Effect of implementation of a smoke-free policy on physical violence in a psychiatric inpatient setting: an interrupted time series analysis

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Summary

Background Smoke-free policies are important to protect health and reduce health inequalities. 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 did an interrupted time series analysis of incident reports of physical assault 30 months before and 12 months after the implementation of the policy in the inpatient wards of South London and Maudsley National Health Service Foundation Trust, London, UK. We used a quasi-Poisson generalised additive mixed model to model the monthly incidence of physical assaults as a function of several explanatory variables.

Findings 4550 physical assaults took place between April 1, 2012, and Sept 30, 2015; 225 (4·9%) of which were smoking-related. After adjustment for temporal and seasonal trends and key confounders (sex, age, schizophrenia or related disorders, or having been sectioned under the Mental Health Act), there was a 39% reduction in the number of physical assaults per month after the policy introduction compared with beforehand (incidence rate ratio 0·61, 95% CI 0·53–0·70; p<0·0001).

Interpretation Introduction of a comprehensive smoke-free policy 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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Introduction

Smoking tobacco during an admission to a psychiatric hospital has been a long-standing, accepted, and expected cultural norm, and a major contributor to the health inequalities experienced by people using these services. This smoking culture has been challenged in the past few years; 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 for Health and Care Excellence[3,4] recommended that health organisations in England, Northern Ireland, and Wales, implement comprehensive smoke-free policies that incorporate: clinical pathways to improve the identification, referral, and treatment of smokers; staff training; prohibition of smoking in hospital grounds and buildings; and 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 working in psychiatric services are often exposed to violence during the course of their work. Findings from a meta-analysis of 35 studies, including 23972 inpatients, showed that 17% of inpatients committed at least one violent act during a hospital admission.[6] In 2014–15, there were 45220 physical assaults against UK National Health Service (NHS) staff working in psychiatric settings (187 assaults per 1000 staff), compared with 19167 assaults in general acute settings (21 per 1000 staff).[7] The adverse effects of violence include injury, fear, low morale, stress, and staff absence.[8,9]

Previous evidence of the effect of smoke-free policies on physical violence showed a reduction,[10–13] no change,[14,15] or an increase in violence towards staff, but a reduction in patient-toward-patient violence.[16] Findings from four studies that combined verbal and physical violence showed no change in overall violence,[17] a decrease,[18,19] and an increase.[20] Differences in methods between studies are evident and no previous study has controlled for time, seasonality, and potential confounders that might have affected rates of violence. Rigorous methods for the evaluation of intended and unintended consequences of smoke-free policies are needed. We aimed to investigate the effect of implementation of a comprehensive smoke-free policy on the number of physical assaults in a large psychiatric organisation in the UK.

Methods

Study design and participants

In this study, we used an interrupted time series design, which is increasingly the method of choice for evaluating

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Research in context

Evidence before this study

We searched electronic databases MEDLINE, Embase, and PsycINFO from date of inception to October, 2016, using combinations of terms related to diagnosis, hospital, smoking, and violence, (eg, "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"). Two further studies were published since October, 2016. We identified seven studies that focused on physical violence after smoke-free policy implementation: four studies reported a decrease in physical violence after implementation; two reported no change; one found an increase in violence towards staff, but a reduction in patient-toward-patient violence. Four other studies combined rates of verbal and physical violence; one reported no change, two reported a decrease, and one reported an increase, which continued after the policy was discontinued. There were methodological differences between studies: the shortest evaluations were 2 weeks before and after policy implementation and the longest was 2 years after policy implementation; sample sizes ranged from 31 to 298 participants; 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 might have impacted on rates of violence.

Added value of this study

This is the first study, to our knowledge, 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 account of other variables that might influence trends over time.

Implications of all the available evidence

Our study adds to previous findings that showed that implementation of smoke-free policies does 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.

the impact of a policy change or quality improvement initiatives.[21] An interrupted time series 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.[22] The method allows the incidence of an outcome after policy introduction to be compared with that beforehand, while filtering out the effect of any underlying temporal or seasonal changes or variations in other potentially confounding variables.[23] For example, evidence of associations between a diagnosis of schizophrenia and violence in psychiatric inpatient units suggests that fewer schizophrenia admissions might result in a lower rate of violence.[6,24]

The study took place in the inpatient wards of South London and Maudsley NHS Foundation Trust (SLaM), a psychiatric NHS organisation in London, UK. SLaM has four hospitals, with about 50 wards and 800 beds, providing a wide range of specialist services to approximately 1·1 million people. 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 h, 23 min a day of clinical time was spent per ward supervising smoking.[25]

A comprehensive smoke-free policy across the four hospital sites started from Oct 1, 2014. Preparations for this began 12 months earlier, 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. The smoke-free policy includes the prohibition of smoking in the buildings and grounds of all hospital premises, no staff-facilitated smoking, and a tobacco dependence treatment pathway. Treatment includes offering smokers nicotine replacement therapy (NRT) within 30 min of arrival on the ward, and combination NRT for the duration of admission from ward staff trained in smoking cessation or dedicated hospital tobacco dependence treatment advisers. The use of disposable electronic (e)-cigarettes is allowed. These are purchased by patients rather than supplied by the hospital, and patients can use them in single bedrooms, but not communal areas. If used, e-cigarettes 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 (aged 18 years or older) up to 30 months before the policy was implemented and up to 12 months after (April 1, 2012, to Sept 30, 2015; 42 datapoints, 30 before policy implementation and 12 after); violence was reported and recorded consistently during this time. The study period allowed us to assess and model any seasonal variation in violence over the course of each year. We included patients from 38 wards caring for people with psychosis, mood, addiction, and dementia disorders. We excluded patients from forensic wards because patients had been exposed to a comprehensive smoke-free policy longer than patients in adult wards. We excluded child and adolescent wards because smoking has historically been prohibited on those wards.

We received audit approval from SLaM's internal clinical audit department to extract data from Datixweb and from the Clinical Record Interactive Search (CRIS) Oversight Committee. CRIS has ethical approval as an anonymised data resource for secondary analyses from Oxfordshire Research Ethics Committee (reference number 08/H0606/71).

Data sources and data collection

We collected information on incidents of physical assault recorded in Datixweb, an online patient safety reporting system. 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.[25,26] Staff are required to record details of incidents of violence online within 24 h of an event, with mandatory structured fields to identify date, ward, and location and a free-text description of the incident and injuries sustained. The staff member who observed the incident usually completes the online form, and 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.

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."[27] We adhered to the specific requirements for physical assault according to NHS Protect, which states that physical contact must be made directly (person to person) or indirectly (use of a weapon, object, liquid, or spittle); and includes intentional acts of assault that are unlawful, unwanted, or unwarranted; incidents of assault with no visible injury; and 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 (eg, smoke, smoking, cig or cigarettes, tobacco, fag, roll up or roll ups, rolli or rollie, water pipe, or 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."[27] 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, only physical assaults are reported to NHS Protect and are therefore more reliably recorded. Also, our 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 spreadsheet (not accessible to others). We categorised each report as a smoking or non-smoking related physical assault based on the definitions described above. Because 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 in which one incident report contained assaults directed towards more than one member of staff or patient. If the number of victims was clearly stated we counted the exact number of assaults. However, if the report was vague and only inferred more than one staff had been assaulted, we counted these as two assaults. If a person was hit multiple times in the same incident, we counted it as one assault.

For all patients who were present on the wards each month, we collected data on demographic and clinical characteristics of known potential confounders of violence on inpatient units: patient sex (percentage of men); age (percentage of patients younger than 45 years); percentage with schizophrenia or related disorders (ICD-10 codes F20–29); percentage with a mood or affective disorder (ICD-10 codes F30–39); patients who had been sectioned under the Mental Health Act (percentage of patients). We also collected data on smokers (percentage of patients). We collected these characteristics using the CRIS system, part of the National Institute for Health Research (NIHR) Maudsley Mental Health Biomedical Research Centre and Dementia Unit.[28] CRIS allows researchers to access anonymised information from patient electronic health records and to search against structured (eg, age, sex) and unstructured fields (user-defined text strings). Results are returned in spreadsheet format and 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.

Outcomes

The primary outcome of this study was the total number of physical assaults per month. Patient-toward-patient and patient-toward-staff assaults were specified as two secondary outcomes.

Statistical analysis

We used a quasi-Poisson generalised additive mixed model (GAMM)[29] 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 0 before the introduction of the smoke-free policy and 1 afterwards) to estimate an incidence rate ratio (IRR) for the effect of the policy. The underlying temporal trend in the number of incidents was captured using a thin plate spline and we used a cyclic-cubic spline to model seasonality. We included data on potentially confounding variables, defined above, in each model to account for the characteristics of patients being treated each month. We included the total number of occupied bed days in each month as an offset term in the model.

Given the small number of datapoints (n=42) and the danger of over-parameterisation, we first built models to estimate the effect of the policy adjusting only for the underlying time trend and seasonality. We then added all other potential confounding variables and used a backwards-fitting approach to build a parsimonious model with $p<0.05$ as an indicator of parameter significance. We examined model residuals for normality and any evidence of remaining autocorrelation between datapoints 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, 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 (version 2013) and the function gamm from the library mcgv[30] in the statistical software RStudio (version 0.99.473) were 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
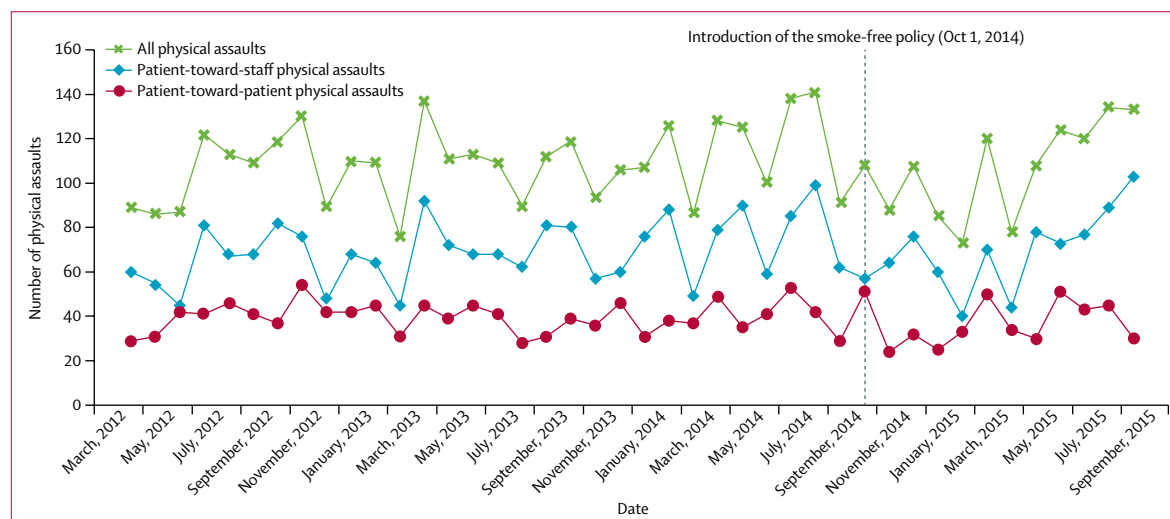

Figure: Number of physical assaults per month between April, 2012, and September, 2015

	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 (95% CI)	0·66 (0·57–0·77)	0·61 (0·53–0·70)	0·64 (0·55–0·74)	0·53 (0·44–0·63)	0·65 (0·53–0·80)	0·85 (0·80–0·92)
p value	<0·0001	<0·0001	<0·0001	<0·0001	0·00031	<0·0001
Variables included in model	..	..	..	..	..	..
Thin plate spline for underlying time trend	*	*	*	*	*	*
Cyclic cubic spline for month	*	..	*	..	*	..
Male	..	*	..	..	..	*
Age <45 years	..	..	..	..	..	..
Patients who smoke	..	*	..	*	..	..
Patients with schizophrenia, schizotypal, or delusional disorder (F20–29)	..	*	..	*	..	*
Patients with mood or 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 R²	0·116	–0·083	0·123	0·197	–0·087	–0·234

*Variable included in the model. MA=moving average. MA(1) is a standard way of describing the nature of the autocorrelation between the model residuals (moving average process of order one).

Table 1: Incident rate ratios estimated by generalised additive mixed model and variables included in the model

and had final responsibility for the decision to submit for publication.

Results

Between April 1, 2012, and Sept 30, 2015, there were 4550 physical assaults during the study period: 2916 patient-toward-staff assaults and 1634 patient-toward-patient assaults. Assaults related to smoking accounted for 225 (4·9%) of the overall violence. Over the study period, 747 338 occupied bed days of care were delivered to patients. 10 269 (57%) of 18 135 patients were male and 10 813 (60%) of 18 135 patients were younger than 45 years. 7180 (40%) of 18 135 patients had a primary diagnosis of schizophrenia or related disorder (ICD-10, F20–29), 3598 (20%) had a mood disorder (F.30–39), and 7357 (40%) other diagnoses (eg, dementia, addiction disorder; and 8007 (44%) were formally detained under mental health legislation. Excluding patients for which smoking status was not known, 11779 (78%) of 15 128 were current smokers. The number of assaults per month varied considerably from month to month throughout the study period, but were generally reduced after the introduction of the smoke-free policy (figure). 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.

After adjustment for all significant confounders, the results 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 with the period before the policy was introduced (IRR 0·61, 95% CI 0·53–0·70; p<0·0001). There was a 47% reduction in the number of patient-toward-staff assaults (0·53, 0·44–0·63; p<0·0001) and a 15% reduction in the number of patient-toward-patient assaults (0·85, 0·80–0·92; p<0·0001).

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.

Discussion

In our study in a large UK mental health organisation, 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. There appears to have been a larger decline in patient-toward-staff violence than patient-toward-patient violence.

Our study had some limitations. The method we used cannot attribute causality or distinguish between the effects of two or more policies introduced simultaneously, but, to our knowledge, 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, and therefore could not assess the change in violence by ward. The models assume no change in the composition of the population at risk over time; 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.

	All physical assaults		Incidents of patient-toward-staff assaults		Incidents of patient-toward-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 (95% CI)	0·69 (0·57–0·84)	0·69 (0·57–0·84)	0·73 (0·68–0·79)	0·69 (0·64–0·74)	0·85 (0·80–0·92)	0·85 (0·80–0·92)
p value	0·00061	0·00061	<0·0001	<0·0001	<0·0001	<0·0001
Variables included in model	..	..	..	..	..	..
Thin plate spline for underlying time trend	*	*	*	*	*	*
Cyclic cubic spline for month	..	..	..	..	..	..
Male	..	..	..	..	*	*
Age <45 years	..	..	..	..	..	..
Patients who smoke	..	..	..	*	..	..
Patients with schizophrenia, schizotypal, or delusional disorder (F20–29)	*	*	*	*	*	*
Patients with mood or 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 R²	0·169	0·169	0·065	0·151	–0·234	–0·234

*Variable included in model. MA=moving average. MA(1) is a standard way of describing the nature of the autocorrelation between the model residuals (moving average process of order one).

Table 2: Parsimonious models assuming patients with missing smoking data are either smokers (worst case scenario) or non-smokers (best case scenario) and variables included in the model

Based on the small number of datapoints, and over-parameterisation evident in the negative values of the adjusted R² values for some outcomes, the results should be treated with caution. The small adjusted R² values suggest we have only captured a small proportion of the variance in the time series. There are probably other variables that influence the number of incidents for which we did not have data, including alcohol and illicit substance use, which was only available for 31% of patients, and previous history of physical violence, which is not consistently recorded in electronic case notes. Missing smoking status data had greatest effect on results for patient-toward-staff assaults, but the direction and significance of effects remained. We acknowledge that patient demographics, clinical characteristics, and behaviour 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,[31,32] but these data were not available.

The strengths of our study include the fact that we examined physical violence for nearly 750 000 bed days of care over a 3-year period. To our knowledge, this is the first study to evaluate the effect of a smoke-free policy on physical assaults using a robust method that takes into account underlying temporal and seasonal trends, as well as the influence of potential confounding factors to isolate the effect of the policy. We assessed one aspect of violence (physical assaults) whereas some previous studies have combined verbal, physical violence, violence towards property, and other disruptive behaviours,[17,20] making it difficult to interpret the true extent of physical violence after policy implementation. The catchment area of SLaM is broadly representative of psychiatric organisations across London, in terms of age, sex, ethnicity, education, and social deprivation,[28] although we acknowledge they might differ from the rest of the UK and other countries. A new way of reporting violent incidents was introduced at the start of our study period and 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 finding might reflect a reliance on clinicians' written reports, which varied in quantity and quality and the contribution of smoking to incidents might have been under-reported. Nevertheless, the introduction of the policy had a wider impact on physical violence at least in the short term. The smoke-free policy includes tobacco dependence treatment, and staff training, and allows the use of e-cigarettes. A systematic review[31] of violence in psychiatric inpatient settings found staff–patient interactions to be the most frequent antecedent to violence and aggression, so the provision of tobacco dependence treatment, staff training, or other aspects of the policy might contribute to changing the culture of how staff interact with patients. Confidence in the findings might be increased by replication of the study in other settings. The apparent increase in assaults towards the end of the study period could have been caused by variations in confounding factors. More data with a longer data collection period after implementation of the policy than used in this study would help to elucidate whether immediate effects were sustained. Our findings are in accordance with most previous studies that show a decrease or no change in physical violence[10–17] after 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 symptoms of mental illness.[33] Nicotine has a half-life of approximately 2 h, 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, which can easily be misinterpreted as evidence that smoking is therapeutic and necessary to prevent agitation. Supporting patients to temporarily abstain from smoking or quit without the discomfort of nicotine withdrawal 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 with smoking tobacco.[34]

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

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