Title

The effect of implementing a smoke-free policy on physical violence within a psychiatric inpatient setting

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ABSTRACT

Background: Smoke-free policies are important to protect health and reduce health inqualities. A major barrier to policy implementation in psychiatric hospitals is staff concern that physical violence will increase. We aimed to assess the effect of implementing a comprehensive smoke-free policy on rates of physical assaults in a large UK mental health organisation.

Methods: We conducted an interrupted time series analysis of incident reports of physical assault 30 months before and 12 months after the implementation of the policy using a quasi-Poisson generalised additive mixed model.

Findings: There were 4,550 physical assaults over the study period; 4.9% of which were smoking-related. When adjusted for temporal and seasonal trends and key confounders, there was a 39% reduction in the number of physical assaults per month following the policy introduction compared to beforehand (Incidence Rate Ratio 0.61, 95% CI 0.53-0.70, $p<0.001$).

Interpretation: The introduction of a comprehensive smoke-free policy in a large psychiatric organisation appeared to reduce the incidence of physical assaults. Adequately resourced smoke–free policies could be part of broader violence reduction strategies in psychiatric settings.

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Research In Context Panel

Evidence before this study

We conducted an up to date search of electronic databases MEDLINE, EMBASE, and PsycINFO from date of inception to October 2016 using combinations of terms related to diagnosis, hospital, smoking and violence, (e.g. "schizophrenia" OR "psychosis" OR "severe mental illness OR "mental hospital" OR "mental health unit" OR "psychiatric unit" AND "smoking" OR "smoking cessation" OR "cigarettes" OR "smok*" OR "smokefree policies" OR "smoking ban" AND "violen*" OR "assault" OR "aggression"). We identified seven studies that focused on physical violence following smoke-free policy implementation: four reported a decrease in physical violence following implementation; two that reported no change; one found an increase in violence towards staff, but a reduction in patient toward patient violence. A further two studies combined rates of verbal and physical violence, one reporting no change and another reporting an increase, which continued after the policy was discontinued. There were methodological differences between studies: the shortest evaluations were one month pre and post policy implementation and the longest two years post policy implementation; sample size ranged from 119 to 298; a variety of measures of violence were used including observational rating scales and incident reports. No study controlled for time, seasonality and potential confounders that may have impacted on rates of violence.

Added value of this study

This is the first study to evaluate the effect of implementing a comprehensive smoke-free policy in mental health settings on rates of violence by using a robust methodology, which takes into account other variables that may influence trends over time.

Implications of all the available evidence

Our study adds to the preponderance of previous findings that implementing smoke-free policies do not lead to an increase in physical violence, as is often feared by mental health clinicians. Providing that implementation of policies are supported by adequately resourced treatment pathways and delivered by

a competent workforce, mental health organisations should not delay in implementing such policies because of the fear of physical violence.

Introduction

Smoking tobacco during an admission to a psychiatric hospital has been a longstanding accepted and expected cultural norm, and a major contributor to the health inequalities experienced by people using these services. Recently, this smoking culture has been challenged; many countries have introduced smoke-free policies in mental health settings in line with policies in other enclosed public places.[1,2] In 2013, the National Institute of Health and Clinical Excellence (NICE)[3,4] recommended that psychiatric organisations in England, Wales and Northern Ireland implement comprehensive smoke-free policies that incorporate: 1) clinical pathways to improve the identification, referral, and treatment of smokers; 2) staff training; 3) prohibition of smoking in hospital grounds and buildings and 4) no staff-facilitated smoking. Findings from surveys suggest that a major barrier to implementing smoke-free policies is staff perceptions that they will result in increased physical violence.[5]

Staff who work in psychiatric services are often exposed to violence during the course of their work. A meta-analysis by Iozzino and colleagues of 35 studies including 23,972 inpatients, reported that 17% committed at least one violent act during a hospital admission.[6] In 2014/15 there were 45,220 physical assaults against UK National Health Service (NHS) staff working in psychiatric settings, accounting for 187 assaults per 1000 staff [7] compared to 19,167 assaults in general acute settings, a rate of 21 per 1000 staff.[7] The adverse impact of violence cannot be overemphasised, and includes injury, fear, low morale, stress, staff absence and loss of productivity.[8,9]

Previous evidence of the impact of smoke free policies on physical violence found: a reduction,[10–13] no change,[14,15] or an increase in violence towards staff but a reduction in patient toward patient violence.[16] Two studies which combined verbal and physical violence found no change,[18] and an increase.[19] Methodological differences between studies are evident and no previous study controlled for time, seasonality and potential confounders that may have impacted rates of violence. Rigorous methods for evaluating intended and unintended consequences of smoke-free policies are needed.

Aim of study: To investigate the effect of implementing a comprehensive smoke-free policy, on rates of physical assaults in a large UK psychiatric organisation.

Methods

Study design

We used an interrupted time series design (ITS), increasingly the method of choice for evaluating the impact of a policy change or quality improvement initiatives.[19] ITS is one of the more robust quasi-experimental research designs, particularly when the investigator does not have control over the implementation of an intervention, or when a randomised controlled trial is unfeasible.[20] The method allows the incidence of an outcome after policy introduction to be compared to that beforehand, whilst filtering out the effect of any underlying temporal or seasonal changes or variations in other potentially confounding variables.[21] For example, people with schizophrenia are more likely to perpetrate violence on in patient units compared to other patients,[7] and so fewer schizophrenia admissions in a given month may result in a lower rate of violence.

Setting and participants

The study took place within the inpatient wards of South London and Maudsley NHS Foundation Trust (SLaM), a psychiatric NHS health organisation in London, England. SLaM has four hospitals, with approximately 50 wards and 800 beds. It provides a wide range of specialist services to a population of approximately 1.1 million. An indoor smoke-free policy was implemented in 2008, after which smokers were escorted to ward gardens for short supervised periods throughout the day to smoke; in July 2014 an average of 2 hours, 23 minutes a day of clinical time was spent per ward supervising smoking.[22] Preparations to go smoke-free began 12 months before the policy was introduced, including engagement events for staff and patients; enhancing the electronic patient health record to include mandatory recording of smoking status; supporting staff to reduce smoking breaks, staff education and training. A comprehensive smoke-free policy across the four hospital sites started from 1st October 2014. The smoke-free policy includes:

1) the prohibition of smoking in the buildings and grounds of all hospital premises; 2) no staff-facilitated smoking and 3) a tobacco dependence treatment pathway. Treatment includes offering smokers nicotine replacement therapy (NRT) within 30 minutes of arrival on the ward, combination NRT for the duration of admission from either ward staff trained in smoking cessation or dedicated hospital tobacco dependence treatment advisors. The use of disposable e-cigarettes is allowed; these are purchased by patients rather than supplied by the hospital, patients can use them in single bedrooms but not communal areas and if used need to be included in the patient's care plan. The policy is supported by an ongoing staff training programme in smoking cessation and management of temporary abstinence.

Participants were those receiving inpatient treatment on adult wards up to 30 months before the policy was implemented and up to 12 months after (1st April 2012 - 30th September 2015); violence was reported and recorded consistently during this time. The study period provided 42 data points (30 before the policy commenced and 12 after) to allow us to assess and model any seasonal variation in violence over the course of each year. Patients from 38 wards caring for people with psychosis, mood, addiction and dementia disorders were included. Forensic wards were excluded as patients had been exposed to a comprehensive smoke-free policy longer than patients in adult wards. Patients in children and adolescent wards were excluded because smoking has historically been prohibited on those wards.

Data collection and sources

Violence: The primary outcome was defined as the total number of physical assaults per month, including both patient-toward-patient and patient-toward-staff assaults, which were individually specified as two secondary outcomes. Incidents of physical assault recorded in 'Datixweb', an online patient safety reporting system were collected. Details of physical assaults towards staff are reported annually to NHS Protect, a central body whose purpose is to manage intelligence on violence against NHS staff. Datixweb has previously been used in studies of patient safety incidents.[22,23] Staff are required to record details of incidents of violence within 24 hours of an event. The record is

completed online with mandatory structured fields to identify date, ward and location; a free text description of the incident and injuries sustained is required. The staff member who observed the incident usually completes the online form, whilst the most senior person on duty is responsible for ensuring that the incident is reported. The report goes through a further level of scrutiny by a senior manager.

For the purpose of this study, we defined physical assault according to NHS Protect's definition, *'The intentional application of force against the person without lawful justification resulting in physical injury or personal discomfort.'*[7] We adhered to the specific requirements for physical assault according to NHS Protect, which include: 1) physical contact must be made directly (person to person) or indirectly (use of a weapon, object, liquid or spittle); 2) an intentional act of assault that is unlawful, unwanted or unwarranted; 3) incidents of assault with no visible injury; 4) assaults occurring during restraint. We further defined assaults related to smoking if the record of the antecedent to the assault included a smoking related term (e.g. smoke/smoking/cig/cigarettes/tobacco/fag/roll up(s)/roll up/rolli(e)/water pipe/cigar).

We excluded all incidents of recorded non-physical assault, also using the NHS Protect's definition - *'The use of inappropriate words or behaviour causing distress and/or constituting harassment.'* [7] We therefore excluded verbal abuse, attempted assaults (without contact), threats, intimidation, harassment, damage to property, racism and inappropriate sexual language or behaviour. Although we recognise that such behaviours are very distressing and harmful, because only physical assaults are reported to NHS Protect, physical violence is more reliably recorded than verbal violence. Also, clinical experience suggests that many staff tolerate verbal abuse as an 'inevitable' part of the job and under-report it.

Anonymous reports were extracted and coded from Datixweb by a researcher (GS) into a locked Excel spreadsheet. Each report was categorised as a smoking or non-smoking related physical assault based on the definitions

described above. As these reports had already been checked by a senior manager, only one person coded the data. Where there was any uncertainty (in 30% of reports), cases were discussed with a second researcher (DR) and a consensus decision agreed. There were several occasions where one incident report contained assaults directed towards more than one member of staff/patient. If the number of victims was clearly stated in the report we counted the exact number of assaults. However if the report was vague but only inferred more than one staff had been assaulted, we counted these as two assaults. If a person was hit multiple times within the same incident, we counted it as one assault.

Other variables: For all patients who were present on the wards each month, data were collected on demographic and clinical characteristics of known potential confounders of violence on inpatient units. These were: patient gender (percentage of males); patient age (percentage of patients under 45); the percentage with schizophrenia or a schizotypal or delusional disorder (indicated by ICD-10 codes F20-29); the percentage with a mood or affective disorder (ICD-10 codes F30-39); and the percentage who had been sectioned under the Mental Health Act. We also collected data on the percentage recorded as smokers. Demographic and clinical characteristics were collected using the Clinical Record Interactive Search (CRIS) system which is part of the NIHR Maudsley Mental Health Biomedical Research Centre and Dementia Unit.[24] CRIS allows researchers to access anonymised information from patient electronic health records and to search against structured (age, gender etc.) and unstructured fields (user-defined text strings). Results are returned in spreadsheet format and are exportable as CSV files for further analysis. The total number of occupied bed days in each month was provided by SLaM and used to account for variations in the number of patients 'at risk' of being involved in a violent incident.

Ethical approval

We received audit approval from SLaM's internal clinical audit department to extract data from Datixweb and from the CRIS Oversight Committee, responsible for ensuring all research projects using CRIS comply with ethical

and legal guidelines. CRIS has ethical approval as an anonymised data resource for secondary analyses from Oxfordshire Research Ethics Committee (reference number 08/H0606/71).

Statistical methods

We used a quasi-Poisson generalised additive mixed model (GAMM)[25] to model the monthly incidence of physical assaults as a function of several explanatory variables. We included in the model a binary exposure variable (coded zero prior to the introduction of the smoke-free policy and one afterwards) in order to estimate an incidence rate ratio (IRR) for the impact of the policy. The underlying temporal trend in the number of incidents was captured using a thin plate spline and a cyclic-cubic spline was used to model seasonality. Data on potentially confounding variables, as defined above, were included in each model in order to account for the characteristics of patients being treated each month. The total number of occupied bed days in each month was included as an offset term in the model.

Given the relatively small number of data points (42) and the danger of over-parameterisation, we first built models to estimate the impact of the policy adjusting only for the underlying time trend and seasonality. We then added all other potential confounding variables to the model and used a backwards-fitting approach to build a parsimonious model taking a p-value of <0.05 as an indicator of parameter significance. We examined model residuals for normality and any evidence of remaining autocorrelation between data points and where necessary fitted an autocorrelated error term. We report adjusted R^2 values as an indicator of model fit.

Data on smoking status were missing for 16.7% of patients each month on average (range 9.6-33.1%). In the primary analyses these patients were excluded from the calculation of the percentage of patients recorded as smokers. However, in a sensitivity analysis we re-fitted parsimonious models including these patients in the calculation, first by assuming patients with missing data were smokers (worst-case scenario) and second by assuming they were non-smokers (best-case scenario). Data management was carried

out in Microsoft Excel and the function 'gamm' from the library 'mcgv'[26] and the statistical software RStudio version 0.99.473[27] was used to model the data.

Role of the funding source

The funder had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

There were 4,550 physical assaults across the study period: 2,916 were patient-toward-staff assaults and 1,634 patient-toward-patient. Assaults related to smoking accounted for 4.9% of the overall violence. Over the study period, 747,338 occupied bed days of care were delivered to patients. The characteristics of patients were: 57% (n=10,269) male; 60% (n=10,813) under 45 years of age; 40% (n=7180) had a primary diagnosis of schizophrenia or related disorder (ICD-10, F20-29), 20% (n=3,598) a mood disorder (F.30-39) and the remainder other diagnoses e.g. dementia, addiction disorder; 44% (n=8,007) were formally detained under mental health legislation. Excluding patients who had smoking status missing, 78% (11,779/15,128) were current smokers. Figure 1 shows the number of assaults per month over the duration of the study. It shows considerable monthly variation throughout, but suggests a reduction after the introduction of the smoke-free policy. Table 1 shows the results of the partly-adjusted and parsimonious GAMM models used to estimate the IRR for the change in number of assaults per month after the introduction of the smoke-free policy.

Insert figure 1 about here please
Insert table 1 about here please

The results adjusted for all significant confounders suggest there was a 39% reduction in the number of violent assaults per month overall in the period after the introduction of the policy compared to before (IRR 0.61, 95% CI 0.53-0.70).

There was a 47% reduction in the number of patient-toward-staff assaults (IRR 0.53, 95% CI 0.44-0.63, p<0.001) and a 15% reduction in the number of patient-toward-patient assaults (IRR 0.85, 95% CI 0.80-0.92, <0.001).

Imputation of missing smoking data did not materially affect the direction and statistical significance of the IRRs estimated from the parsimonious models (table 2). There were, however, some small differences in the variables included as significant in these models, including smoking status, which was not retained in the model for all assaults, and in the magnitude of the effect estimates.

Insert table 2 about here please

Discussion

There was a significant reduction in the number of physical assaults after the introduction of the comprehensive smoke-free policy, when controlling for time, seasonality and confounders of violence. Tentatively, there appears to have been a larger decline in patient-toward-staff violence compared to patient-toward-patient violence.

Limitations: The method we used cannot attribute causality nor distinguish between the effects of two or more policies introduced at the same time, but we believe the smoke-free policy was the only new policy to be implemented across the whole organisation during the study period. We were unable to separate the data for confounders for individual wards so could not assess the smoke-free policy separately by ward. The models assume no change over time in the composition of the population at risk; we accounted for this to an extent by including several variables to indicate the characteristics of the case-mix of patients being treated each month.

Based on the relatively small number of data points, and over-parameterisation evident in the negative values of the adjusted R^2 values for some outcomes, the results should be treated with caution. The relatively small values of adjusted R^2 suggest we have only captured a small proportion of the variance in the time series. It is likely there are other variables which influence the number of incidents but which we did not have data on to incorporate into the model. These include data on alcohol and illicit substance use, which were only available for 31% of patients and previous history of physical violence which is not consistently recorded in electronic case notes. Missing data for smoking status (16.7%) had greatest impact on results for patient-on-staff assaults, but the direction and significance of effects remained. We acknowledge that patient demographics, clinical characteristics and patient behaviours are not the only determinants of violence on inpatient units. Other potential contributory factors include staff variables, features of the physical environment and external influences such as family stress,[28,29] but these data were not available.

Strengths: This study examined physical violence for nearly 750,000 bed days of care over a three year period. To our knowledge this is the first study to evaluate the impact of a smoke-free policy on physical assaults using a robust method which takes into account underlying temporal and seasonal trends as well as the influence of potential confounding factors in order to isolate the effect of the intervention. We assessed one aspect of violence (physical assaults) whereas some previous studies have combined verbal, physical violence, violence towards property and other disruptive behaviours,[17,18] making it difficult to interpret the true extent of physical violence following the implementation of the smoke-free policy. The catchment area of the organisation where the study took place (SLaM) is broadly representative of psychiatric organisations across London, in terms of age, gender, ethnicity, education and social deprivation,[24] although we acknowledge they may differ from the rest of the UK. A new way of reporting violent incidents was introduced at the start of our study period which was sustained throughout, thus making it unlikely that changes in the way our outcome was reported were being falsely attributed to the smoke-free policy.

The contribution of violence directly related to smoking was minimal over the whole study period. This may reflect reliance on clinicians' written reports which varied in quantity and quality and it is possible that the contribution of smoking to incidents was under-reported. Nevertheless, the introduction of the smoke-free policy had a wider impact on physical violence at least in the short term. It is important to recognise that the smoke-free policy includes tobacco dependence treatment, staff training, and allowing the use of e-cigarettes. A systematic review of violence in psychiatric inpatient settings found staff-patient interactions to be the most frequent antecedent to violence and aggression,[28] so the provision of tobacco dependence treatment, staff training or other aspects of the policy may contribute to changing the culture of how psychiatric staff address smoking with patients. Confidence in the findings would be increased by repetition of the study in other settings. The apparent increase in assaults towards the end of the study period may be the result of variations in confounding factors. More data with a longer post-policy data period would help to elucidate whether immediate impacts were

sustained. Our findings are in accordance with the preponderance of previous research that show a decrease or no change in physical violence[10–17] following the implementation of a smoke-free policy.

Psychiatric organisations and policy makers need to address the belief that smoking helps prevent aggression in inpatient settings. Staff often confuse tobacco withdrawal symptoms with mental health symptoms.[30] Nicotine has a half-life of approximately two hours, resulting in withdrawal symptoms soon after a cigarette is smoked, including restlessness, irritability and a preoccupation with finding opportunities to smoke. Smoking a cigarette during a period of withdrawal will appear to calm the patient, as nicotine blood levels are replenished; this is easily misinterpreted as evidence that smoking is therapeutic and necessary to prevent agitation. Supporting patients to temporarily abstain from smoking without the discomfort of nicotine withdrawal or encouraging a quit attempt can be achieved by promptly offering inpatient smokers NRT on admission, increasing the dose for heavily dependent smokers and education on the benefits of NRT compared to smoking tobacco.[31]

Concerns about violence are impeding the introduction of smoke-free policies worldwide and such concerns may not be substantiated. Instead, adequately resourced smoke–free policies could be part of broader violence reduction strategies in psychiatric settings.

Author contributions

Conception: Debbie Robson. Methods (design) Debbie Robson, Gilda Spaducci, Ann McNeill, Duncan Stewart, Tom Craig, Lisa Szatkowski. (Data collection) Gilda Spaducci, Debbie Robson, Mary Yates. Analysis: Lisa Szatkowski. Drafting, revising article & final approval of the version to be submitted: Debbie Robson, Gilda Spaducci, Ann McNeill, Duncan Stewart, Tom Craig, Mary Yates, Lisa Szatkowski.

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Figure 1: Number of physical assaults per month (vertical line indicates introduction of comprehensive smoke-free policy)

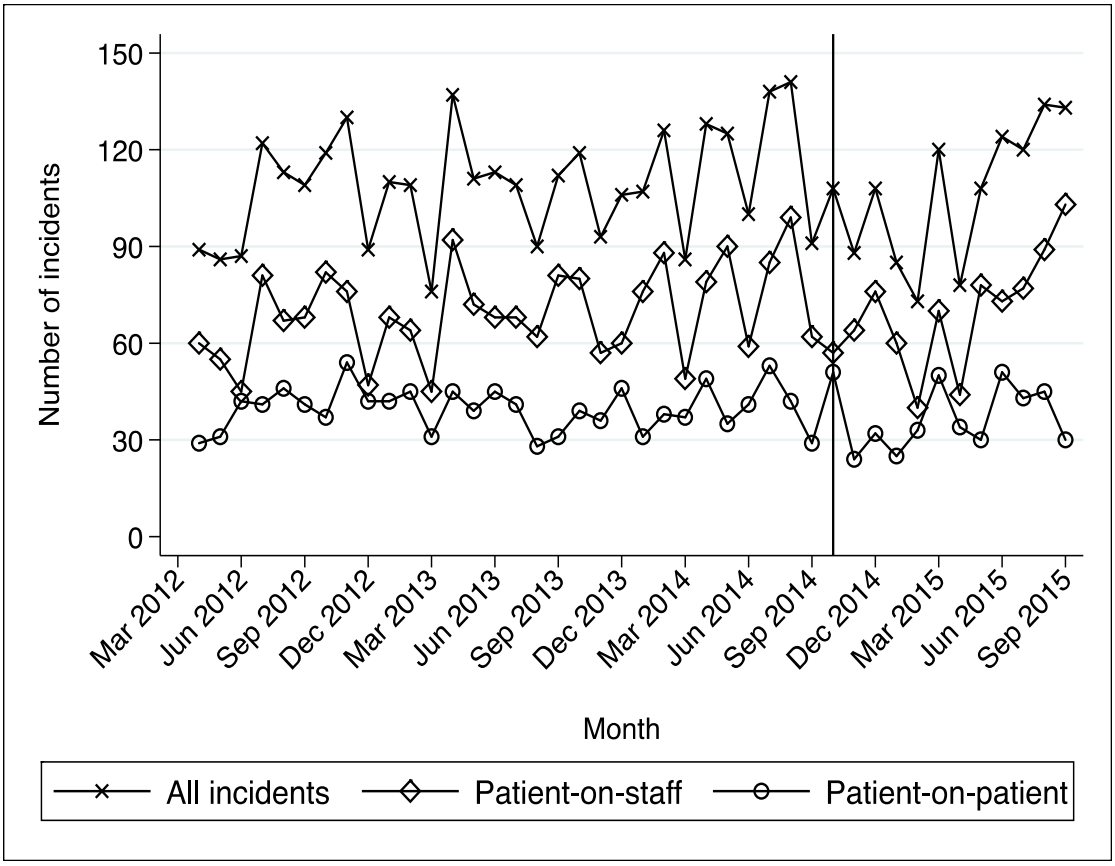

Table 1: Incident rate ratios estimated by GAMM

	All physical assaults		Patient-toward-staff assaults		Patient-toward-patient assaults	
	Adjusted for time and month	Parsimonious model	Adjusted for time and month	Parsimonious model	Adjusted for time and month	Parsimonious model
Incidence rate ratio (IRR)	0.66	0.61	0.64	0.53	0.65	0.85
95% CI	0.57-0.77	0.53-0.70	0.55-0.74	0.44-0.63	0.53-0.80	0.80-0.92
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Variables included in model:						
Thin plate spline for underlying time trend	✓	✓	✓	✓	✓	✓
Cyclic cubic spline for month	✓		✓		✓	
% patients male		✓				✓
% patients aged <45						
% patients who smoke		✓		✓		
% patients with schizophrenia/ schizotypal/ delusional disorder (F20-29)		✓		✓		✓
% patients with mood/ affective disorder (F30-39)		✓		✓		
% patients sectioned under Mental Health Act						
Autocorrelated residuals	MA(1)	MA(1)	MA(1)	MA(1)	MA(1)	MA(1)
Adjusted R^2	0.116	-0.083	0.123	0.197	-0.087	-0.234

✓ Included in the model. MA= moving average

Table 2: Parsimonious models assuming patients with missing smoking data are either smokers (worst case scenario) or non-smokers (best case scenario)

	All physical assaults		Incidents of patient-on-staff assaults		Incidents of patient-on-patient assaults	
	Assume smokers (worst case scenario)	Assume non-smokers (best case scenario)	Assume smokers (worst case scenario)	Assume non-smokers (best case scenario)	Assume smokers (worst case scenario)	Assume non-smokers (best case scenario)
Incidence rate ratio (IRR)	0.69	0.69	0.73	0.69	0.85	0.85
95% CI	0.57-0.84	0.57-0.84	0.68-0.79	0.64-0.74	0.80-0.92	0.80-0.92
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Variables included in model:						
Thin plate spline for underlying time trend	✓	✓	✓	✓	✓	✓
Cyclic cubic spline for month						
% patients male					✓	✓
% patients aged <45						
% patients who smoke				✓		
% patients with schizophrenia/ schizotypal/ delusional disorder (F20-29)	✓	✓	✓	✓	✓	✓
% patients with mood/ affective disorder (F30-39)	✓	✓	✓			
% patients sectioned under Mental Health Act						
Autocorrelated residuals	MA(1)	MA(1)	MA(1)	MA(1)	MA(1)	MA(1)
Adjusted R^2	0.169	0.169	0.065	0.151	-0.234	-0.234

✓ Included in model. MA=moving average