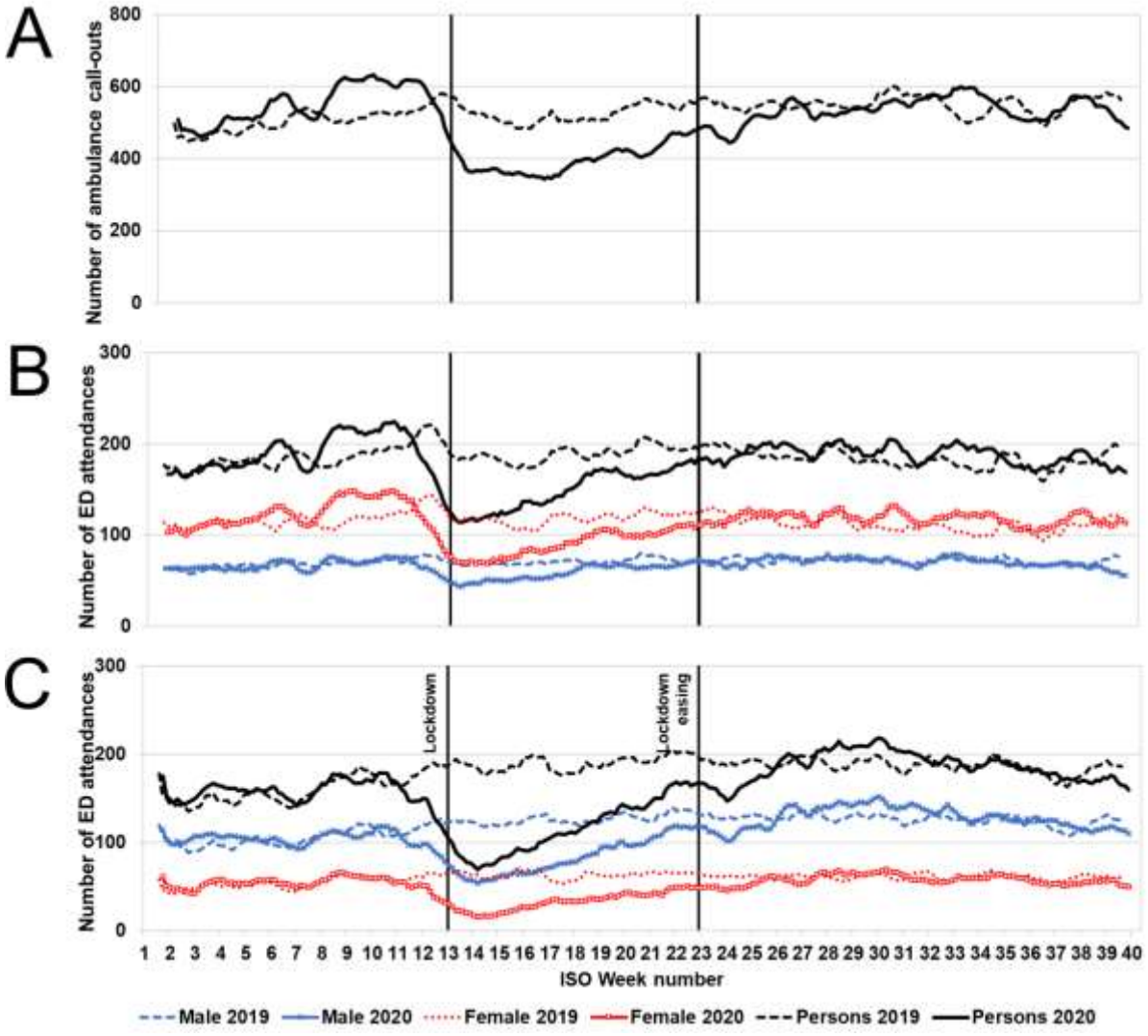


Measures of self-harm

Overdose

From January 2020 to the announcement of stay at home and social distancing advice on 11 March 2020 (ISO week 11), ambulance call outs for overdose/ingestion/poisoning (OD) increased and then sharply decreased until the start of lockdown (**Figure 5A**) when calls were 29% reduced compared to that expected from the model (**Table 1**). From the start of lockdown, the number of callouts gradually increased and during the post-lockdown period (ISO weeks 23 to 40), callouts were slightly reduced at 6% lower than estimated had the pandemic not occurred (37 fewer mean daily call outs; 95% confidence interval -45 to -28) (**Table 1**).

Figure 5: Ambulance call outs and emergency department attendances for indicators of self-harm - overdose and excess alcohol use in comparison to selected key dates in the pandemic. A) Ambulance call outs for overdose; B) ED attendances for overdose; C) ED attendances for excess alcohol use. Shown as daily numbers of call outs/attendances presented as bank holiday (BH) adjusted 7 day moving averages (7dma) and by gender (ED only).



Attendances to EDs for overdoses increased markedly during January and February 2020 (particularly in females) compared to 2019 (**Figure 5B**). Attendances showed a sharp drop following the introduction of social distancing advice on 11 March 2020 (ISO week 11) and

by the start of lockdown levels were 47% reduced compared to that expected using the model (**Table1**). This was followed by a gradual increase to levels similar to 2019 (and for both genders) during the post-lockdown period (ISO weeks 23 to 40) (**Figure 5B**).

Excess alcohol use

Attendances to EDs for excess alcohol use showed a drop following the introduction of social distancing advice in early March 2020 (ISO week 11) and continued to drop at the start of lockdown (**Figure 5C**). The interrupted time series model estimated that there were 47% fewer attendances than expected on 23 March 2020 (**Table 1**). During lockdown, there was a gradual increase, with levels post-lockdown only slightly reduced (6%) compared to that expected using the model (**Table 1**). Attendances were consistently higher in males than females.

Discussion

Principal results

Looking across the healthcare systems, all showed an initial dip in attendance for mental health conditions after the introduction of social distancing advice in early March 2020 and the first lockdown, and then increased. This pattern mirrored total (all cause) activity in each system and attendances for other non-COVID-19 conditions [10]. For NHS 111 and GP OOH mental health activity levels post-lockdown were increased (by 10% for NHS 111 and 21% for GP OOH). For GP in-hours the levels of mental health consultations remained at approximately 13% percent lower compared to modelled levels expected if the pandemic had not occurred. It is possible that there has been a shift in consulting on mental health issues from GP in-hours services to other health services such as NHS 111 and GP OOH.

Healthcare contacts for depression to in hours GPs mirrored that for all mental health attendances showing a decrease during the pre-lockdown and lockdown periods then

returning to levels approximately a fifth lower than that expected. Healthcare contacts for depression to GP OOH mirrored those for other attendances showing a decrease during the pre-lockdown and lockdown periods then returning to levels about 13% increased to that expected (although daily numbers were low).

The number of contacts to GPs for anxiety showed different patterns in-hours and out-of-hours. GP in-hours contacts decreased and remained 14% lower compared to that expected during the post-lockdown period. Healthcare contacts to GP OOH for anxiety increased during lockdown and remained at about 15% above expected levels during the post-lockdown period.

Healthcare contacts to NHS111 for sleep disorders increased during lockdown then remained elevated until the end of the study period. Daily numbers of calls to NHS 111 about sleep difficulties increased by approximately a quarter in the post-lockdown period to that expected, thus there was a persisting and notable continuing impact.

Surveillance of mental health during COVID-19

The COVID-19 pandemic has resulted in several surveillance initiatives to monitor the impact of the pandemic on mental health. PHE publishes a regular overview of such impact (particularly using population surveys, longitudinal studies and results from academic studies) [28].

Analysis using the Clinical Practice Research Datalink (CPRD) showed a similar marked reduction in consulting to in hours GPs for a variety of mental health conditions and a persisting impact with reduced levels to July 2020 [5]. The authors used an interrupted time series approach using weekly data, taking the exposure as the introduction of lockdown and comparing back to 2017. The authors described the likely unmet need for mental health services and highlighted the need to prepare for increased demand. A further study examined the impact of the pandemic on primary care-recorded mental health disorders and reported a drop in reported illness during March/April 2021. Selected mental health disorders

had returned to similar levels by September 2020 in England (however remained a third lower in the rest of the UK) [4].

Results from two longitudinal UK population cohorts showed that anxiety and lower wellbeing, but not depression, had increased during the COVID-19 pandemic compared with pre-pandemic assessments. The percentage of individuals with probable anxiety disorder was almost double during the COVID-19 pandemic [7].

The marked and continuing impact of the pandemic on good sleep is described in other studies, in the UK those experiencing sleep problems increased from 16% percent to 25% in April 2020 [28]. In Italy during the period of lockdown 42% reported sleep disturbances with 17% [29] described as moderate or severe; and in a cross sectional survey in France 19% were categorised as having insomnia [30].

A study in the US using ED syndromic surveillance showed a similar reduction in consulting for a variety of mental health conditions in early March but median visit rates for suicide attempts and overdoses for the period mid-March 2020 to October 2020 were higher than the rates for the same period in 2019 [31].

Real-time surveillance used Google trend data to assess the impact of the pandemic on mental health in the US, identifying pandemic associated spikes in anxiety [32].

Syndromic surveillance of mental health following incidents

There are examples of syndromic surveillance systems being used to monitor impact on mental health post public health incidents. Such systems have been predominantly using a single data source rather than across healthcare services and include the use of ED [33] and Twitter [34] (social media) analysis following terrorist attacks in France. ED surveillance for mental health in New York State was conducted post Hurricane Sandy [35] and ED surveillance of attendances for mental health and substance use presenting to Californian EDs concluded that mental health data from syndromic systems are uniquely available in

real time as an indicator of service utilisation and thus particularly useful for emergency events [36].

Although not included in our study, the Improved Access to Psychological Therapies (IAPT) programme in England also offers a service to people with common mental health problems (CMHPs). IAPT principally offers cognitive behavioural therapies and people can be referred or can self-refer. IAPT reports a reduction in referral (including self-referral), entering and completing therapy, post lockdown (**Supplementary Figure 1**) [37].

Strengths and Limitations

This work has several strengths: it describes impact on healthcare seeking behaviour for mental health issues across a variety of healthcare provision ranging from NHS telephone help lines to ED attendances. The surveillance systems used here are well established and cover England (although several are sentinel systems). Such diversity of surveillance systems enables us to triangulate and describe both consistent trends across systems and to look for changes in severity.

The multiple healthcare systems on which these surveillance systems are based use various coding systems / triage mechanisms and thus we have established different data sets, but similar diagnostic/ syndromic groupings to enable a multiple cross-condition 'snapshot' for monitoring the impact of future major public health incidents.

Although we analysed these data retrospectively, we now have a 'common mental health' presentation surveillance package including an ontology of relevant codes across the multiple systems which can be prospectively incorporated into routine monitoring, and thus enabling the real-time use for mental health surveillance with validated baselines for future events. Such analyses could additionally include assessing the impact by age, sex, severity and geography. These data are available in near-real-time (daily except for the ORCHID system which is twice weekly).

There are however several limitations to this work: the changes in healthcare provision and guidance on which services to use during the pandemic will have impacted on established baselines causing difficulties in interpretation of changes in consulting. For example, the observed change in consulting numbers may have been driven either by true changes in incidence or the national advice not to consult in person with a GP. It is also possible that other changes in the scheduled GP service, such as greater use of text messaging or online consultations, may have meant that not all encounters were captured or be recorded as "clinical administration" within the GP computerised medical record. The move to 15-minute appointments may have also contributed to the fall in consultation numbers [38].

Using routinely available healthcare data it is difficult to disentangle true changes in the incidence of mental health conditions from the effect of public health messaging, healthcare seeking behaviour, and changes in healthcare provision. These multiple and complex drivers of change have made interpretation of surveillance data difficult during the COVID-19 pandemic [11]. We focus here on the cross-healthcare usage for syndromes associated with mental health and describe trends, rather than directly inferring changes in community incidence.

The changing trends we have observed are likely to reflect the 'tip of the iceberg' in terms of mental health impact on the community. It is known that most patients with mental health conditions or poor wellbeing are likely to self-care or not seek help from a healthcare provider [39-41]. Further work is needed to understand the impact of this pandemic on mental health and wellbeing.

The impact of the pandemic on mental health may not be fully understood for some time yet, and therefore these syndromic indicators/systems should continue to be monitored.

This work has established a surveillance 'package' that can be applied to routine public health surveillance programmes to undertake real time surveillance of mental health presentations during future major health protection incidents.

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Contributors

GES, SH, SdeL and AJE conceived the study; SH, AL, HH and RM extracted data and performed the data analysis; RAM provided statistical support for the analysis; GES, SH, AL, UH and RM wrote the first draft of the manuscript. All authors drafted the manuscript for

important intellectual content, contributed to revision of the final version of the manuscript, approved the final version submitted.

The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Competing Interests

All authors report no conflicts to declare.

Ethical approval

Not required.

Data sharing

The datasets used in this study are not publicly available. The aggregated data used for the time series analyses can be made available on request through the PHE Office for Data Release: https://www.gov.uk/government/publications/accessing-public-health-england-data/about-the-phe-odr-and-accessing-data.

The ORCHID data can be accessed by researchers. An application form and the data request procedures can be found on the following website https://orchid.phc.ox.ac.uk/index.php/orchid-data. Approval is on a project-by-project basis. Ethical approval by a UK National Health Service Research Ethics Committee is needed before any data release or other appropriate approval. Researchers wishing to directly analyse patient-level pseudonymised data will be required to complete information governance training and work on the data from the secure servers at the University of Oxford. Patient-level data cannot be taken out of the secure network. We encourage interested researchers to attend the short courses on how to analyse primary care or RCGP Research and Surveillance Centre data, which are open to enrolment twice a year.

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