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Abstract

The introduction of smoke-free policies is increasingly common in mental health settings, in order to improve health. However, a barrier to implementing smoke-free policies is staff concern that violence will increase. We conducted a systematic review comparing the rates of violence before and after the introduction of smoke-free policies in mental health settings.

Two authors searched major electronic databases. **We included studies** reporting the prevalence of violence (verbal and/or physical or combined) before and after the introduction of a smoke-free policy in a mental health, forensic or addiction setting.

We included eleven studies in the review. **A narrative synthesis was used to describe the key results of each study.** Six studies measured physical violence specifically; four reported a decrease or no change and two reported a **short term** increase. Five of these six studies **also** measured verbal violence; two found an increase, with one of the studies reporting **that this increase was temporary**. Three reported a decrease in verbal violence. A further five studies evaluated the rate of combined verbal and physical violence; four reported a decrease or no change and the other an increase.

We conclude that the introduction of smoke-free policies generally do not lead to an increase in violence. There is a need for more robust studies to support this finding. However, the conclusions from this review may be a step in reducing staff concerns.

Keywords: violence, tobacco, smoking, mental health, policy

Systematic review registration: PROSPERO registration number: CRD42016036328

Smoking disproportionately affects the health and wellbeing of people who use mental health services (McNeill 2001); however it is only recently that there has been a concentrated effort on reducing harm from smoking in this population. International policies and guidelines focus on the need for comprehensive smoke-free policies in mental health settings (National Institute for Health and Care Excellence 2013; Department of Health New South Wales 2009); they recommend increasing the provision of evidence based treatment for tobacco dependence, **making** changes to the hospital environment to prohibit smoking in buildings and grounds and **providing** staff training to assess and treat tobacco dependence. Reviews of smoke-free policies implemented in mental health settings suggest that completely smoke-free environments protect people from second hand smoke, are associated with changes to the smoking culture (Lawn & Campion 2013) and can have a positive impact on patients' motivation to quit, and on smoking status (Stockings et al 2014).

However, the implementation of smoke-free policies in mental health settings has been problematic. Barriers to implementation include staff beliefs that smoke-free policies will have a negative effect on relationships with patients (Wye et al 2010), may lead to patients absconding (Beemer 1993) or discharging themselves against medical advice (Rustin 1998). Some staff believe facilitating patients to smoke can help manage their agitation and diffuse difficult situations (Ratschen et al 2009) and that if smoking is prohibited, patient's behavior will deteriorate (Stubbs et al 2004). Fear of an increase in violence remains a barrier to implementing such policies (**Hehir et al 2013, Voci et al 2010 & Wye et al 2010**) which has resulted in some hospitals to rescind smoke-free

policies and revert back to allowing smoking within hospital buildings and grounds (Campion et al 2008 & Crockford et al 2009).

A previous literature review, over a decade old (Lawn & Pols 2005), examined the effects of implementing smoke-free policies in mental health settings, including violence and concluded that staff fears about violence were mostly unfounded. Specifically, the review identified 26 studies of comprehensive and partial smoke-free policies between 1988 and 2002. **Ten** of the studies evaluated the impact on violence, **three of which measured violence through questionnaires or selective case studies of patients struggling with the smoke-free policy and another two of the studies were unclear about how they measured violence.** All but one of these **ten studies** found no change or a decrease **in violence** following the implementation of smoke-free policies.

We aimed to update and systematically review the influence of smoke-free policies on violence in mental health settings, using **quantitative** measures of **the occurrence of** violence. **Specifically, we aimed to review whether introducing a smoke-free policy in any adult mental health setting led to a change in rates of physical or verbal violence.**

Methods

Registration and protocol **We conducted this** systematic review in line with Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) statement (Moher et al 2009), adhering to a published protocol in PROSPERO (ref CRD42016036328).

Eligibility criteria

We included: 1. observational studies (retrospective, cross-sectional or cohort), randomised controlled trials and mixed method studies).

2. Studies that reported numbers and/or means of verbal and/or physical violence towards staff and other patients or violence towards objects or property, before and after the implementation of a smoke-free policy.

3. Studies that **reported quantitative measure of violence** (i.e. **through** rating scales or official incident reports).

4. Any type of smoke-free policy, incorporating either total smoking bans (which prohibit smoking in both buildings and grounds) or partial smoking bans (which prohibit smoking in only certain areas of the hospital property).

5. Studies could be published in any language.

6. Settings included **adult** acute mental health, forensic or addiction inpatient, outpatient or community clinic settings.

7. Studies included in published journal articles only and at any time from the date of inception of the journal to 03.04.2017.

Information sources and searches

Authors GS and BS searched the electronic databases MEDLINE, EMBASE, PsycINFO, British Nursing Index, **CINAHL and Psychology and Behavioural Sciences Collection** by date of inception to 03.04.2017 using the following terms: “schizophrenia” OR “psychosis” OR “bipolar” OR “depression” OR “mental illness” OR “serious mental

illness" OR "severe mental illness" OR "personality disorder" OR "drug dependence"
OR "substance abuse" OR "addiction" OR "mental hospital" OR "mental health
hospital" OR "hospital ward" 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" OR
"untoward". **The Cochrane Library was searched using the following terms: Psychosis
OR mental health AND smok* OR smoking ban AND violen*. The Pubmed database
was also searched using the terms smoke free AND violence. We also screened
reference lists of eligible articles and relevant papers to identify any potential studies
that met the criteria of our review.**

**Following the searches, author GS screened all of the studies at title and abstract
level. Two authors checked that the full text papers (GS and DR) met the eligibility
criteria. Any discrepancies were resolved through consultation with author BS.**

Study selection, data collection and items

One author (GS), extracted the data from the included studies **into Excel** using a
predetermined data extraction form and a second author (DR) checked **all of** the
extracted data to obtain the following information: first author, country, setting, type
of ward, population, sample size, patient demographics, type of study, data collection
period and data collection methods used, type of policy and date implemented and
number of violent incidents. Disagreements were resolved by discussion between the
two review authors and mediated by consultation with a third reviewer (BS).

Quality of individual studies

We examined the risk of bias in the included studies using a modified version of the Newcastle-Ottawa Scale (Takahashi and Hashizume 2014 & Wells et al 2008). **We judged** each study on three broad domains: 1) the selection of the study groups; 2) comparability and confounding; and 3) measurement of outcome variables. Studies were rated independently by two reviewers (GS and DR) and assigned an average score.

Synthesis of results

Due to the heterogeneity of the included studies, formal quantitative meta-analysis was not possible. Therefore, we employed a narrative synthesis to describe the key results of each study. **Five of the included studies reported outcomes of violence according to smoking status, three of which determined this a priori (Harris et al 2007, Hempel et al 2002 & Rauter et al 1997) and two of which determined this in a post hoc manner (Campion et al 2008 & Cormac et al 2010). Therefore, we also reported the rates of violence according to smoking status for the studies that reported outcomes in this way and we determined this on a post hoc basis.**

Results

Study selection

Figure 1 describes the results of the search and the study selection process. Following the removal of duplicates, **we identified** a total of 3059 articles. After initial screening based on titles and abstracts, **28** articles remained for further evaluation of eligibility.

After inspection of these articles, 17 were excluded because violence was not measured **quantitatively** or violence was not a specific outcome (details are provided in Figure 1 **and excluded references are provided in the Supporting Information table**). The findings from the study by Ryabik et al (1994) were also reported by Velasco et al (1996) therefore we only included the latter study to avoid duplication. This resulted in eleven studies included for the review (Gee et al 2017; Riad-Allen et al 2017; Cormac et al 2010; Voci et al 2010; Campion et al 2008; Harris et al 2007; Hempel et al 2002; Quinn et al 2000; Rauter et al 1997; Haller et al 1996 & Velasco et al 1996).

Insert Figure 1 here please

Characteristics of the included studies

A description of the eleven included studies is provided in Table 1. All of the studies were conducted in settings providing psychiatric care, either from an acute or secure inpatient facility or from community clinic settings. **We did not identify any studies conducted in addiction settings.** The majority of studies were conducted in North America, five in the USA (Hempel et al 2002; Quinn et al 2000; Rauter et al 1997; Haller et al 1996 & Velasco et al 1996); three in Canada (Riad-Allen et al 2017; Voci et al 2010 & Harris et al 2007); two studies were conducted in the UK (Gee et al 2017 & Cormac et al 2010) and one in Australia (Campion et al 2008). All of the studies were observational. In seven studies violence was measured cross-sectionally before and after the implementation of the policy (Riad-Allen et al 2017; Voci et al 2010; Campion et al 2008; Quinn et al 2000; Rauter et al 1997; Haller et al 1996 & Velasco et al 1996).

The remaining four were cohort studies, using the same sample both pre and post implementation (Gee et al 2017; Cormac et al 2010; Harris et al 2007 & Hempel et al 2002).

Insert Table 1 here please

Characteristics of the participants

Three studies reported diagnosis; the majority of patients had either diagnosis of psychosis or a mood disorder. **Five of the included studies reported the sample size used, comprising of a total of 548 participants and** sample sizes ranged from 31 (Gee et al 2017) to 298 (Cormac et al 2010). Five of the included studies reported gender (Gee et al 2017 Harris et al 2007; Hempel et al 2002; Haller et al 1996 & Velasco et al 1996) and five studies reported the smoking status of the participants (Gee et al 2017; Cormac et al 2010; Harris et al 2007; Hempel et al 2002; Haller et al 1996).

Smoke-free policies

The date of implementing smoke-free policies varied across the studies, ranging from as early as 1991 (Rauter et al 1997) up until 2014 (Gee et al 2017). Nine of the studies were conducted in settings where smoking was banned in buildings and grounds after the policy; five of which prohibited both smoking and all tobacco products (Riad-Allen et al 2017; Cormac et al 2010; Harris et al 2007; Hempel et al 2002 & Quinn et al 2000). In one study, patients were prohibited from smoking indoors and within a 9m radius from the entrances to the buildings (Voci et al 2010). In the other study, patients were allowed to smoke outside in designated open air smoking areas (Rauter et al 1997).

We have summarised the treatment and support offered for tobacco dependence in relation to the smoke-free policy and patient adherence to the policy in Table 2. Treatment and support was described in all of the studies, with the exception of Harris et al (2007) and included staff training to identify and treat tobacco withdrawal symptoms and patient education about smoking and tobacco dependence treatment. The level of adherence to the policy was described in six of the studies (Campion et al 2008, Cormac et al 2010, Harris et al 2007, Hempel et al 2002, Rauter et al 1997, Riad-Allen et al 2017 & Voci et al 2010), issues of non-adherence included patient access to smoking materials, either from relatives or staff.

Please insert Table 2 here Measures of violence

Studies used a variety of methods to measure changes in violence including official incident reports, the Overt Aggression Scale, patient records, chart reviews and staff observations (Table 1). We report study outcomes at the longest follow-up period in Table 3. Study outcomes at other follow-up time points are reported in the text. Table 3 includes the eight different ways the studies calculate rates of violence (total number of weekly, monthly and yearly incidents, or mean number of daily, weekly, monthly and yearly incidents or number of shifts with violence). **Six studies reported on rates of physical violence specifically, which included physical contact, such as punching, kicking, slapping and spitting, either directed towards people or towards objects. Five of these six studies also measured verbal violence, which included hostile or**

threatening behaviour without physical contact. Five studies reported combined numbers of physical and verbal violence and these could not be separated.

Insert Table 3 about here please

Quality of individual studies

Table 4 describes the average risk of bias for each included study. Some studies selected their sample from entire hospitals and others from just one ward. Sample sizes were small or inadequately described and many studies did not report the demographic or clinical characteristics of their samples. Few studies described their definition of violence. None of the studies controlled for potential confounders of violence on inpatient wards, such as demographic and clinical characteristics of patients.

Insert Table 4 here please

Changes in violence after smoke free policy implementation

Physical violence

Six studies assessed physical violence as a specific outcome (Table 3), **four reported a decrease or no change and two reported** mixed findings **according to** smoking status and victim of assault. Cormac et al (2010) reported an increase in physical violence for non-smokers during the month after policy implementation and a decrease four months after the policy to a lower rate than at pre implementation. **F**or smokers, physical violence temporarily decreased one month after, but increased to a greater

rate relative to before the introduction of the policy at four month follow-up, **though** these changes were not statistically tested. Harris et al (2007) reported that in open wards there was a significant increase in physical violence directed towards staff by smokers, **2.76 95% CI's (0 to 6.24) and 7.35 (0 to 21.0)**, but a significant decrease in physical violence directed towards other patients one year after the policy was implemented, **7.76 95% CI's (0 to 21.5) and 1.82 (0 to 4.81)**. However Harris et al (2007) expressed some doubt about the validity of their findings and suggested that a peak in violence against staff occurred several months after the introduction of the policy, whereas a peak in violence towards other patients occurred several months before the introduction of the policy. Rates of physical violence remained unchanged for non-smokers both towards staff and towards patients on open wards. In secure wards rates of violence by smokers and non-smokers remained unchanged, both for assaults directed towards staff and towards other patients. Hempel et al (2002) reported no significant change in weekly means of physical violence for non-smokers and smokers one month after introducing their policy.

Violence reduced by half ($p<.01$) one month after the policy in the study by Quinn et al (2000). Velasco et al (1996) reported no change in physical assaults immediately after the policy and at two year follow-up. Haller et al (1996) reported no significant change in shifts with physical aggression during the first month of the ban and at four month follow-up. Cormac et al (2010) and Haller et al (1996) included changes in violence towards property and objects in their evaluation; both reported one additional incident after the policy compared to beforehand.

Verbal violence

Of the five studies which assessed verbal violence as a specific outcome (Table 3), two reported an increase (Cormac et al 2010 & Velasco et al 1996) and three reported a decrease (Hempel et al 2002; Haller et al 1996 & Quinn et al 2000) after the policy was introduced. Velasco et al (1996) reported that verbal violence significantly increased immediately post policy ($p<.01$) but returned to baseline levels at two year follow up. Cormac et al (2010) reported an increase in verbal violence for both smokers and for non-smokers, though this increase was not statistically tested.

Haller et al (1996) reported that the proportion of shifts in which patients were verbally violent significantly decreased during the first month of the ban ($p<.01$). This then subsequently returned to pre policy levels at the fourth month after the ban. Hempel et al (2002) reported the number of incidents of verbal violence decreased across all participants one month after the ban, though was only statistically significant for heavy smokers who smoked 19 or more cigarettes per day ($p=0.034$). Quinn et al (2000) reported that verbal violence significantly decreased ($p<.01$) one month after the ban was implemented.

Physical and verbal violence combined

Five studies combined verbal and physical assaults (Table 3), one study reported an increase (Campion et al 2008), three studies reported a decrease (Gee et al 2017; Riad-Allen et al 2017 & Rauter et al 1997) and one study found no change (Voci et al 2010)

after the introduction of a policy, relative to before. Campion et al (2008) reported there was an increase in overall violence in the six weeks after the smoke-free policy was introduced. Twelve months before the policy was introduced there were 22 incidents that were believed to be non-smoking related and zero smoking related. Six months before, they reported 41 non-smoking incidents and one smoking related incident. In the six week period when the policy was being implemented, there were 36 non-smoking related incidents compared to 20 smoking related incidents, though this was not statistically tested. The smoke-free policy was terminated after six weeks. However, overall violence persisted, often to higher levels than during the smoke-free period.

Rauter et al (1997) found a decline in overall violence at nine months after the introduction of the policy; however, statistical tests were not conducted to measure the significance of this reduction. Both Gee et al (2017) and Riad-Allen et al (2017) reported a statistically significant reduction in violence at one week follow-up ($p=0.03$) and at one year follow-up ($p=0.04$) respectively. The study conducted by Voci et al (2010) found no significant change in rates of assaults across all settings at two year follow up.

Smoking restrictions

Two studies evaluated rates of violence in settings where patients were allowed to continue to smoke in the hospital grounds (Table 1). One study found a reduction in

violence (Rauter et al 1997) and the other study found no significant change in rates of violence (Voci et al 2010).

Discussion

In this systematic review **we** included eleven studies evaluating the impact of implementing smoke-free policies in mental health settings dating back to 1991. **Out of the 11 studies included in this review, eight (72%) reported** either no change or a reduction in verbal or physical violence, **one study found an increase in violence (over a six month period) and two reported mixed findings of both an increase and decrease in violence.** This is despite variations in the types of settings included, the study duration and the measures employed.

Our findings support the conclusions made in a previous review by Lawn and Pols (2005) that found implementing a smoke-free policy **generally** does not increase violence. However, we were unable to draw the same conclusion regarding **their** finding that there was less violence in settings where the policy included a smoking ban in both buildings and grounds compared to grounds only. We only found two studies evaluating policies including a partial ban, one of which showing a decrease in violence and the other study showing that rates of violence remained the same.

There have been various suggestions posed by the individual study authors for finding a decrease or no change in violence following the implementation of smoke-free

policies. Hempel et al (2002) suggested their smoke-free policy may have improved social interaction between smokers and non-smokers on the ward and eliminated the trading of cigarettes and the associated coercion when forcing other patients to give up their cigarettes. Other authors suggest the policy can reduce the opportunity for disagreements between staff and patients over smoking breaks and access to cigarettes (Gee et al 2017).

Most authors reported that NRT was made available to support the implementation of the policy (Gee et al 2017; Riad-Allen et al 2017; **Cormac et al 2010**; Voci et al 2010; **Campion et al 2008**, Hempel et al 2002; Haller et al 1996 & Velasco et al 1996).

Tobacco withdrawal symptoms (including restlessness and irritability) are sometimes misinterpreted as agitation by mental health staff (Lawn & Campion 2013). **It** is plausible that the treatment of tobacco withdrawal symptoms plays an important role in the prevention and management of violence of smokers in mental health settings.

However none of our included studies **tested whether patients who received NRT were any more or less likely to be violent**. We know from other research that hospital patients find smoke-free policies acceptable if they feel that NRT minimizes their tobacco withdrawal symptoms (Stockings et al 2015). Further research is needed to explore if there is an association between the provision and uptake of NRT and effect on violence.

Limitations of the majority of studies include a lack of operationalizing violence, which could lead to under reporting or over reporting the number of verbal or physical assaults. **Study designs were also limited, as many studies** used simple before and

after comparisons of the effect of the policy on violence without taking into account other factors that may have influenced the change in rates of violence. Potential confounders of violence on inpatient units include being of a younger age, being male, having a diagnosis of schizophrenia and being detained (Dack et al 2013). Studies also did not adjust for temporal and seasonal changes. Evaluation periods were often short (one study as short as one week after the introduction of the policy) – not allowing enough time to fully evaluate the effect of the policy on violence. **Additionally, the policy was not always adhered to. In some of the hospitals patients often still accessed smoking materials and there were some issues of secretive smoking, which may limit the interpretation of the results.**

Six of the included studies were subject to bias; particularly the cross-sectional studies on the domains of selection of participants, confounding and measurement of study outcome and thus our interpretations should be treated with caution. Three of the studies introduced their data collection methods for the purpose of the study, where staff were used to collect the number of violent incidents (Haller et al 1996, Velasco et al 1996 & Quinn et al 2000). It was also unclear if patients were aware they were being studied, which may have influenced both staff reporting and patient behaviour.

We were **restricted** to providing a narrative synthesis rather than conducting a meta-analysis because the studies were too heterogeneous – they varied considerably in how they reported rates of violence, either reporting raw total number of incidents,

weekly mean number of incidents, monthly or yearly mean number of incidents. **We did not search the grey literature however reference lists of studies were screened.**

The strengths of this systematic review include the use of robust eligibility criteria and only included studies which measured violence **quantitatively** (reporting the number of assaults from official incident reports, nursing observations and patient records) and excluding staff beliefs or perceptions of violence. We also distinguished between the different categories of violent behavior (i.e. verbal and physical).

Future studies should focus on using longer evaluation periods, and ensure that physical and verbal violence are well defined in order to accurately report the number of assaults and control for potential confounders. More rigorous and consistent methods of reporting rates of violent incidents are required, so that more precise and comparable data can be generated (Bowers 2000). It may also be helpful for future studies to provide a context of the violence, to see whether the assault occurred in relation to smoking and how the assault was managed in regards to offering support to manage tobacco withdrawal.

Conclusion

The findings from **our** review show that implementing smoke-free policies **in mental health settings** generally **does** not lead to an increase in violence. Where an increase in violence was reported, this was found to be temporary or potentially explained by other factors. The findings from this review can contribute to refuting the long held

belief that smoke-free policies will lead to an increase in violence **in mental health settings.**

Relevance to Clinical Practice

The impact of verbal and physical violence in mental health settings cannot be underestimated and includes staff burnout, emotional distress, symptoms of post-traumatic stress disorder, poor job satisfaction and staff sickness (Taylor & Barling 2004, Needham et al 2005). **Some** staff in mental health settings believe that implementing smoke-free policies will detrimentally affect staff and patient interaction, will lead to an exacerbation of mental health symptoms and to an increase in violence (Lawn et al 2015). Staff in psychiatric services are nearly three times more likely to oppose implementing smoke-free policies compared to staff working in general hospital settings (McNally et al 2006). Smoke-free policies, that include the prohibition of smoking and the treatment of tobacco dependence have the potential to transform the smoking culture in mental health settings (Lawn & Campion 2013) and can have a positive impact on **patient** outcomes, **including a reduction in cigarette consumption during admission and post discharge and an increased motivation to quit** (Stockings et al 2014). **Contrary to staff concerns, the implementation of smoke-free policies in mental health settings generally do not lead to an increase in violence** and in some cases can lead to a reduction in violence.

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Table 1: Characteristics of studies included in the review

Study	Sample size	Participant characteristics	Setting	Methods
Policy included smoking ban in buildings and grounds				
Campion et al (2008)	Not reported	Not reported	Queensland, Australia, 1 mental health unit of a hospital comprising of 1 locked ward (8 high dependency beds) and 1 open ward (26 low dependency beds)	Design: multiple cross sectional Data Collection tool: Incident reports
Cormac et al (2010)	298	73% smokers	Nottingham, England 1 High secure long stay psychiatric hospital	Design: cohort study Data collection tool: Incident reports
Gee et al (2017)	31	Males $n = 27$, females $n = 4$ 100% smokers	South London, England 3 psychiatric hospitals	Design: cohort study Data Collection tool: members of staff provided number of violent incidents per week
Haller et al (1996)	162	Males $n = 88$, females $n = 74$ Diagnosis: schizophrenia $n = 48$, mood disorder $n = 51$, other $n = 63$. 51% smokers	California, USA, 1 locked inpatient unit of a psychiatric hospital comprising of 16 beds	Design: multiple cross sectional Data collection tool: Overt Aggression Scale
Harris et al (2007)	119	Males $n = 106$, females $n = 13$ Diagnosis: schizophrenia $n = 56$, affective and other psychoses $n = 17$, personality disorder $n = 20$,	Ontario, Canada 6 open units comprising of 147 beds and 1 maximum-security unit comprising of 140 beds	Design: multiple cross sectional Data collection tool: Clinical records

		learning disability $n = 14$, unspecified $n = 12$ 92% smokers		
Hempel et al (2002)	140	Males $n = 120$, females $n = 20$ Authors reported the majority had schizophrenia 78.5% smokers	Texas, USA 1 Maximum secure hospital. Number of beds not reported	Design: multiple cross sectional Data collection tool: Clinical records
Quinn et al (2000)	Not reported	Not reported	Wichita Falls, USA 1 state hospital. Number of beds not reported	Design: multiple cross sectional Data collection tool: Overt Aggression Scale
Riad-Allen et al (2017)	Not reported	Not reported	Toronto, Canada 1 public mental health hospital comprising of 550 beds, with 25 inpatient services and 100 outpatient clinics	Design: multiple cross sectional Data collection tool: Incident reports
Velasco et al (1996)	96	Males $n = 45$, females $n = 51$	Kentucky, USA 1 Locked psychiatric unit of university hospital comprising of 25 beds	Design: multiple cross sectional Data collection tool: Nursing staff recorded observations
Policy included smoking ban in buildings only				
Rauter et al (1997)	Not reported	Not reported	New Hampshire, USA Psychiatric hospital, comprising of 145 beds	Design: multiple cross sectional Data collection tool: incident reports

Vocal (2010)	Not reported	Not reported	Toronto, Canada 4 mental health and addiction institutions, comprising of 28 inpatient units, 100 outpatient clinics	Design: multiple cross sectional Data collection tool: Incident reports
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Table 2: Details of included smoke-free policies: treatment for tobacco dependence and adherence to policy

Study	Treatment and support in relation to policy	Patient adherence to policy
Campion et al (2008)	Nicotine Replacement Therapy (NRT) protocols were developed and distributed. Support and information sessions regarding the smoke-free policy were conducted by nurses for patients.	Patients were found to congregate outside of the unit to smoke and were given access to smoking materials by staff.
Cormac et al (2010)	Staff were trained to identify and treat tobacco withdrawal symptoms. Education given to patients about smoking and tobacco dependence treatment. NRT for nicotine withdrawal, was made available for patients.	Search policies and procedures prohibited patients from accessing smoking materials, though authors reported hospital security staff found tobacco and ignition sources on several occasions after the policy was implemented.
Gee et al (2017)	NRT was made available and prescribed for 65% of the patients after the implementation of the policy.	Not reported.
Harris et al (2007)	Not reported.	Patients in open wards had more opportunity to access smoking materials, either from visitors or whilst off grounds for work or leisure activities. This was not the case in secure wards.
Haller et al (1996)	Staff were trained to identify and treat tobacco withdrawal symptoms. Nicotine gum or patches were prescribed for any patients who experienced withdrawal symptoms and written materials about managing cigarette cravings were given to patients.	Not reported.
Hempel et al (2002)	Education given to patients about smoking and tobacco dependence treatment. Nicotine patches, nicotine gum and bupropion were made	Occasionally, staff and family members supplied smoking materials to patients.

	available for patients that were experiencing withdrawal symptoms.	
Quinn et al (2000)	Education given to patients about smoking and tobacco dependence treatment.	Not reported.
Rauter et al (1997)	Education given to patients about smoking and tobacco dependence treatment. Nicorette gum prescription increased for patients that were newly admitted and could not leave the unit to smoke.	Patients were occasionally found in possession of smoking materials.
Riad-Allen et al (2017)	Tobacco use was clinically managed by assessment, treatment and care planning, and engaging staff, patients and families.	Report from questionnaire that patients were more likely to adhere to policy post implementation compared to attitudes before the implementation of the policy.
Velasco et al (1996)	Nicotine gum and patches were made available for patients.	Not reported.
Voci et al (2010)	Healthcare professionals were trained on the effective use of NRT and brief tobacco dependence interventions. Staff were trained on managing problematic behaviour stemming from violations of the smoke-free policy. Subsidised NRT and bupropion were made available to outpatients at reduced cost.	There was no change in incidents of secretive smoking, as perceived by staff.

Table 3: Rates of verbal and physical violence before and after the implementation of a smoke-free policy [†]

Physical violence				
	Measurement	Pre policy	Post policy	Change in violence [§]
Haller et al (1996) [‡]	Total number of shifts with violent incidents 1 month before and 4 months after policy	13	4	No significant change.
Quinn et al (2000) [‡]	Total number of incidents 1 month before and 1 month after policy	266	133	Significant decrease.
Velasco et al (1996) [‡]	Mean daily incidents 6 weeks before and 2 years after policy	0.2	0.4	No significant change.
Cormac et al (2010)	Total number of incidents 4 months before and 4 months after policy	Assaults perpetrated by smokers=25 Assaults perpetrated by non-smokers=38	Assaults perpetrated by smokers=34 Assaults perpetrated by non-smokers=22	Increase for smokers and a decrease for non-smokers (not statistically tested).
Hempel et al (2002)	Weekly mean incidents 1 month before and 1 month after policy	Assaults perpetrated by heavy smokers=0.03 Assaults perpetrated by non-smokers=0.04	Assaults perpetrated by heavy smokers= 0 Assaults perpetrated by non-smokers=0.22	No significant change.

Harris et al (2007)	Yearly mean incidents 1 year before and 1 year after policy	Assaults perpetrated by smokers in open wards: towards patients= 7.76 towards staff=2.76	Assaults perpetrated by smokers in open wards: towards patients= 1.82 towards staff=7.35	Significant decrease perpetrated by smokers towards other patients in open wards.
		Assaults perpetrated by non-smokers in open wards: towards patients= 34.4 towards staff=85.6	Assaults perpetrated by non-smokers in open wards: towards patients=29.9 towards staff=81.1	Significant increase perpetrated by smokers towards staff in open wards.
		Assaults perpetrated by smokers in maximum security wards: towards patients= 0.91 towards staff=0.63	Assaults perpetrated by smokers in maximum security wards: towards patients= 0.93 towards staff=0.80	No significant change for smokers in secure wards and for non-smokers, both in open and secure wards.
		Assaults perpetrated by non-smokers in maximum security wards: Towards patients=0.96 Towards staff=1.89	Assaults perpetrated by non-smokers in maximum security wards: Towards patients=0.92 Towards staff=2.56	

Verbal violence

Cormac et al (2010)	Total number of incidents 4 months before and 4 months after policy	Assaults perpetrated by smokers=99 Assaults perpetrated by non-smokers=33	Assaults perpetrated by smokers=84 Assaults perpetrated by non-smokers=46	Increase for smokers and a decrease for non-smokers. (not statistically tested).
Hempel et al (2002)	Weekly mean incidents 1 month before and 1 month after policy	Assaults perpetrated by heavy smokers=0.26 Assaults perpetrated by non-smokers=0.34	Assaults perpetrated by heavy smokers=0.11 Assaults perpetrated by non-smokers=0.04	Significant decrease for heavy smokers. No significant change for the rest of the smokers and for non-smokers.
Haller et al (1996) [‡]	Total number of shifts with violent incidents 1 month before and 4 months after policy	30	30	No significant change.
Quinn et al (2000) [‡]	Total number of incidents 1 month before and 1 month after policy	1,184	656	Significant decrease.
Velasco et al (1996) [‡]	Mean daily incidents 6 weeks before and 2 years after policy	1.3	0.6	No significant change.
Combined verbal and physical violence				

Campion et al (2008)	Total number of incidents 12 months before and 6 weeks after policy	Number of assaults not related to smoking=22 Number of assaults related to smoking=1	Number of assaults not related to smoking=36 Number of assaults related to smoking=20	Increase including smoking related assaults (not statistically tested).
Gee et al (2017)	Mean weekly incidents 2 weeks before the ban and a week after policy	0.45	0	Significant decrease.
Rauter et al (1997)	Monthly mean 9 months before and 9 months after policy	Number of assaults not related to smoking=46 Number of assaults related to smoking=3	Number of assaults not related to smoking=34.3 Number of assaults related to smoking=8	No change (not statistically tested).
Riad-Allen et al (2017) [†]	Mean weekly incidents 6 months before and 18 months after policy	13.67	10.72	Significant decrease.
Voci et al (2010) [‡]	Total number of incidents 12 months before and 2 years after policy	Inpatient=178 Outpatient=17 Emergency=28	Inpatient=149 Outpatient=24 Emergency=19	No significant change.

[†] We report the number of assaults for the longest follow-up

[‡] Number of assaults are not distinguished by smoking status

[§] Results on changes in violence are based on what the authors have concluded

Table 4: Quality of Individual Studies (Modified Version of Newcastle-Ottawa Scale)

Domains	Selection of participants	Comparability/Confounding	Measurement of outcomes
Cohort studies			
Hempel et al (2002)	**	**	**
Harris et al (2007)	**	**	**
Cormac et al (2010)	**	**	**
Cross sectional studies			
Campion et al (2008)	*	*	*
Haller et al (1996)	*	*	*
Quinn et al (2000)	*	*	**
Rauter et al (1997)	*	*	*
Velasco et al (1996)	**	*	*
Voci et al (2010)	**	**	*
Gee et al (2017)	*	*	*
Riad- Allen et al (2017)	*	**	**

Legend

Not reported =0

no = 0 [high risk of bias]

mostly no = *

mostly yes =**

yes = *** [low risk of bias]

Figure 1. Study Selection Process