A PRELIMINARY INVESTIGATION REGARDING VIOLENCE ON A YORKSHIRE HOSPITAL PSYCHIATRIC WARD

32102717

Summary

Violence is a common occurrence on psychiatric wards, and its incidence is on the rise [2;3]. We perform an initial analysis on data arising from an observational study in a Yorkshire hospital psychiatric ward, and return our findings on some questions of interest. We found strong evidence of a relationship between the number of Restraint and Control staff present on a ward, and the proportion of incidents that were 'Near Misses'. We also suggest possible relationships between the sex of a patient, and the frequency and type of incidents they may cause. We recommend that further statistical investigations be undertaken to discover the true nature of these relationships and others.

1. Introduction

Violence is commonly encountered when caring for the mentally ill [3]. It has a large effect on both the individuals involved, and the organisation of the facilities and services provided in special care psychiatric wards [3]. With the incidence of violence and agression reportedly on the increase [2;3], it is becoming ever more important to discover the associations and causes of these behaviours, in order to manage them more efficiently.

1.1. **The Yorkshire Hospital Study Data.** The data arose from a study conducted by a Yorkshire Hospital, and pertains to the occurrence of violent incidents on a special care psychiatric ward. Data was collected between January 2011 and June 2013, and incidents were grouped by month of occurrence. The ward had 12 beds and admitted around 80 patients per year. There were a total of 170 incidents over the period, with every month except June 2011, July 2011, and August 2011 having at least one incident occur. It is unclear whether the data for these months is missing, however we have chosen to treat them as true data points for reasons discussed in §3. Information on what variables were measured can be found in the Appendix, Table 5. We have been asked to investigate the following questions:

A) What were the trends in violence over time?
B) Did the incident mix change over time?
C) i) Is there a difference in the incidents pertaining to male and female perpetrators?
    ii) Were particular perpetrators responsible for large numbers of incidents?
D) i) Did the relative frequencies of victim grade change over time?
    ii) Were particular individuals attacked with disproportionate frequency?
E) What was the effect of the control and restraint training on the number and severity of the attacks?

1.2. **Preliminary Statistics.** Of the 170 incidents, 98 were committed by females and 72 were committed by males. We do not have any information on the ratio of male to female patients on the ward, except that there was high turnover. There were, however, only 38 individual perpetrators, 13 of which were female and 25 were male. Similarly, 83 of the victims were female, 58 were male, 23 were 'both' (denoting the Restraint and Control Team), and 6 were non-human victims. Again we do not have any information on the ratio of male to female non-patients, so can not infer reasons for why more women were attacked than men.

The incidents were divided into 4 categories; 'Near Miss', 'Assault', 'Serious Assault', and 'Life-threatening Assault' (defined in the Appendix, Table 6). 'Near Miss' constituted 73 of the 170 incidents, 50 were 'Assault' incidents, 42 were 'Serious Assault' incidents, and there were only 5 'Life-Threatening Assault' incidents. The majority of incidents, 64, involved Nurse Staff. In addition 27 involved Assistant Nurses, 23 involved the Restraint and Control Team, 23 involved another patient, and 33 more incidents involved other grades of victims. The number of staff trained in Restraint and Control of violent patients increased through time, initially starting at 5 for the first incident and reaching 23 for the final incident.

2. Results and analysis

2.1. **Trends in violence over time.** Considering each month as a separate time period leads to a large amount of variation in the number of incidents per time period, thus to identify trends in the data we group the time periods into quarters. In total the data spans 10 full quarters. The trends are demonstrated in Figure 1a, from which we can see a clear peak in Quarter 1 2012 (January to March 2012 inclusive), which interrupts a steadily declining pattern, followed by another peak in Quarter 1 2013.
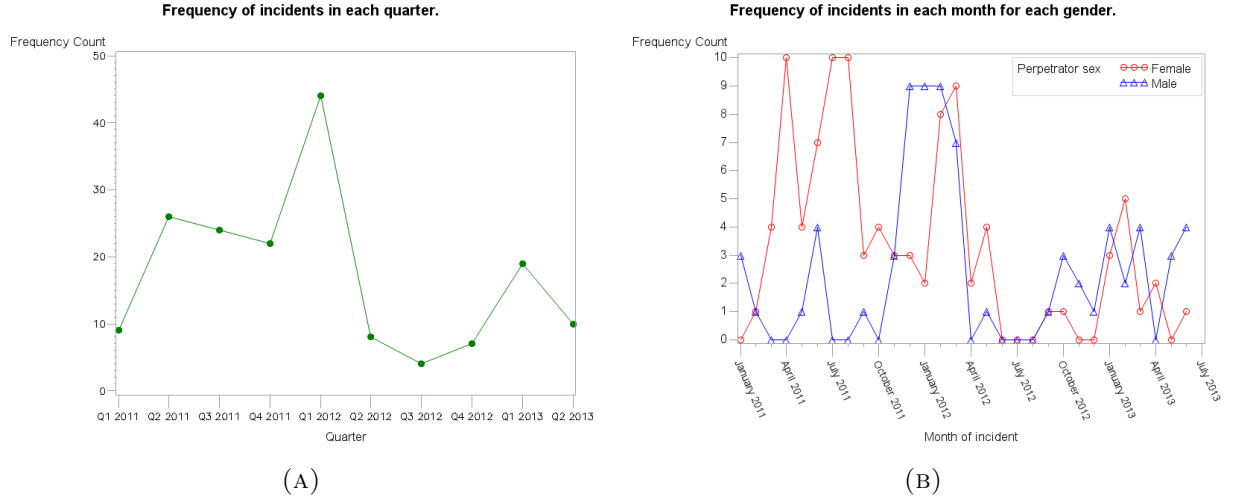

(A)

(B)

FIGURE 1. Plots showing the trends in incident count over time: (A) The frequency of incidents in each quarter during the study. (B) The frequency of incidents for each month during the study, split into two groups demonstrating the contribution of male and female perpetrators to the total incident count through time.

2.2. **Trends in incident mix.** By again grouping the data into quarter time periods, we can see from Figure 2a that there is a clear increasing trend in the proportion of incidents that are categorised as 'Near Miss'. The patterns for the other classification of incidents are less clear, though it could be said that the proportion of 'Serious Assault' incidents are reduced as time goes on. Since there are so few occurrences, it is difficult to comment on the 'Life-Threatening Assault' incidents, however we can note that they constituted a smaller proportion of incidents in the second half of the study than the first. It can also be noted that the majority of the 'Life-Threatening Assault' incidents occurred in the relative first quarter of each year.

2.3. **Differences between male and female perpetrators.** As detailed in §1.2 and Table 1 there were less female perpetrators than male, however, a larger proportion of the incidents were committed by females. We can see from Figure 1b that for almost the entire first year the number of incidents attributed to female perpetrators was far above those attributed to male perpetrators. During the period surrounding the end of first year, we can see there is a large drop the number of incidents attributed to female perpetrators and a severe spike in those attributed to male perpetrators. Following this spike, there is a complementary spike in the number of incidents attributed to female perpetrators at the beginning of the second year. After these spikes, the number of incidents by each sex decline rapidly, and then remain approximately the same for the remainder of the study, with the number of incidents attributed to male perpetrators being generally slightly higher.

While female perpetrators did have a mean number of incidents per perpetrator of 8, the distribution of incidents attributed to each perpetrator was highly skewed. The majority of female perpetrators had less than 5 incidents attributed to them, and over half of all female perpetrators had less than 2.
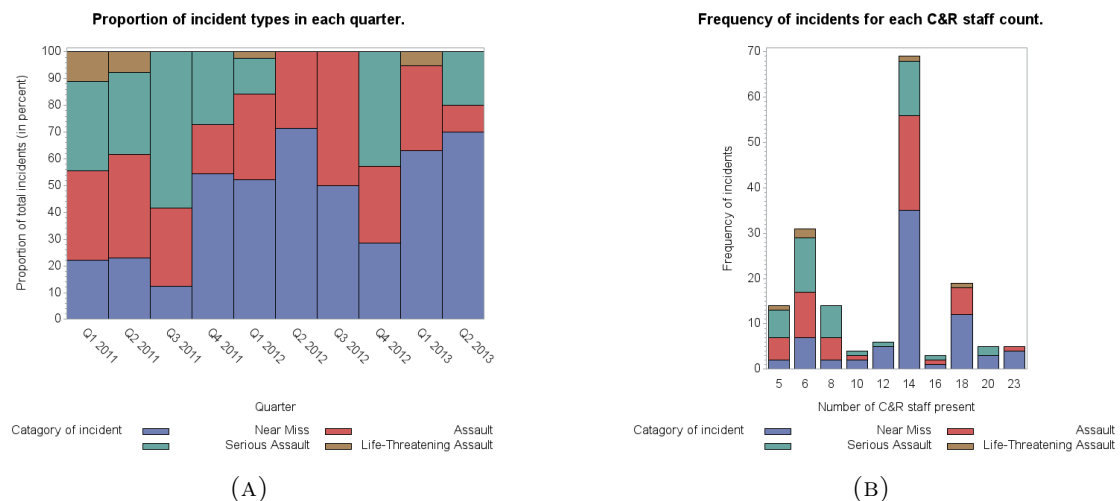
FIGURE 2. Bar plots showing the incident mix through time: (A) A bar plot showing the incident mix by proportion for each quarter. (B) A bar plot for each of the different observed counts of Restraint and Control staff present at each incident, showing the proportion of incident types in each category.

	Male	Female	Both
Number of incidents (Percentage of total)	72 (42%)	98 (58%)	170
Number of perpetrators (Percentage of total)	25 (66%)	13 (34%)	38
Mean number of incidents per perpetrator	~3	~8	~4

TABLE 1. A summary table for incidents and perpetrators by sex.

2.4. **Perpetrators of interest.** The details of the of the 8 perpetrators with the highest number of incidents attributed to them can be found in Table 2. We can see that 5 of the highest offending individuals were female, including the two highest offending individuals which had incident counts far above that of the third highest individual.

We can also look at those individuals who committed the most serious incidents. Table 3 details the individuals who committed 'Life-Threatening' offences, of which there were 5. We can see that all 5 of these individuals were male, and that all 5 committed their 'Life-Threatening' offence in the first half of their respective year, the majority being in the first quarter of their respective year. Except for the first individual, all the perpetrators had total incident counts ≤ 3. Perpetrator 15 is also present on Table 2 as one of the individuals responsible for a large number of incidents.

Perp. ID	Sex	No. of Incidents	First Incident	Last Incident	Categories of Incidents
7	Female	29	Jun. 2011	Mar. 2013	NM: 6, A: 12, SA: 11, LTA: 0
2	Female	26	Feb. 2011	Oct. 2011	NM: 9, A: 9, SA: 8, LTA: 0
14	Male	20	Dec. 2011	Feb. 2013	NM: 12, A: 5, SA: 3, LTA: 0
19	Female	17	Feb. 2012	Apr. 2012	NM: 12, A: 5, SA: 0, LTA: 0
15	Male	10	Dec. 2011	Feb. 2012	NM: 1, A: 2, SA: 6, LTA: 1
4	Female	8	Mar. 2011	Nov. 2011	NM: 1, A: 3, SA: 4, LTA: 0
9	Female	5	Aug. 2011	Aug. 2011	NM: 1, A: 0, SA: 4, LTA: 0
11	Male	5	Sep. 2011	May. 2011	NM: 3, A: 1, SA: 1, LTA: 0

TABLE 2. Details of the 8 perpetrators who had the highest number of incidents.

2.5. **Trends in victim grade over time.** There are some very clear trends that can be seen in Figure 3b, 3c, and 3d. The most obvious is the declining trend in the proportion of victims

Perp. ID	Sex	No. of Incidents	Date of LTA Incident	Categories of all incidents
15	Male	10	Jan. 2012	NM: 1, A: 2, SA: 6, LTA: 1
1	Male	3	Jan. 2011	NM: 1, A: 0, SA: 1, LTA: 1
33	Male	3	March. 2013	NM: 1, A: 1, SA: 0, LTA: 1
8	Male	2	Jun. 2011	NM: 1, A: 0, SA: 0, LTA: 1
5	Male	1	May. 2011	NM: 0, A: 0, SA: 0, LTA: 1

TABLE 3. Details of the 5 perpetrators who committed 'Life-Threatening' incidents.

who have the grade 'Staff Nurse' in each year. It drops from 48% in the first year to 17% in the third year. This is complemented by an increasing trend in the proportion of victims that have the grade 'Restraint and Control Team', which increases from a negligible percentage in the first year, to 34% in the third year. There is also a declining trend in the number of victims who have the grade 'Assistant Nurse', but the victim grade 'Patient' makes up a much larger proportion of victims in the second and third year than in the first.
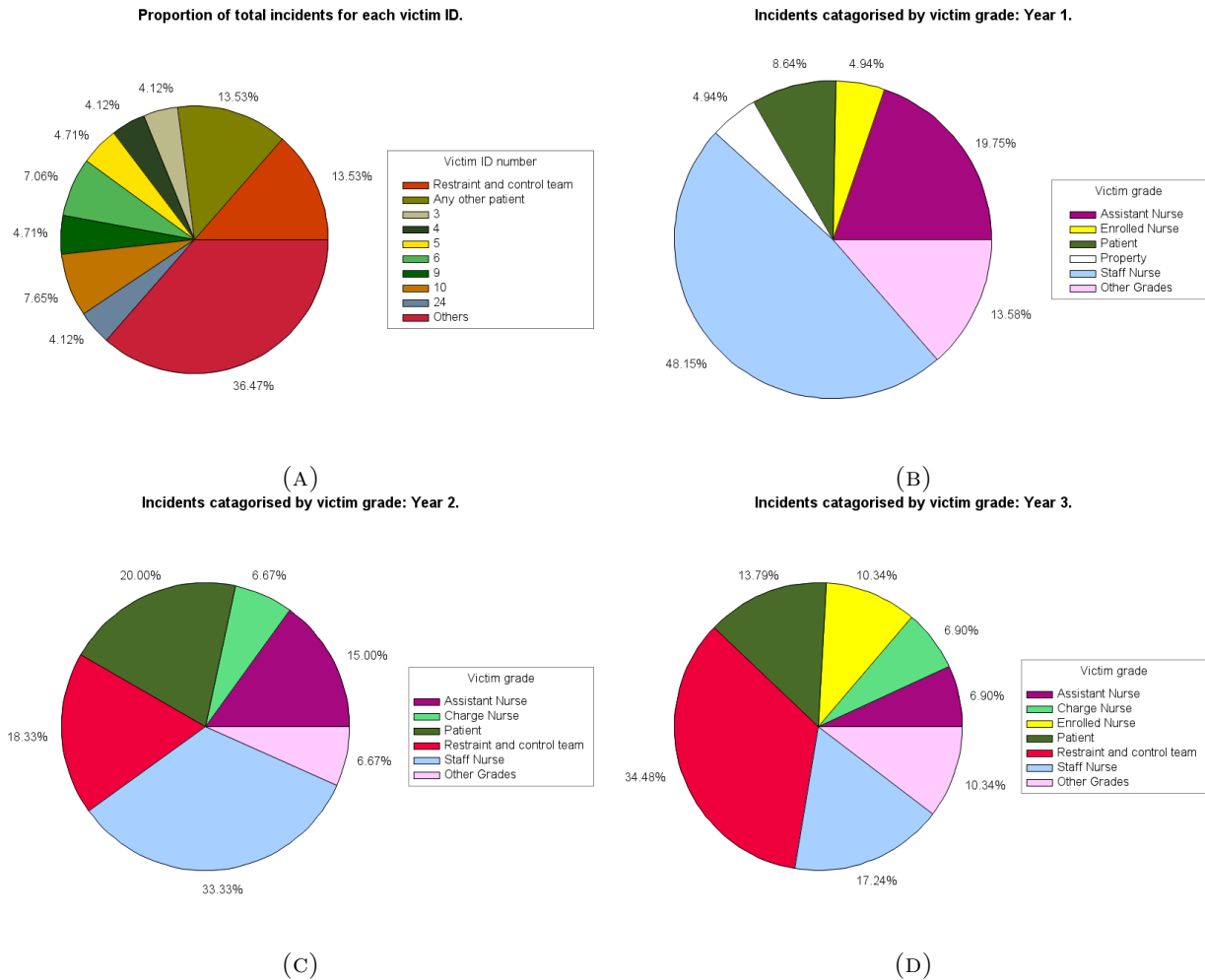

(A)

(B)

(C)

(D)

FIGURE 3. Pie charts demonstrating the proportions of incidents for different groups. Details of each 'Other' segment can be found in the Appendix, Table 7. (A) The proportion of total incidents that are associated with each Victim ID. (B) The proportion of total incidents in the first year that are associated with each Victim Grade. (C) The proportion of total incidents in the second year that are associated with each Victim Grade. (D) The proportion of total incidents in the third year that are associated with each Victim Grade.

2.6. **Individuals of interest.** The 'Restraint and Control team' and 'other patients' were victims in approximately 27% of the total incidents (13.5% each), as detailed in Figure 3a. However these victim IDs are a actually general IDs given to many individuals, if we concentrate only on individual people, we can see from Table 4 that the majority of the individual victims have the grade 'Staff Nurse'. Three of these individual victims were also the victims of 'Life-Threatening Assault' incidents.

Victim ID	Sex	No. of Incidents	Victim Grade	Categories of all incidents
10	Female	13	Staff Nurse	NM: 0, A: 5, SA: 7, LTA: 1
6	Female	12	Staff Nurse	NM: 4, A: 4, SA: 4, LTA: 0
5	Male	8	Staff Nurse	NM: 6, A: 1, SA: 0, LTA: 1
9	Female	8	Assistant Nurse	NM: 2, A: 1, SA: 5, LTA: 0
3	Male	7	Staff Nurse	NM: 1, A: 4, SA: 1, LTA: 1
4	Female	7	Staff Nurse	NM: 1, A: 2, SA: 4, LTA: 0
24	Male	7	Charge Nurse	NM: 5, A: 1, SA: 1, LTA: 0

TABLE 4. Details of the 7 victims who had the highest number of incidents.

2.7. **Effect of Restraint and Control training.** The Restraint and Control team are supposed to intervene with an incident to stop a 'Near Miss' becoming a 'Assault'. Thus to judge whether or not the training had an effect on the severity of attacks we can consider if the proportion of incidents that were 'Near Misses' in each time period increased as time went on. This was already discussed in §2.5, and demonstrated in Figure 2a.

We can judge the effect of training on the number of incidents by simply looking at the number of incidents over time, this again was done in §2.1 and Figure 1a. We can see that, generally, the initial training during the first year, was associated with an increasing trend in the number of incidents, after this in the second year there was a generally decreasing trend. The trend in the third year is less clear, especially since data was only collected for the first half of the year, however, we can say that the incident count remains relatively low. The number of trained Restraint and Control staff increased throughout the whole period.

We could also consider how the number of trained Restraint and Control staff present at each incident effects the number and severity of incidents. This is demonstrated in Figure 2b where we can see that higher numbers of R&C staff lead to a higher proportion of incidents being 'Near Misses', and that apart from the two outliers, having more R&C staff present is generally associated with lower incident counts.

3. DISCUSSION

It is clear from §2.1 and Figures 1a and 1b that the number of violent incidents in the second half of the study was far lower than the first. It is not generally possible to say whether the whole period had one trend, as it appears to have a cyclical pattern. The severe increase and subsequent decline surrounding the first quarter of 2012 suggest some sort of event or temporary change. It may be useful to to learn more about what happened in this period, to try to explain this phenomenon. A similar phenomenon occurred in the first quarter of 2013, though to a lesser extent. They're may be similarities in these periods, that the other periods do not share, that lead to these spikes. To be able to suggest more definitive reasons for these events, we would require more information. The lower incident count in the second half of the study could be attributed to the increase in the number of Restraint and Control staff, but it is difficult to make conclusions with such limited information. The two peaks discussed also complicate the decision. We do, however, believe that the increase in Restraint and Control staff could be the cause of the later lower incident counts, and would suggest using formal statistical tests to investigate these relationships.

We have chosen to treat the three months that did not have any incidents as true data because of the trends surrounding them. There is a clear, sharp, declining trend just before the period, and a slow increasing trend after. Its presence is not a juxtaposition in the data.

The incident mix clearly changed over time, which is demonstrated by Figure 2. It is clear that the proportion of 'Near Miss' incidents increased over time. It would make sense that this was caused by an increase in the number of Restraint and Control staff, as they're job is to stop incidents escalating beyond the 'Near Miss' category. We can also see from Figure 2b that the proportion of incidents that are categorised as 'Near Miss' increase with the number of C&R staff present at each incident. This provides strong evidence for a causal relationship between the two. This relationship should definitely be investigated using formal statistical tests.

In §2.3 we show that there is a clear difference between male and female perpetrators. Females were less likely to be involved in an incident than males, but the females involved in incidents caused a larger number of incidents than males. Male perpetrators, however, are more likely to commit more violent acts, with all 5 of the 'Life-Threatening Assault' incidents during the period being caused by male perpetrators. We also outlined the perpetrators responsible for the most incidents and those responsible for the most serious incidents. For the most part, those who committed the most serious offences did not commit many other offences, and those who committed an extremely large number of offences never went so far as to commit a 'Life-Threatening Assault'. This could suggest different profiles for these different types of offenders, and with more information it may be possible to predict the type of offender (if any) that a patient may be. Some of these perpetrators were outliers, however, they may have some common features or covariates that would explain why they made such a severe departure from the majority of offenders.

As stated in §2.5, there are clear changes in the relative frequencies of victim grade over time. The increase in the proportion of victims that are on the 'Restraint and Control team' is a good indication that the training is effectively allowing the trained personnel to intervene with incidents. The reduction in 'Staff Nurse' victims could simply be due to their grade changing to 'Restraint and Control team' as more nurses received C&R training, similarly with 'Assistant Nurse'. The increase in the proportion of incidents where other patients were the victims is more difficult to explain however, and it unclear whether it is related to more nursing staff being trained in Restraint and Control. There were some individuals that were attacked disproportionately, as detailed in Table 4. We would recommend collecting more information of these individuals, to try and discover whether they have certain common covariates that could signpost them.

3.1. **Recommendations.** The investigation we have performed shows promise for the existance of certain relationships, such as those between Restraint and Control training and a reduction in the severity or frequency of incidents. As suggested, these relationship can be investigated using formal statistical tests, such as ANOVA. If these relationships are found to exist, further investigation and a larger, more thorough observational study should follow. Additional information should be collected on the incidents, the backgrounds of the perpetrators and victims, and any information that could help explain the spikes in the number of incidents. Using the data collected in this study, it may be possible to fit simple models, such as a generalised linear model, for response variables such as "Probability that a patient will commit a 'Life-Threatening' offence" or "The predicted number of incidents in a given month". These models could take advantage of the data collected on the time of each incident, the severity of each incident, the sex of the perpetrator and the victim, the number of incidents caused by the perpetrator already, and more. There is a strong chance, however, that there will be a lot of unexplained variance between individuals (or time periods) if only the covariates measured in this study are used. For instance, there have been relatioships found between violence in patients and their age[3], whether they admitted voluntarily[1;3], previous episodes and longer periods of hospitalisation[1]. It has also been found that the risk of violence decreased with younger staff[4]. If the goal of the reader is to create a predictive model, we would suggest that further studies be undertaken.

References

[1] Cesare Maria Cornaggia, Massimiliano Beghi, Fabrizio Pavone, and Francesco Barale. Aggression in psychiatry wards: A systematic review. *Psychiatry Research*, 189(1):10 – 20, 2011.

[2] Joy Duxbury and Richard Whittington. Causes and management of patient aggression and violence: staff and patient perspectives. *Journal of Advanced Nursing*, 50(5):469–478, 2005.

[3] D V James, N A Fineberg, A K Shah, and R G Priest. An increase in violence on an acute psychiatric ward. a study of associated factors. *The British Journal of Psychiatry*, 156(6):846–852, 1990.

[4] Cathy Owen. Violence and aggression in psychiatric units. *Psychiatric Services*, 49(11):1452–1457, 1998. PMID: 9826247.

4. Appendix

Variable	Description
Incident number	The incident number. They were consecutive incidents over time.
Month of incident	The month in which the incident took place.
Category of incident	'Near Miss', 'Assault', 'Serious Assault', 'Life-threatening Assault'.
Incident Score	'Near Miss' = 2, 'Assault' = 5, 'Serious Assault' = 10, and 'Life-threatening Assault' = 20.
Perpetrator ID	Each perpetrator was given a separate identity number.
Sex of Perpetrator	Male or Female.
Perpetrator: incident number	The number given to each incident by a perpetrator.
Perpetrator: last incident?	Indicator variable for the last incident by a perpetrator.
Victim ID	ID of victim. Some IDs were personal and some were generic.
Sex of Victim	Male, Female, Both (R&C team), None (property).
Victim: incident number	The number given to each incident on each victim.
Victim: last incident?	Indicator variable for the last incident on a victim.
Victim Grade	Victim grade.
R&C staff present	The number of staff on the ward who had been trained in the control and restraint of violent patients.

TABLE 5. Details of the variables measured during the study.

Incident Category	Description
Near Miss	Patient made an attempt to be physically violent but no-one was hurt because, for example, they were restrained by nurses in the approved fashion or whatever they were throwing missed its intended victim or because property not people was attacked.
Assault	Patient struck another person but without leaving bruises, inflammation, etc. It excludes blows to the head area and use of a weapon.
Serious Assault	Patient struck another person on head, or left bruises or other injury. Some assaults with weapons would come under this but not many. An example would be throwing a cup of tea.
Life-Threatening Assault	Use of most weapons, strangulation attempts, breaking bones, etc.

TABLE 6. Details of the types of incident defined in the study.

Figure	Description of 'Other' segment
3a	Victim IDs: 7, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 27, 28, 29, 30, 32.
3b	Victim Grades: 'Charge Nurse', 'Consultant', 'Domestic Staff', 'Nursing Staff', 'Restraint and Control Staff'.
3c	Victim Grades: 'Domestic Staff', 'Enrolled Nurse', 'Property'.
3d	Victim Grades: 'Domestic Staff', 'Locum Nurse', 'Property'.

TABLE 7. Details of the contents of the 'other' segments in Figure 3.

```
1
2  OPTIONS LS = 72 PS = 30;
3
4  LIBNAME Project 'H:\MATH550SAS\Project\';
5  OPTIONS FMTSEARCH =(WORK Project library);
6
7
8
9  /****************** DATA ENTRY ******************/
10
11 PROC FORMAT LIBRARY = PROJECT;
12 VALUE Monthfmt
13         1 = 'January 2011'
14         2 = 'February 2011'
15         3 = 'March 2011'
16         4 = 'April 2011'
17         5 = 'May 2011'
18         6 = 'June 2011'
19         7 = 'July 2011'
20         8 = 'August 2011'
21         9 = 'September 2011'
22        10 = 'October 2011'
23        11 = 'November 2011'
24        12 = 'December 2011'
25        13 = 'January 2012'
26        14 = 'February 2012'
27        15 = 'March 2012'
28        16 = 'April 2012'
29        17 = 'May 2012'
30        18 = 'June 2012'
31        19 = 'July 2012'
32        20 = 'August 2012'
33        21 = 'September 2012'
34        22 = 'October 2012'
35        23 = 'November 2012'
36        24 = 'December 2012'
37        25 = 'January 2013'
38        26 = 'February 2013'
39        27 = 'March 2013'
40        28 = 'April 2013'
41        29 = 'May 2013'
42        30 = 'June 2013'
43        31 = 'July 2013';
44
45 VALUE Incident_typefmt
46             1 = 'Near Miss'
47             2 = 'Assault'
48             3 = 'Serious Assault'
```

```
49                4 = 'Life−Threatening  Assault';
50
51 VALUE $Perp_Sexfmt
52           'M' = 'Male'
53           'F' = 'Female';
54
55 VALUE Last_attack_perpfmt
56              0 = 'Not  the  last  incident'
57              1 = 'Last  incident';
58
59 VALUE Victim_IDfmt
60          1 = 'Restraint  and  control  team'
61          2 = 'Any  other  patient'
62          7 = 'Property  only'
63          12 = 'Any  member  of  the  domestic  staff'
64          22 = 'Consultant'
65          32 = 'Occupational  therapist'
66          33 = 'Visitor';
67
68 VALUE $Victim_Sexfmt
69           'M' = 'Male'
70           'F' = 'Female'
71           'B' = 'Both (for  the  restraint  and  control  team)'
72           'N' = 'None (for  property)';
73
74 VALUE Last_attack_vicfmt
75              0 = 'Not  the  last  incident'
76              1 = 'Last  incident';
77
78 VALUE $Victim_grade
79           'SN' = 'Staff  Nurse'
80           'EN' = 'Enrolled  Nurse'
81           'CN' = 'Charge  Nurse'
82           'NO' = 'Nursing  Officer'
83           'NA' = 'Assistant  Nurse'
84           'SR' = 'Locum  Nurse (no  psychiatric  training)'
85           'OT' = 'Occupational  Therapist'
86           'CR' = 'Restraint  and  control  team'
87           'CS' = 'Consultant'
88           'DM' = 'Domestic  Staff'
89           'VS' = 'Visitor'
90           'PT' = 'Patient'
91           'PR' = 'Property';
92
93
94 VALUE Monthincfmt
95          1 = 'January'
96          2 = 'February'
97          3 = 'March'
98          4 = 'April'
99          5 = 'May'
100         6 = 'June'
101         7 = 'July'
102         8 = 'August'
103         9 = 'September'
104         10 = 'October'
105         11 = 'November'
106         12 = 'December';
```

```
107
108  VALUE Quarterfmt
109          1 = 'Q1 2011'
110          2 = 'Q2 2011'
111          3 = 'Q3 2011'
112          4 = 'Q4 2011'
113          5 = 'Q1 2012'
114          6 = 'Q2 2012'
115          7 = 'Q3 2012'
116          8 = 'Q4 2012'
117          9 = 'Q1 2013'
118         10 = 'Q2 2013';
119
120  RUN;
121
122
123
124  DATA Project.data;
125  INFILE 'H:\MATH550SAS\Project\violence.dat' TRUNCOVER;
126  INPUT Incident_ID Month_of_attack Type_of_attack Score_of_attack
127      Perp_ID Perp_Sex $ Perp_attack_num Perp_last_attack
128      Vic_ID Vic_Sex $ Vic_attack_num Vic_last_attack Vic_grade$ CR_staff_present;
129  RUN;
130
131
132  DATA Project.Dates;
133  INPUT Month_of_attack Month Year Quarter;
134  CARDS;
135  1  1  2011  1
136  2  2  2011  1
137  3  3  2011  1
138  4  4  2011  2
139  5  5  2011  2
140  6  6  2011  2
141  7  7  2011  3
142  8  8  2011  3
143  9  9  2011  3
144  10  10  2011  4
145  11  11  2011  4
146  12  12  2011  4
147  13  1  2012  5
148  14  2  2012  5
149  15  3  2012  5
150  16  4  2012  6
151  17  5  2012  6
152  18  6  2012  6
153  19  7  2012  7
154  20  8  2012  7
155  21  9  2012  7
156  22  10  2012  8
157  23  11  2012  8
158  24  12  2012  8
159  25  1  2013  9
160  26  2  2013  9
161  27  3  2013  9
162  28  4  2013  10
163  29  5  2013  10
164  30  6  2013  10
```

```
165 31 7 2013 11
166 ;
167 RUN;
168
169
170
171 PROC SORT DATA = Project.Data;
172 BY Month_of_attack;
173 RUN;
174
175 PROC SORT DATA = Project.Dates;
176 BY Month_of_attack;
177 RUN;
178
179 DATA Project.Data1;
180 MERGE Project.Data Project.Dates;
181 BY Month_of_attack;
182 RUN;
183
184
185
186 DATA Project.Datafmt;
187 SET Project.Data1;
188 LABEL Incident_ID = 'Incident ID number'
189     Month_of_attack = 'Month of incident'
190     Type_of_attack = 'Catagory of incident'
191     Score_of_attack = 'Score given to incident'
192     Perp_ID = 'Perpetrator ID number'
193     Perp_Sex = 'Perpetrator sex'
194     Perp_attack_num = 'Perpetrator incident number'
195     Perp_last_attack = 'Perpetrators last incident?'
196     Vic_ID = 'Victim ID number'
197     Vic_Sex = 'Victim sex'
198     Vic_attack_num = 'Victim incident number'
199     Vic_last_attack = 'Victims last incident?'
200     Vic_grade = 'Victim grade'
201     CR_staff_present = 'Number of C&R staff present'
202     Month = 'Month of incident'
203     Year = 'Year of incident';
204 FORMAT Month_of_attack Monthfmt. Type_of_attack Incident_typefmt. Perp_Sex $Perp_
        Sexfmt. Perp_last_attack Last_attack_perpfmt.
205     Vic_ID Victim_IDfmt. Vic_Sex $Victim_Sexfmt. Vic_last_attack Last_attack_
        vicfmt.
206     Vic_grade $Victim_grade. Month Monthincfmt. Quarter Quarterfmt.;
207 RUN;
208
209
210
211
212 /****************** Summary Tables ******************/
213
214 /* An example */
215
216 PROC TABULATE DATA = project.datafmt;
217 CLASS Perp_sex Vic_sex type_of_attack PERP_ID Vic_ID Month_of_attack Vic_grade CR
        _staff_present;
218 Table Vic_ID*type_of_attack;
219 RUN;
```

```
220
221
222
223  /****************** Plots for time ******************/
224
225
226  PROC FREQ DATA = Project.Datafmt;
227  TITLE 'Simple Frequency Table for Time';
228  TABLES Quarter/ SPARSE OUT = Project.QuarterFreq;
229  RUN;
230
231  SYMBOL1 VALUE = dot COLOR = green height = 1.5 INTERPOL = join;
232
233  AXIS1 MAJOR = (height = 1.5)
234      MINOR = None
235      VALUE = (FONT = simplex Height =1.3);
236
237  AXIS2 MAJOR = (height = 1.5)
238      VALUE = (FONT = simplex Height =1.3);
239
240
241  PROC GPLOT DATA = Project.QuarterFreq;
242  TITLE 'Frequency of incidents in each quarter.';
243  PLOT COUNT*Quarter / HAXIS = AXIS1 VAXIS = AXIS2;
244  RUN;
245  QUIT;
246
247
248
249  /****************** Plots for time by sex ******************/
250
251
252  PROC FREQ DATA = Project.Datafmt;
253  TITLE 'Simple Frequency Table for time by sex';
254  TABLES Month_of_attack*Perp_sex/ SPARSE OUT = Project.TimePerpSexFreq;
255  RUN;
256
257  DATA project.TimePerpSexFreq garbage;
258  SET project.TimePerpSexFreq;
259  IF Perp_sex = ' ' THEN OUTPUT garbage;
260  ELSE OUTPUT project.TimePerpSexFreq;
261  RUN;
262
263  DATA project.TimePerpSexFreq1;
264  SET project.TimePerpSexFreq;
265  IF Month_of_attack = 31 THEN do; count = ' '; end;
266  RUN;
267
268  GOPTIONS reset = all;
269  SYMBOL1 VALUE = circle COLOR = red height = 1.5 INTERPOL = join;
270  SYMBOL2 VALUE = triangle COLOR = blue height = 1.5 INTERPOL = join;
271
272  LEGEND1 ACROSS = 1
273      POSITION = (RIGHT INSIDE TOP)
274      SHAPE = SYMBOL(5,1.5)
275      MODE = SHARE
276      FRAME;
277
```

```
278  AXIS1 ORDER = (1 to 31 by 3)
279      MAJOR = (height = 1.5)
280      MINOR = (Number = 2)
281      value=(angle=-65 h=1.3)
282  ;
283
284  AXIS2 MAJOR = (height = 1.5)
285      MINOR = none
286      value =(h=1.5)
287  ;
288
289  PROC GPLOT DATA = Project.TimePerpSexFreq1;
290  TITLE 'Frequency of incidents in each month for each gender.';
291  PLOT COUNT*Month_of_attack = Perp_sex/ SKIPMISS HAXIS = AXIS1 VAXIS = AXIS2
         LEGEND = LEGEND1;
292  RUN;
293  QUIT;
294
295
296
297  /****************** Plots for attack categories over time ******************/
298
299
300
301  PROC FREQ DATA = Project.Datafmt;
302  TITLE 'Simple Frequency Table for type of incident by quarter';
303  TABLES Quarter*Type_of_attack/ SPARSE OUTPCT OUT = Project.QuarterCatagoryFreq;
304  RUN;
305
306  DATA Project.QuarterCatagoryFreq garbage;
307  SET Project.QuarterCatagoryFreq;
308  IF Type_of_attack = '.' THEN OUTPUT garbage;
309  ELSE OUTPUT Project.QuarterCatagoryFreq;
310  RUN;
311
312  GOPTIONS RESET = ALL HTITLE = 1.8 HTEXT = 1.5;
313
314  AXIS1 value=(angle = -45 height = 1.5);
315  AXIS2 label = (angle = 90 'Proportion of total incidents (in percent)') value=(
         height = 1.5);
316
317  PROC GCHART DATA = Project.QuarterCatagoryFreq;
318  TITLE 'Proportion of incident types in each quarter.';
319  VBAR Quarter /
320  SUMVAR = PCT_ROW
321  DISCRETE
322  SPACE =0
323  SUBGROUP = Type_of_attack
324  PATTERNID = SUBGROUP
325  WIDTH = 8
326  MAXIS = AXIS1
327  RAXIS = AXIS2;
328  RUN;
329
330
331  /****************** Pie charts for individual ID proportions ******************
         /
332
```

```sas
333
334 goptions reset=all border
335         HTITLE = 1.8 HTEXT = 1.5
336         colors=(CXCF3D00 CX808000 CXBCBA8B CX2C4321
337                 CXFFE300 CX50B454 CXA6242F CX69839C
338                 CX005F00 CXC17500 CX506686 CXDFE0D7
339                 CX676667 CXCBD5E8 CXC72037 CXFFCF00);
340
341
342 title1 "Proportion of total incidents for each victim ID";
343
344 legend1 across=1 cborder=CX676667
345        label=(justify=center position=(top center) "Victim ID number")
346        position=(middle right) value=(justify=left);
347
348 proc gchart data=PROJECT.DATAFMT;
349 TITLE 'Proportion of total incidents for each victim ID.';
350    pie VIC_ID /
351        type=PERCENT   discrete angle=0 value=outside slice=none
352        fill=solid    otherlabel="Others"
353        noheading legend=legend1 ;
354 run;
355 quit;
356
357
358
359 /****************** Plots for attack categories over time ******************/
360
361
362 GOPTIONS RESET = ALL HTITLE = 1.8 HTEXT = 1.5;
363
364 legend1 across=1 cborder=CX808080
365        label=(justify=center position=(top center) "Victim grade")
366        position=(middle right) value=(justify=left);
367
368 Data project.datafmty1 project.datafmty2 project.datafmty3;
369 SET project.datafmt;
370 IF Year = 2011 THEN OUTPUT project.datafmty1;
371 ELSE IF Year = 2012 THEN OUTPUT project.datafmty2;
372 ELSE OUTPUT project.datafmty3;
373 RUN;
374
375 PATTERN1 color = CXA6087F;
376 PATTERN2 color = CX5FDF83;
377 PATTERN3 color = CXF2DA99;
378 PATTERN4 color = CX455E99;
379 PATTERN5 color = CXFFFF00;
380 PATTERN6 color = CXFFCBFF;
381 PATTERN7 color = CX486C28;
382 PATTERN8 color = CXFFFFFF;
383 PATTERN9 color = CXED003B;
384 PATTERN10 color = CXA7CFFF;
385
386
387 PROC GCHART DATA = Project.datafmty1;
388 TITLE 'Incidents catagorised by victim grade: Year 1.';
389 PIE Vic_grade /
390 TYPE = PERCENT
```

```
391  ANGLE = 0
392  VALUE = OUTSIDE
393  SLICE = NONE
394  noheading
395  fill= solid
396  otherlabel="Other Grades"
397  othercolor = CXFFCBFF
398  legend = legend1;
399  RUN;
400  Quit;
401
402
403  PATTERN1 color = CXA6087F;
404  PATTERN2 color = CX5FDF83;
405  PATTERN3 color = CX455E99;
406  PATTERN4 color = CXFFFF00;
407  PATTERN5 color = CX486C28;
408  PATTERN6 color = CXFFFFFF;
409  PATTERN7 color = CXED003B;
410  PATTERN8 color = CXA7CFFF;
411
412  PROC GCHART DATA = Project.datafmty2;
413  TITLE 'Incidents catagorised by victim grade: Year 2.';
414  PIE Vic_grade /
415  TYPE = PERCENT
416  ANGLE = 0
417  VALUE = OUTSIDE
418  SLICE = NONE
419  noheading
420  fill= solid
421  otherlabel="Other Grades"
422  othercolor = CXFFCBFF
423  legend = legend1;
424  RUN;
425  Quit;
426
427
428
429  PATTERN1 color = CXA6087F;
430  PATTERN2 color = CX5FDF83;
431  PATTERN3 color = CX455E99;
432  PATTERN4 color = CXFFFF00;
433  PATTERN5 color = CXD46000;
434  PATTERN6 color = CX486C28;
435  PATTERN7 color = CXFFFFFF;
436  PATTERN8 color = CXED003B;
437  PATTERN9 color = CXA7CFFF;
438
439  PROC GCHART DATA = Project.datafmty3;
440  TITLE 'Incidents catagorised by victim grade: Year 3.';
441  PIE Vic_grade /
442  TYPE = PERCENT
443  ANGLE = 0
444  VALUE = OUTSIDE
445  SLICE = NONE
446  noheading
447  fill= solid
448  otherlabel="Other Grades"
```

```
449 othercolor = CXFFCBFF
450 legend = legend1;
451 RUN;
452 Quit;
453
454
455 /****************** Plots for frequency of incidents for each number of RC staff
          present ******************/
456
457 GOPTIONS RESET = ALL HTITLE = 1.8 HTEXT = 1.5;
458
459 PROC FREQ DATA = Project.Datafmt;
460 TITLE 'Simple Frequency Table for CR Staff incident counts';
461 TABLES CR_staff_present/ SPARSE OUT = Project.CRFreq;
462 RUN;
463
464
465 DATA Project.Datafmt garbage;
466 SET Project.Datafmt;
467 IF Type_of_attack = ' ' THEN OUTPUT garbage;
468 ELSE OUTPUT Project.Datafmt;
469 RUN;
470
471
472
473 AXIS1 value=(height = 1.5);
474 AXIS2 label = (angle = 90 'Frequency of incidents') value=(height = 1.5);
475
476
477 PROC GCHART DATA = PROJECT.datafmt;
478 TITLE 'Frequency of incidents for each C&R staff count.';
479 VBAR CR_STAFF_PRESENT /
480 DISCRETE
481 SUBGROUP = Type_of_attack
482 PATTERNID = SUBGROUP
483 MAXIS = AXIS1
484 RAXIS = AXIS2;
485 RUN;
```