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THE RELATIONSHIP BETWEEN SERVICE ECOLOGY, SPECIAL OBSERVATION AND SELF-HARM DURING ACUTE IN-PATIENT CARE: THE CITY-128 STUDY

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Background: Special observation (the allocation of nurses to watch over nominated patients) is one means by which psychiatric services endeavour to keep in-patients safe from harm. The practice is both contentious and of unknown efficacy.

Aims: To assess the relationship between special observation and self-harm rates, by ward, whilst controlling for potential confounding variables.

Method: A multivariate cross sectional study collecting data on self-harm, special observation, other conflict and containment, physical environment, patient and staff factors for a six month period on 136 acute admission psychiatric wards.

Results: Constant special observation was not associated with self-harm rates, but intermittent observation was associated with reduced self-harm, as were levels of qualified nursing staff and more intense programmes of patient activities.

Conclusions: Certain features of nursing deployment and activity may serve to protect patients. The efficacy of constant special observation remains open to question.

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Maintaining the safety of acutely disturbed in-patients during periods of psychiatric crisis is difficult. Some may be suicidal or want to harm themselves, while others may be vulnerable, prone to abscond or pose a danger to other people. One way to keep a

patient safe is to allocate an identified person to their care, called special observation (SO). It can take two forms: the constant presence of the observer with the patient or intermittent checks at short time intervals.

There is no evidence on the efficacy of SO (1). Deaths during SO have been reported (2), and the practice may only shift the risk to the time when SO is terminated, or into the post-discharge period. Some have argued that it is inherently depersonalising and that nursing care should focus more on giving support and developing relationships with patients (3), while others see SO as having an important preventive role (4). Intermittent observation has also been criticised as being by definition inefficacious (5;6).

The purpose of this study was to assess the relationship between special observation and self-harm rates, by ward, whilst controlling for potential confounding variables (patient characteristics, service environment, physical environment, patient routines, other patient behaviours, use of other containment methods and staff characteristics).

METHOD

Data were collected from acute wards on rates of self-harm, special observation, other conflict and containment methods, the patients admitted, the staff team and the environment of the ward. Multilevel modelling was then used to assess relationships between the main items of interest (special observation and self-harm) whilst controlling for the effects of other variables.

Sample

The target sample size was 128 acute NHS psychiatric wards, their patients and staff, geographically situated proximate to three centres (London, Central England, Northern England). In the north the sample included Blackpool and Preston, to the west Shropshire, to the east Leicester, and to the south London. Acute psychiatric wards were defined as those that primarily serve acutely mentally disordered adults, taking admissions in the main directly from the community, and not offering long-term care or accommodation. Wards that were organised on a speciality basis, or that planned to change population served, location, function, or which were scheduled for refurbishment during the course of the study were excluded. Each centre identified all eligible wards within reasonable travelling distance of their research base. It was initially intended to randomly sample wards, with replacement for refusals to participate. However the geographical dispersion of wards meant that to achieve the requisite sample size, the Northern and Central England centres had to recruit all available wards within practical reach for data collection. In London, it was possible to randomly sample from a list of 112 wards. Data were collected over a period of six months on each ward. Commencement of data collection by selected wards was staggered over an 18 month period, for logistical reasons. In essence this meant that at each research centre groups of wards started the study in four or five cohorts during 2004-2005.

Data collection and instrumentation

Information on the ward physical environment and the policies in operation was collected on a site visit by a researcher and a form completed by the ward manager;

data on the main outcome measures were collected by end of shift reports by the nurses in charge; the ward multidisciplinary team were required to complete a selection of standardised questionnaires, parcelled into several batches to reduce demand on busy practitioners; and smaller samples of patients and staff were asked to complete questionnaires.

The shift report version of the **Patient-staff conflict checklist** (PCC-SR) (7) was used to log the frequency of patient conflict behaviours (e.g. self-harm, absconding, violence, medication refusal) either attempted or successful, and the staff containment measures used to maintain safety (e.g. intermittent special observation, constant special observation, seclusion, physical restraint etc.) and was compiled using strict definitions at the end of every nursing shift. On entry to the study, ward nursing staff received training in the use of the PCC-SR, and each ward was provided with a handbook giving definitions of items. For all incidents of self-harm or attempted suicide, a Bongar Lethality Scale (8) was completed as part of the PCC-SR, to assess the severity of the incident. The PCC-SR was supplemented with additional items to include age, gender, diagnosis, ethnicity, and postcode of patient's place of residence, for those patients admitted during the shift. In recent tests based on use with case note material, the PCC has demonstrated an inter-rater reliability of 0.69 (9), and has shown a significant association with rates of officially reported incidents (10).

Basic ward data was collected on two forms, one completed by the researcher visiting the ward in conjunction with the ward manager, the second completed by the ward manager alone. Staff attitude to difficult patients was assessed using the **Attitude to Personality Disorder Questionnaire** (APDQ) (11). Ward structure was assessed

using the Order and Organisation, Programme Clarity and Staff Control subscales of the **Ward Atmosphere Scale** (WAS) (12). The quality of ward leadership was assessed by taking the score for the Ward Manager, as rated by ward staff, using the **Multifactor Leadership Questionnaire** (MLQ) (13). Multidisciplinary team cohesion was assessed using the **Team Climate Inventory** (TCI) (14). Burnout was assessed using the **Maslach Burnout Inventory** (MBI) (15). Some staff and patients (ten per ward) were asked to complete the **Attitude to Containment Measures Questionnaire** (ACMQ) (16). This scale provides relative measures of views on acceptability, efficacy, dignity, safety of patients and safety for staff of different forms of containment for disturbed behaviour.

Procedure

Initial management approval in principle for wards to participate in the study was sought in advance from Trust Chief Executives. Ethical approval for the study was obtained from the North West Multi-centre Research Ethics Committee (Ref. MREC 03/8/085). Following sample identification and research governance approval, letters were sent inviting each selected ward manager and their teams to participate in the City-128 study, detailing the purposes and advantages of participation, and the nature of the commitment required. Expression of interest resulted in a site visit to the ward and its team by a researcher, who made a presentation about the study, and collected ward assessment data. At this point staff were instructed on how to collect Patient-staff Conflict Checklist shift reports (PCC-SR). A project liaison person was appointed from the ward personnel, and contacts were also made with Directors of Nursing and senior managers to ensure that everything went smoothly. Data collection commenced immediately and continued for six months on each participating ward.

Wards were recruited to the study in several separate cohorts at each research centre. Batches of questionnaires for staff were issued to the wards at roughly monthly intervals, with instructions for their completion. Completed questionnaires were posted in a sealed box on each ward, and collected at regular intervals by the research assistant.

Response rates

In London, one Trust declined to participate, and of wards randomly sampled in participating Trusts, two declined and one was excluded due to a scheduled refurbishment. In the North West, 16 wards refused to participate, most on the grounds of commitment to other projects, and with three hospitals (accounting for 8 of the 16 ward refusals) declining to participate at higher management levels than the ward managers. In this centre, an additional four wards were excluded due to scheduled refurbishments, and three wards excluded due to extremely poor response rates (no more than two or three PCC-SRs per week). In Central England, no Trust or ward refused to participate, and no wards had plans for refurbishment necessitating their exclusion. Because of over sampling for anticipated dropouts, which did not occur, a total of 136 wards completed data collection for this study. Over 45,000 PCC-SRs (67% of the total potential returns) and 9,000 other questionnaires were collected for this study (mean response rate of 49% per questionnaire). A full analysis of the response rates and other variables in relation to data validity and reliability can be found in the full report (17).

Preparation of the data for analysis

The large number of variables available meant that some consolidation was advisable prior to the analysis. Compound scores for the observability and physical environment quality, banned items, restriction on patients, etc., were therefore created. The separate scores produced by most of the questionnaires were also highly inter-correlated (r = 0.7 or greater), and where this was the case scores were combined prior to analysis by taking means at the ward level.

Conflict and containment event counts were standardised to wards of 20 beds (i.e. [count/bed numbers] x 20), so that variation due to the size of wards was removed. All continuous variables (conflict and containment rates, compound scores, questionnaire scores and other items) were converted to z scores prior to analysis to allow for appropriate comparisons of effect, as items were on very different scales.

Information was collected on 16,240 admissions, of which 4,112 had valid postcodes that could be matched to local area geographical data, allowing the calculation by ward of a mean Index of Multiple Deprivation (IMD) (18), and Social Fragmentation Score (SFS) (19;20). Descriptive data on all modelled variables is provided in Table 1, together with univariate associations with rates of self-harm incidents.

Analytic method

Multilevel random effects modelling was carried out using MLwiN 2.02 on total Bongar Lethality Scale score for the shift, which was dichotomised, into no incidents and incidents, due to distributional problems of the original score (very few incidents). The model was tested to ensure that a binomial distribution was appropriate and that there was no extra binomial variation that needed to be accounted

for. Random effects modelling allows for the fact that the wards were only a sample of all possible wards and similarly Trusts were only a sample from all possible Trusts. A three level model was explored with shifts at the lowest level (1), wards at level 2 and Trusts at level 3. That is shifts were nested within wards, which were nested within Trusts. Shifts were chosen as a level because of clustering effects within AM, PM and Night shifts; wards for similar reasons, and Trusts because they represent organisational units with single local policies and operational procedures. The penalised quasilikelihood method of estimation (PQL) was used with second order linearisation, since this method does not tend to underestimate variance (21).

The model was produced through a staged process of backward selection, deselecting the least significant at each stage, leaving only variables significant at $p \leq 0.05$. Each group of variables (domain) was used to build a separate initial model, then the significant variables were used to construct a final comprehensive model using the same process of backward selection. A small number of the study wards operated on a two 12 hour shift pattern, so a categorical variable indicating this was incorporated as a constant at every stage of the analysis, without being removed due to not being statistically significant. While there were significant associations between some of the independent variables in our study, sometimes to the extent of multicollinearity (see further below), there was no logical reason why any particular variables should be considered to be intervening, rather than potentially causal in their own right; nor is there any evidence in the existing research literature that this is the case (22). However it is possible that some variables might play that role, perhaps particularly conflict behaviours other than self-harm. We therefore present the results of the separate domain analyses, as well as the final complete models.

Following the construction of this overarching model, another model was constructed using the same methods, with more major self-harm (termed 'moderate', Bongar raw score of 2 or above) as the dichotomous dependent variable. Analyses using higher cut off points were not possible, due to the rarity of incidents at increasing levels of severity.

FINDINGS

The study wards

The 136 wards of the sample were situated within 67 hospitals within 26 NHS Trusts. The mean number of beds per ward was 21, with a range of 11 to 30, with an average of 51% of these beds in single rooms. Most wards (48%) were built in the 1980s and 1990s, with 17% in 2000 or later, 19% in the 1960s and 1970s, and only 16% prior to this. The mean number of nursing staff in post per bed was 0.99 WTE (s.d. 0.22); the mean proportion of these staff who were qualified nurses was 0.61 (s.d. 0.12), and the mean vacancy rate was high, at 15%. Male only and female only wards were in the minority (13% and 14% respectively), with most (73%) being for both genders. A significant proportion of wards (41%) had no establishment Occupational Therapists allocated to them, and the vast majority (87%) had no dedicated Clinical Psychologist time at all.

Multilevel models

There were 4,062 shifts during which a self harm incident occurred, representing 8.7% of the total. The vast majority of these (3,510, or 7.5% of all shifts) were minor, with Bongar scores of 0 or 1 (death impossible or very highly improbable).

Tables 2 and 3 depict the results of multilevel modelling with self-harm as the dependent variable. The first results column of each table shows the models resulting from within domains analyses (i.e. just the patient variables, or just the service environment variables), the second results column shows the final combined model, and the third the results of variance partitioning (using method D of Goldstein) (23), identifying at which level associations occur.

For all self-harm (Table 2, final combined model) the proportion of patients admitted with a diagnosis of schizophrenia was associated with decreases in rates along with IMD, intermittent observation and having qualified staff on duty. For qualified nursing staff, the main level of association was that of Trust, perhaps reflecting organisation-wide nurse staffing policies. It is interesting to note that the presence of student nurses in the all self-harm model shows the opposite pattern, with association with self-harm impacting at the shift level, perhaps indicating a more direct influence. For intermittent observation the association was at shift level, indicating a within shift correlation between greater intermittent observation and lower risk of a self-harm incident. Doors locked for less than 3 hours had no significant association but for any periods greater than this were associated with more self-harm, with the these associations being at both ward and shift level. Rates of use of Constant SO were not significantly associated with self-harm.

For moderate to serious self-harm (Table 3, final combined model), the variables that were associated with reduced moderate self-harm were having planned patient activities and intermittent observation, he latter again showing an association at the shift level. For all the other variables there was an increased significant chance of a moderate self-harm incident. The proportion of patients admitted of Caribbean ethnicity showed the greatest odds of a moderate self-harm incident.

In both models, throughput of patients shows associations at both Trust and shift levels. This indicates that not only were shifts in which an admission occurred at a higher risk of a self-harm incident, but that Trusts with high patient throughput also had higher risks. Associations at the Trust level are, however, difficult to interpret, as they may reflect the impacts of a numbers of overall policies in relation to practice, service structure, or resource allocation.

Multicollinearity

Several elements of the dataset were consolidated prior to analysis (ward observability, physical environment quality, banned items, restrictions, etc.) in order to provide for meaningful results, and to reduce the total number of variables to a manageable level. Where questionnaires producing more than one score were highly correlated with themselves (0.7 or larger) compound measures were created. Multicollinearity did not influence our resulting models, as all pairwise correlations were less than 0.4 (Belsey et al 1980), and the highest Variance Inflation Factor was 1.4 (Neter et al 1996).

Sensitivity analyses

Three analyses were conducted to assess the sensitivity of the above results to different ways of dealing with missing data. In the first of these exercises, the 10 lowest responding wards (returning less than 196 PCC-SRs) were excluded and the multilevel model of all self-harm conducted again. In the second exercise, the 10 wards that declined most sharply in their response rates over the course of the study (correlation response rate/week with time by week of less than – 0.67) were excluded and the modelling exercise conducted again. Finally, the effect of excluding admissions where 3 or more data items were missing (excluding postcodes) was assessed.

Excluding the 10 lowest responding wards had no effect on the domain models or the full model, producing an identical result. Excluding those wards with the steepest declines in response rates also had little effect, with some changes to the domain models, but the full model was only slightly different from that produced by including all the data, with the added inclusion of proportion of admissions considered to pose a risk of harm to others becoming significant, and aggression towards objects substituting for aggression to others. The use of a more conservative criterion for the inclusion of admission data impacted on findings related to ethnicity, as well as removing the variable 'admissions per day' from both the domain and full models. In relation to patient characteristics, this analysis lead to the substitution of 'proportion of patients Caribbean' with 'proportion of patients white'. However the proportion of patients white was highly correlated with the proportion of staff white ($r = 0.79$), introducing a problem with collinearity, and possibly indicating that staff and patient ethnicity may have interactive effects.

DISCUSSION

No relationship was found between constant SO and rates of self-harm. However intermittent observation was inversely correlated with self-harm rates. That inverse correlation persisted in the model of moderate to severe self-harm, and in all analyses assessing sensitivity to missing data. The absence of a positive correlation between self-harm and constant SO is surprising, as self-harm or suicide risk is the most commonly cited reason for its use (24). The relationship between constant SO and self-harm may be bi-directional, with self-harm leading to constant SO, and SO in turn reducing self-harm. Such bi-directional effects would obscure relationships in this cross sectional study.

Little has been written about the use of intermittent observation. One source (25) reports its successful use to reduce absconding rates, and another describes how constant SO can be reduced by instituting documented intermittent checks on all patients (26). In a study of student psychiatric nurses (27) an association is reported between approval of intermittent observation as a containment method, and positive attitudes to patients. However nurses interviewed in one study criticised it as being ineffective (6), and the National Confidential Inquiry into Homicides and Suicides has recommended that alternatives be developed (28). The findings of this study suggest that the use of intermittent observation may be an effective way to reduce self-harm. It ensures the regular presence of nurses all over the ward, and might provide opportunities for patient initiated interaction at moments of distress or dysphoria. It could be that there is some intervening variable accounting for this link, although a

wide range of potential candidate variables have been accounted for in our modelling exercise. As the study design is correlational, no firm causal conclusion can be drawn.

The findings do not support the idea that staff attitudes or group factors have any impact upon self-harm rates on acute wards. Previous evidence had suggested that positive attitudes towards patients and the provision of an effective structure of rules and routines acted to reduce self-harm and other patient conflict behaviours (29;30). In this study no relationship was found between staff attitudes and self-harm rates. The influence of staff functioning over rates of self-harm was supported by the finding that the availability of qualified nurses was associated with reduced self-harm rates (and the presence of student nurses or unqualified nurses with the reverse), but the variance partitioning exercise showed different levels of impact for different staffing variables, possibly indicating that other latent unmeasured variables may underlie these effects. The provision of patient activity sessions was strongly associated with lower levels of more severe self-harm, suggesting that an effective structure of routine for patients has a preventive effect.

The features of admissions that are associated with the rates of self-harm on wards include youth and non-schizophrenia diagnoses. This does not necessarily mean that it was the patients with these features, singularly or collectively, that self-harmed. It could equally well have been the impact of higher numbers of such patients on others and the ward atmosphere that triggered others to self-harm. Larger numbers of people without schizophrenia probably indicates higher numbers with affective disorders of various types, also with known associations with suicide and self-harm. The lack of an association of self-harm rates with numbers admitted for risk of harm to self is

initially curious. However 61% of all admissions were indicated as coming into hospital because of this risk, and it would appear that (a) the level of identified risk is so much higher than the frequency of the actual event that there is little association, and (b) staff also identified those who were a risk to themselves through cognitive disorganisation and self neglect, thus reducing the predictive value of this variable.

The association of high proportions of Caribbean admissions and rates of self-harm is interesting, especially given the strength of the association. However our sensitivity analysis around missing data on admissions indicates that some caution is called for with regard to the specific association with Caribbean ethnicity and self-harm, as this may simply represent a wider association between ethnic minority status and self-harm. In the univariate ward level analysis, higher proportions of admissions of all ethnic minority categories were associated with raised rates of self-harm. Further complications were the association between patient and staff ethnicity, and the geographically localised presence of ethnic minority communities. There is an association between higher numbers of ethnic minority staff/patients and more self-harm, however the precise nature of this link is difficult to determine from our data. This association has been found before in an ecological analysis of self-harm in the community, where raised rates were found amongst whites living in areas with high ethnic minority populations (31;32). This finding calls for more detailed research.

The Index of Multiple Deprivation for the localities from which patients were drawn was found to be inversely associated with self-harm, indicating that wards serving localities with lower levels of deprivation experience higher rates of self-harm. Previous research demonstrates positive associations between suicide and deprivation

(20;33;34) and between self-harm and deprivation (34;35). However all these studies are of community populations rather than patients admitted with a mental illness. One previous study in Denmark showed that for admitted patients, there was a direct positive relationship between income and suicide (36). The similar finding in this study may be due to service organisation factors, for example it is known that different districts vary tenfold in the numbers of people who are admitted to psychiatric care following a self-harm incident (37).

The volume of admissions to a ward, or its throughput, seems to have a negative impact, stimulating increased incidents of self-harm. This effect has been previously reported (38) in a longitudinal analysis of admissions and adverse incidents. Some of this impact is likely to be due to new admissions arriving on the ward in a highly disturbed and acutely ill condition, and self-harming within the same shift. An alternative or additional interpretation is that new admissions might make the ward less predictable for existing patients, heighten anxiety, and precipitate self-harm by others.

The associations found between self-harm and other conflict behaviours are not all easily explicable. The link with absconding might be indicative of patients leaving the ward and self-harming, and the link of more severe self-harm with aggression to objects might reflect the utilisation of objects in the act, for example a patient putting a fist through a window. The association with aggression to others may reflect a tie between inwardly and outwardly directed aggression by the same patients (39), or it may mean that aggressive behaviour within the ward heightens anxiety and other emotions within the ward community, stimulating self-harm. The link with aggression

to objects has been reported by others (38;40). The association with refusal to see workers may suggest that patients withdraw from interaction, activities and staff prior to self-harming.

In this correlational study, the direction of causality cannot be established. This applies to the locking of the ward door, which may have been a consequence or an antecedent of self-harm. If locking the ward door did lead to increases in self-harm, this appears to be limited to more minor self-harm, as the association was not present in the moderate self-harm model. Strikingly, many of the other common security practices of acute psychiatry, such as the banning of harmful items, searches of patient property, and restrictions on patient activities or access to kitchen or bathing facilities appeared to have no association with self-harm rates.

STRENGTHS AND LIMITATIONS

The basic design of multilevel modelling element of this study is correlational, therefore although associations between variables have been reported, the direction of causality cannot be concluded. However many potential additional underlying or intervening variables were incorporated in the analysis.

The large number of variables entered in the modelling exercise means that some reported associations may be due to chance. This weakness is counterbalanced by the overall size of the dataset collected. In addition, the random selection of wards strengthens the external validity of the findings, and the use of multilevel modelling provides more accurate estimates of effects than other methods.

The ideal form of data for this study would have been comprehensive data on patients admitted and occupying the study wards, including rigorous diagnostic information and past patient history, coupled with end of shift reports indicating which patients had engaged in which conflict behaviours, or been subject to which containment measures. However this was not practicable given the size of the study and other commitments of staff.

Despite the size of the dataset collected, there were few incidents of more severe self-harm. Moreover, even to conduct this subsidiary analysis, the criteria for more severe self-harm had to be set at an undesirably low level. As a consequence, the analysis conducted on this was less statistically powerful, and less specific. The failure of some variables to show an association might be due to that diminished power, rather than there being no connection with severe self-harm.

CONCLUSIONS

The multilevel models suggest that the use of intermittent observation may act to reduce rates of self-harm. A positive association was found between self-harm and locking of the ward door, however the direction of causality cannot be finally determined using this study design. The potential for positive effect on self-harm rates indicates the need for further research into the effects on patients and staff of door locking.

A large proportion of the variance between wards and Trusts in self-harm rates is accounted for by the types of patient admitted, the localities they serve, and the throughput of patients. Of these patient features, the most striking is ethnic minority status, an association not previously reported. The findings do not support a strong role for staff factors in the determination of self-harm rates on wards, and no association was found with leadership, team functioning, attitude to patients, burnout or ward atmosphere. However the presence of qualified nursing staff and the provision of patient activity sessions were both associated with lower rates of self-harm.

Wards and Trusts providing few planned patient activity sessions, or using low rates of intermittent observation, should reconsider both their policies and their provision of resources to wards so that these may be increased.

The current policy drift towards smaller bed numbers and greater patient throughput seems likely to lead to greater levels of self-harm on wards, and may need to be reconsidered. There is a known problem in the interaction between the psychiatric services and ethnic minority communities in the UK (Healthcare Commission 2007), and it is now clear that this extends to rates of self-harm. Further research in these areas is a priority.

4817 words

LB, RW, PN, TA and AS designed the overall study; SC designed the geographical aspects, KB designed ethnicity related aspects, and DP designed health economics

aspects of the study; TA conducted the statistical analysis in conjunction with LB; DH contributed the service user viewpoint; all contributed to the interpretation of findings and to the final manuscript.

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Table 1. Descriptive statistics of modelled variables, with univariate associations with self-harm rates *[The authors suggest that only significant associations are reported in the paper version, whilst the full table is made available in the online version]*

Variable	Source	Type	Mean or %	sd	Lowest	Highest	Univariate assoc. with self- r	p	Standardised to ward size	Level entered	Entered as z score
Patient Domain											
Proportion of admissions male	PCC-SR	Numeric	0.49	0.26	0.00	1.00	-0.152	0.078	No	Ward	Yes
Proportion of admissions with schizophrenia	PCC-SR	Numeric	0.32	0.15	0.05	0.81	-0.034	0.696	No	Ward	Yes
Proportion of admissions under 35	PCC-SR	Numeric	0.47	0.13	0.11	0.87	0.375	<0.001	No	Ward	Yes
Proportion of admissions detained under MHA	PCC-SR	Numeric	0.30	0.15	0.03	0.74	0.302	<0.001	No	Ward	Yes
Proportion of patients admitted for risk of harm to self	PCC-SR	Numeric	0.61	0.12	0.19	1.00	0.015	0.867	No	Ward	Yes
Proportion of patients admitted for risk of harm to others	PCC-SR	Numeric	0.32	0.15	0.06	0.75	0.354	<0.001	No	Ward	Yes
Proportion of admissions white	PCC-SR	Numeric	0.67	0.25	0.18	1.00	-0.581	<0.001	No	Ward	Yes
Proportion of admissions Irish	PCC-SR	Numeric	0.03	0.05	0.00	0.22	0.291	0.001	No	Ward	Yes
Porportion of admissions Caribbean	PCC-SR	Numeric	0.11	0.12	0.00	0.46	0.640	<0.001	No	Ward	Yes
Proportion of admissions African	PCC-SR	Numeric	0.05	0.07	0.00	0.31	0.411	<0.001	No	Ward	Yes
Proportion of admissions Asian	PCC-SR	Numeric	0.07	0.07	0.00	0.31	0.167	0.052	No	Ward	Yes
Proportion of admissions other ethnicity	PCC-SR	Numeric	0.05	0.06	0.00	0.33	0.273	0.001	No	Ward	Yes
Index of Multiple Deprivation	PCC-SR	Numeric	33.68	12.08	11.30	69.73	-0.012	0.888	No	Ward	Yes
Social Fragmentation Index	PCC-SR	Numeric	0.55	0.64	-0.51	2.45	0.200	0.020	No	Ward	Yes
Patient approval of containment	ACMQ	Numeric	35.33	2.69	25.40	42.33	-0.304	<0.001	No	Ward	Yes
Service environment domain											
Admissions during shift	PCC-SR	Numeric	0.35	0.65	0.00	3.00	0.109	<0.001	No	Shift	Yes
Rate of admissions per day	Ward Manager	Numeric	0.71	0.33	0.17	2.50	0.217	0.011	No	Ward	Yes
Ward served by crisis intervention team	Ward Manager	Categorical	65%				0.141	0.103	No	Ward	No
Ward served by home treatment team	Ward Manager	Categorical	52%				-0.134	0.119	No	Ward	No
Ward served by assertive outreach team	Ward Manager	Categorical	82%				-0.051	0.553	No	Ward	No
Ward served by early intervention team	Ward Manager	Categorical	45%				0.032	0.716	No	Ward	No
Number of beds (ward size)	Ward Manager	Numeric	21.05	3.79	11.00	30.00	-0.339	<0.001	No	Ward	Yes
Number of patients with LoS > 3 months	Ward Manager	Numeric	4.50	3.58	0.00	15.00	-0.144	0.095	No	Ward	Yes
Psychiatric Intensive Care Unit access	Ward Manager	Categorical	86%				0.035	0.686	No	Ward	No
Seclusion Room access	Ward Manager	Categorical	51%				-0.024	0.784	No	Ward	No

Physical environment domain											
Proportion of beds in single rooms	Researcher	Numeric	0.51	0.36	0.00	1.00	0.289	0.001	No	Ward	Yes
Windows in doors of single rooms (some or all)	Researcher	Categorical	91%				0.069	0.423	No	Ward	No
Index of Ward Observability	Researcher	Numeric	9.10	3.32	3.00	26.00	-0.112	0.193	No	Ward	Yes
Physical environment quality	Researcher	Numeric	35.64	3.80	25.00	44.00	-0.145	0.093	No	Ward	Yes
Patient routines domain											
Community meetings held regularly	Ward Manager	Categorical	87%				0.044	0.613	No	Ward	No
No. sesssions of planned patient activity/week	Ward Manager	Numeric	7.75	6.7	0	30	0.037	0.678	No	Ward	Yes
Conflict domain											
Verbal aggression	PCC-SR	Numeric	0.77	1.50	0.00	18.33	0.007	0.127	Yes	Shift	Yes
Physical aggression against objects	PCC-SR	Numeric	0.15	0.57	0.00	15.71	0.028	<0.001	Yes	Shift	Yes
Physical aggression against others	PCC-SR	Numeric	0.11	0.51	0.00	14.29	0.029	<0.001	Yes	Shift	Yes
Smoking in non smoking area	PCC-SR	Numeric	0.82	1.64	0.00	15.71	0.025	<0.001	Yes	Shift	Yes
Refusing to eat	PCC-SR	Numeric	0.29	0.58	0.00	10.48	-0.003	0.469	Yes	Shift	Yes
Refusing to drink	PCC-SR	Numeric	0.13	0.43	0.00	11.58	-0.006	0.181	Yes	Shift	Yes
Refusing to attend to personal hygiene	PCC-SR	Numeric	0.42	0.86	0.00	10.48	-0.004	0.334	Yes	Shift	Yes
Refusing to get out of bed	PCC-SR	Numeric	0.22	0.61	0.00	13.75	-0.010	0.038	Yes	Shift	Yes
Refusing to go to bed	PCC-SR	Numeric	0.15	0.52	0.00	11.00	0.010	0.030	Yes	Shift	Yes
Refusing to see workers	PCC-SR	Numeric	0.06	0.31	0.00	13.75	0.023	<0.001	Yes	Shift	Yes
Alcohol misuse (suspected or confirmed)	PCC-SR	Numeric	0.11	0.39	0.00	9.00	0.008	0.081	Yes	Shift	Yes
Substance misuse (suspected or confirmed)	PCC-SR	Numeric	0.10	0.40	0.00	9.57	0.002	0.686	Yes	Shift	Yes
Attempting to abscond	PCC-SR	Numeric	0.22	0.70	0.00	12.22	0.012	0.008	Yes	Shift	Yes
Absconding (missing without permission)	PCC-SR	Numeric	0.10	0.36	0.00	10.00	0.020	<0.001	Yes	Shift	Yes
Absconding (official report)	PCC-SR	Numeric	0.06	0.27	0.00	6.00	0.020	<0.001	Yes	Shift	Yes
Refused regular medication	PCC-SR	Numeric	0.29	0.56	0.00	13.75	0.003	0.532	Yes	Shift	Yes
Refused PRN medication	PCC-SR	Numeric	0.10	0.35	0.00	10.00	0.002	0.615	Yes	Shift	Yes
Demanding PRN medication	PCC-SR	Numeric	0.37	0.83	0.00	11.11	0.004	0.351	Yes	Shift	Yes

Containment domain											
Banned items	Ward Manager	Numeric	34.88	4.24	25.00	48.00	0.174	0.043	No	Ward	Yes
Searching intensity	Ward Manager	Numeric	15.21	1.93	11.00	22.00	0.203	0.018	No	Ward	Yes
Restrictions on patients	Ward Manager	Numeric	16.79	3.20	11.00	24.00	0.082	0.345	No	Ward	Yes
Drug/Alcohol sensitivity and monitoring	Ward Manager	Numeric	20.60	2.44	14.00	28.00	0.035	0.682	No	Ward	Yes
Door security	Ward Manager	Numeric	7.65	1.24	6.00	12.00	0.128	0.139	No	Ward	Yes
Alarms	Ward Manager	Numeric	11.54	1.54	8.00	14.00	0.162	0.059	No	Ward	Yes
Guards	Ward Manager	Numeric	2.49	0.64	2.00	4.00	-0.014	0.868	No	Ward	Yes
CCTV used on ward	Ward Manager	Categorical	15%				0.131	0.127	No	Ward	No
CCTV used on unit	Ward Manager	Categorical	29%				0.142	0.098	No	Ward	No
PRN medication	PCC-SR	Numeric	0.72	1.04	0.00	12.22	0.032	<0.001	Yes	Shift	Yes
IM medication (enforced)	PCC-SR	Numeric	0.05	0.22	0.00	4.29	0.017	<0.001	Yes	Shift	Yes
Sent to PICU or ICA	PCC-SR	Numeric	0.01	0.13	0.00	6.67	0.005	0.258	Yes	Shift	Yes
Seclusion	PCC-SR	Numeric	0.02	0.19	0.00	10.53	0.010	0.035	Yes	Shift	Yes
Special observation (intermittent)	PCC-SR	Numeric	1.70	2.40	0.00	13.75	-0.047	<0.001	Yes	Shift	Yes
Special observation (constant with engagement)	PCC-SR	Numeric	0.35	0.73	0.00	11.25	0.004	0.357	Yes	Shift	Yes
Special observation (constant without engagement)	PCC-SR	Numeric	0.09	0.51	0.00	15.71	-0.001	0.776	Yes	Shift	Yes
Show of force	PCC-SR	Numeric	0.09	0.44	0.00	12.22	0.018	<0.001	Yes	Shift	Yes
Manually restrained	PCC-SR	Numeric	0.06	0.32	0.00	13.75	0.023	<0.001	Yes	Shift	Yes
Time out	PCC-SR	Numeric	0.10	0.55	0.00	12.94	0.023	<0.001	Yes	Shift	Yes

Staff demographics domain											
Regular qualified nurses on duty	PCC-SR	Numeric	1.99	0.96	0.00	7.27	0.012	0.008	Yes	Shift	Yes
Regular unqualified nurses on duty	PCC-SR	Numeric	1.55	0.99	0.00	6.67	-0.026	<0.001	Yes	Shift	Yes
Bank/agency qualified nurses on duty	PCC-SR	Numeric	0.33	0.66	0.00	6.67	0.045	<0.001	Yes	Shift	Yes
Bank/agency unqualified nurses on duty	PCC-SR	Numeric	0.65	0.90	0.00	6.67	-0.013	0.007	Yes	Shift	Yes
Student nurses on duty	PCC-SR	Numeric	0.33	0.73	0.00	9.09	0.019	<0.001	Yes	Shift	Yes
Consultant Psychiatrists in post	Ward Manager	Numeric	3.40	1.94	0.00	11.00	-0.011	0.899	No	Ward	Yes
Other doctors in post	Ward Manager	Numeric	3.70	3.43	0.00	21.00	0.004	0.966	No	Ward	Yes
Occupational therapists in post	Ward Manager	Numeric	0.67	0.83	0.00	4.00	0.110	0.204	No	Ward	Yes
Clinical psychologists in post	Ward Manager	Numeric	0.13	0.38	0.00	2.00	0.200	0.020	No	Ward	Yes
Number of Cons. Psychiatrists locums	Ward Manager	Numeric	0.71	0.95	0.00	5.00	-0.235	0.006	No	Ward	Yes
Nursing vacancy rate	Ward Manager	Numeric	0.15	0.12	-0.28	0.48	0.098	0.255	No	Ward	Yes
Proportion staff male	MBI	Numeric	0.35	0.20	0.00	0.86	0.259	0.002	No	Ward	Yes
Proportion staff over 30 years of age	MBI	Numeric	0.76	0.16	0.22	1.00	0.165	0.055	No	Ward	Yes
Proportion of staff white	MBI	Numeric	0.63	0.35	0.00	1.00	-0.566	<0.001	No	Ward	Yes
Proportion of staff Irish	MBI	Numeric	0.03	0.06	0.00	0.29	0.109	0.208	No	Ward	Yes
Proportion of staff African	MBI	Numeric	0.18	0.24	0.00	1.00	0.476	<0.001	No	Ward	Yes
Proportion of staff Caribbean	MBI	Numeric	0.05	0.09	0.00	0.46	0.311	<0.001	No	Ward	Yes
Proportion of staff Asian	MBI	Numeric	0.03	0.08	0.00	0.57	0.222	0.009	No	Ward	Yes
Proportion of staff other ethnicity	MBI	Numeric	0.08	0.12	0.00	0.67	0.278	0.001	No	Ward	Yes
Staff group and attitude domain											
Mean Multifactor Leadership Questionnaire score	MLQ	Numeric	9.09	1.44	3.75	13.10	0.075	0.386	No	Ward	Yes
Mean Team Climate Inventory score	TCI	Numeric	3.58	0.37	2.62	4.73	0.175	0.042	No	Ward	Yes
Mean Ward Atmosphere Scale score (programme clarity and order and organisation)	WAS	Numeric	6.58	0.92	4.18	8.54	0.264	0.002	No	Ward	Yes
Ward Atmosphere Scale score (staff control)	WAS	Numeric	1.76	0.76	0.14	4.34	0.197	0.022	No	Ward	Yes
Attitude to Personality Disorder Scale (total score)	APDQ	Numeric	20.22	1.55	16.56	26.50	0.134	0.119	No	Ward	Yes
Mean Maslach Burnout Inventory Score (emotional exhaustion and depersonalisation)	MBI	Numeric	11.80	3.49	4.69	23.58	0.117	0.176	No	Ward	Yes
Maslach Burnout Inventory Score (personal accomplishment)	MBI	Numeric	35.77	3.06	28.09	45.14	0.166	0.054	No	Ward	Yes
Mean Attitude to Containment Measures Questionnaire	ACMQ	Numeric	39.51	1.82	34.80	43.73	-0.018	0.834	No	Ward	Yes

*Pearson correlation of standardised rate of self-harm with standardised variables where applicable

Table 2. Multilevel models for all self-harm

	Domain models				Final combined model				Level of effect		
	Odds	Lower 95% C.I.	Upper 95% C.I.	sig.	Odds	Lower 95% C.I.	Upper 95% C.I.	sig.	Trust	Ward	Shift
Patient											
Proportion schizophrenia*	0.793	0.679	0.926	<0.01	0.787	0.679	0.911	<0.01	x	x	
Proportion under 35*	1.292	1.109	1.505	<0.01	1.273	1.096	1.477	<0.01	x	x	
Proportion Caribbean*	1.701	1.445	2.001	<0.001	1.516	1.301	1.766	<0.001	x	x	
Index of Mulitple Deprivation*	0.773	0.654	0.913	<0.01	0.812	0.697	0.946	<0.01	x	x	
Service environment											
Admissions during shift	1.262	1.226	1.300	<0.001	1.257	1.219	1.297	<0.001			x
Admissions per day*	1.255	1.069	1.474	<0.01	1.198	1.039	1.383	<0.05	x	x	
Physical environment											
None											
Patient routines											
None											
Conflict											
Aggression to objects	1.034	1.002	1.066	<0.05							
Aggression to others	1.059	1.028	1.090	<0.001	1.041	1.009	1.074	<0.05			x
Refusing to drink	0.960	0.925	0.996	<0.05							
Refusing to go to bed	1.034	1.000	1.069	<0.05							
Refusing to see workers	1.040	1.012	1.069	<0.01	1.037	1.007	1.068	<0.05		x	
Attempting to abscond	1.043	1.009	1.078	<0.05							
Absconding officially reported	1.044	1.012	1.077	<0.01	1.054	1.022	1.088	<0.001			x
Containment											
door locked < 1 hr	1.270	0.982	1.642	ns	1.226	0.950	1.582	ns			
door locked 1-3 hrs	1.221	1.008	1.480	<0.05	1.196	0.991	1.444	ns			
Door locked more than three hours	1.514	1.178	1.946	<0.01	1.480	1.156	1.895	<0.01		x	x
Door locked full shift	1.240	1.102	1.395	<0.001	1.203	1.070	1.353	<0.01		x	x
PRN	1.108	1.070	1.148	<0.001	1.096	1.058	1.136	<0.001	x		x
Seclusion	1.030	1.001	1.061	<0.05							
Intermittent observation	0.807	0.763	0.855	<0.001	0.827	0.783	0.874	<0.001			x
Manual restraint	1.066	1.035	1.098	<0.001	1.045	1.013	1.078	<0.01	x		
Staff demographics											
Qualified nurses on duty	0.946	0.907	0.985	<0.01	0.941	0.901	0.982	<0.01	x		
Student nurses on duty	1.053	1.017	1.091	<0.01	1.050	1.012	1.090	<0.01			x
Proportion staff white*	0.687	0.550	0.859	<0.001							
Staff attitudes/group											
None											

*Variables entered at ward level, all other entered at shift level.

Table 3. Multilevel models of moderate self-harm

	Domain models				Final combined model				Level of effect		
	Odds	Lower 95% C.I.	Upper 95% C.I.	sig.	Odds	Lower 95% C.I.	Upper 95% C.I.	sig.	Trust	Ward	Shift
Patient											
Proportion Caribbean*	1.493	1.124	1.984	<0.01	1.477	1.125	1.940	<0.01	x	x	
Index of Multiple Deprivation*	0.694	0.508	0.947	<0.05							
Service environment											
Assertive outreach team*	0.479	0.235	0.976	<0.05							
Admissions during shift	1.105	1.014	1.205	<0.05	1.101	1.010	1.200	<0.05	x		x
Physical environment											
None											
Patient routines											
Patient activity sessions*	0.553	0.384	0.796	<0.001	0.537	0.382	0.755	<0.001	x	x	
Conflict											
Physical aggression against objects	1.120	1.066	1.176	<0.001	1.110	1.054	1.168	<0.001			x
Absconding (official report)	1.108	1.033	1.190	<0.01	1.124	1.050	1.204	<0.001	x		x
Demanding PRN medication	1.119	1.038	1.205	<0.01							
Containment											
Given PRN medication	1.259	1.166	1.359	<0.001	1.221	1.132	1.318	<0.001	x		x
Intermittent observation	0.830	0.727	0.949	<0.01	0.872	0.768	0.990	<0.05		x	x
Show of force	1.079	1.015	1.147	<0.05							
Manual restraint	1.062	1.003	1.124	<0.05	1.080	1.028	1.134	<0.01	x		
Staff demographics											
No. Consultant psychiatrists in post*	1.443	1.069	1.948	<0.05							
Proportion of staff white*	0.696	0.494	0.981	<0.05							
Staff attitudes/group											
None											

*Variables entered at ward level, all other entered at shift level.

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