Violent behaviour by general psychiatric patients in Sweden – validation of Classification of Violence Risk (COVR) software

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A R T I C L E   I N   F O

Article history:
Received 8 July 2010
Received in revised form 7 December 2010
Accepted 8 December 2010
Available online xxxx

Keywords:
Violence
Mental disorders
Prospective studies
Risk assessment

A B S T R A C T

The objectives of the study are to report the 20-week base rate of violent behaviour in the community among a general psychiatric patient population from Stockholm and to establish the validity of a violence risk assessment software program, Classification of Violence Risk (COVR), in a European setting. Three hundred and thirty one patients at two psychiatric hospitals in Stockholm were interviewed upon discharge. Telephone interviews with the patients and collaterals were conducted 10 and 20 weeks later. The violent behaviour was also measured through a national criminal register. The allocation of patients into different risk groups according to COVR software was compared with the occurrence of actual acts of violence during the follow-up. The base rate of violent behaviour was 5.7% and a ROC-analysis showed that the AUC for COVR was 0.77. Since there were few patients in the high risk groups, the 95% confidence interval for the proportion of violent patients was wide. The base rate of violent behaviour is relatively low in Sweden and prediction is therefore difficult. The predictive validity of COVR software is comparable to other risk assessment tools.

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1. Introduction

One part of a physician’s assessment of a candidate for civil commitment (and involuntary psychiatric treatment) in Sweden is to consider the patient’s dangerousness to self or others. Although this need for risk assessment of people with mental illness has become a mantra in Sweden as in many other countries, empirical data on the base rate and other core characteristics of the non-institutional violent behaviour by a non-forensic patient population are sparse. Rather, Swedish research on this topic has been dominated by large register studies using violent convictions after discharge as an outcome (Lindqvist and Allebeck, 1990; Fazel et al., 2008), which only covers a fraction of all violent incidents. Most acts of violence are not recorded in a criminal register.

One of the conclusions of a comprehensive and authoritative Swedish review on violence risk assessment is that the results from studies from other countries can not automatically be translated into Swedish practice (SBU, 2005). The different base rates of violent behaviour in different countries and in different populations within countries is one crucial factor to consider in decisions concerning best practice in risk assessment (Douglas and Ogloff, 2003; Munro, 2004; Doyle and Dolan, 2006). The lower the base rate of violence, the more difficult it is to make accurate predictions. Consequently, the most serious (and rare) violent acts, such as homicide, are much more difficult to predict correctly than somewhat less serious (and more common) violent acts, such as assault (Munro, 2004). The base rate is also influenced by the duration of the observation period, and the clinical perspective is usually hours, days or, for out-patients, some months. It is not very helpful for a clinician encountering a psychiatric patient to know that there is a high risk that this person may commit an act of violence within the coming 10 years.

The MacArthur Violence Risk Assessment Study has developed the risk prediction instrument Classification of Violence Risk (COVR™) (Monahan et al., 2001, 2005). The instrument is based on the data from the so-far largest prospective violence risk study of psychiatric patients. COVR is a software program, with a tree-based prediction model, involving numerous risk and protective factors, too many to handle manually (Monahan et al., 2005). Different factors are assessed for different patients and the program produces a series of questions, up to a maximum of 40, that emerge on the screen depending on the patient’s answer to the previous question. The software performs an analysis of the responses resulting in a risk calculation that categorizes the likelihood of future violent behaviour into five risk groups, with an estimated risk ranging from 1% to 76%. This result can be expressed in several formats; category, frequency and probability. The COVR software is a registered product and the cost of the program is $320. The cost for each produced report after the installation of the software is approximately $10 (January 2010).
COVR was developed in the USA on the largest psychiatric clinical study on the violent behaviour and is easy and fast to administrate. However it has not been validated in non-institutional settings outside the USA, which is an important step in a validation process. This study was therefore designed with the twofold aim (I) to report the base rate of the violent behaviour among general psychiatric patients in Sweden, and (II) to examine the predictive validity of COVR in a European setting. The study is part of a larger project on the violent behaviour and violent victimization among psychiatric patients, whereof one study is published (Sturup et al., in press).

2. Method

2.1. Design and setting

This is a prospective, clinical, follow-up study with telephone interviews of participants and collageners 10 and 20 weeks after a baseline interview at hospital discharge, with additional follow-up data from The National Register for Criminal Convictions.

The sampling was conducted at the two largest public psychiatric hospitals in Stockholm County (1.9 million inhabitants) serving 289,000 and 400,000 people, respectively. Both hospitals provide voluntary as well as involuntary care. Patients were recruited from the two general psychiatric wards at the first hospital and from seven general psychiatric wards at the second hospital (excluding a ward that does not participate in research as the staff thought patients would become unsettled by questions regarding violent behaviour). Patients were also recruited from the emergency unit at the second hospital, which serves the entire Stockholm County.

In Sweden, health care of any kind is provided at a low cost to the individual. The private sector in psychiatry was, at the time of the study, small and of marginal importance. The treatment of patients with dependency disorders is run by a separate mental health service in Stockholm, although many dually diagnosed patients are still cared for in psychiatry (Lindqvist, 2007).

2.2. Sample

Inclusion criteria for the study were: (I) age between 18 and 60 years, (II) returning home after an acute consultation or admission at either of the two hospitals, (III) having a Swedish social security number (needed for access to records and national registers), (IV) having a clinical ICD-diagnosis (WHO, 1992), and (V) capacity to pursue an interview in Swedish or English.

Approximately 975 patients were eligible, 497 were approached (50%) and 390 agreed to participate (78% of all approached). Those who were not approached had been discharged at a time when the research assistant was occupied with other interviews or off duty. There were only small difference age (36.6 years versus 36.9 years), percent females (52% versus 47%) and duration of hospitalization (143 versus 172) between the participants and refusals (Sturup et al., in press). There were no significant differences between the participants and refusals except that patients with a diagnosis of a personality disorder were significantly more likely to participate compared to patients with other diagnoses.

Fifty-nine of the 390 participants could not be reached for follow-up interviews. Thus, there is complete follow-up data for 331 patients (67% of all approached) whereas 34 (10%) participated only in the 10 week follow-up, 23 (7%) only in the 20 week follow-up, and 274 (83%) gave interviews on both occasions. For 83 participants (25%), additional collateral follow-up data was retrieved. A comparison of the patients with and without any follow up interview is shown in Table 1.

2.3. Procedure and measures

Patients were interviewed from January 10 to December 12, 2007 by two external research assistants. When hospital staff announced that a patient was to return home, the patient, after a determination of eligibility, was asked to participate. In order to minimize the risk that the study per se was affecting the clinical treatment and the dependent variable, the baseline interview was conducted after formal discharge but before the patient left the hospital building. The participants were assured that the information from the research interview would not be reported to the responsible clinician unless it concerned a threat towards a named person or a case of child maltreatment. The duration of the interview was 15–20 min and no compensation was offered to the participants. The study was approved by the Stockholm Regional Ethical Committee (Dnr 2006:1231–31).

Data on gender, age, admission/not admission, duration of hospital stay, voluntary/involuntary treatment and diagnosis, were collected from the medical case records and/or from the responsible clinician. The patient interview comprised questions concerning country of birth and income, followed by the COVR assessment. We chose to use the clinical diagnosis rather than conduct a specific diagnostic research interview since an extension of the research interview was likely to jeopardize the response rate and data quality.

Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Follow-up (n=331)</th>
<th>Drop-out (n=59)</th>
<th>Test statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>174 (53%)</td>
<td>29 (49%)</td>
<td>$\chi^2=0.234$</td>
<td>0.629</td>
</tr>
<tr>
<td>Male</td>
<td>157 (47%)</td>
<td>30 (51%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, mean (sd)</td>
<td>36.6 (12.0)</td>
<td>38.9 (10.6)</td>
<td>F-ratio = 2.905</td>
<td>0.170</td>
</tr>
<tr>
<td>Admitted n (%)</td>
<td>209 (63%)</td>
<td>42 (71%)</td>
<td>$\chi^2=1.413$</td>
<td>0.235</td>
</tr>
<tr>
<td>Days hospitalised, mean (sd)</td>
<td>12.6 (21.9)</td>
<td>21.9 (28.2)</td>
<td>Z-value = -1.199</td>
<td>0.046*</td>
</tr>
<tr>
<td>Civially committed n (%)</td>
<td>85 (26%)</td>
<td>20 (34%)</td>
<td>$\chi^2=2.006$</td>
<td>0.157</td>
</tr>
<tr>
<td>Diagnosis n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mood disorder (F30–F39)</td>
<td>109 (31%)</td>
<td>15 (26%)</td>
<td>$\chi^2=1.301$</td>
<td>0.254</td>
</tr>
<tr>
<td>Neurotic and stress-related disorders (F40–F49)</td>
<td>73 (22%)</td>
<td>13 (22%)</td>
<td>$\chi^2=0.000$</td>
<td>0.997</td>
</tr>
<tr>
<td>Psychosis (F20–F29)</td>
<td>58 (18%)</td>
<td>18 (30%)</td>
<td>$\chi^2=5.382$</td>
<td>0.020</td>
</tr>
<tr>
<td>Personality disorder</td>
<td>49 (14%)</td>
<td>6 (10%)</td>
<td>$\chi^2=0.888$</td>
<td>0.346</td>
</tr>
<tr>
<td>Other (All other)</td>
<td>22 (7%)</td>
<td>5 (9%)</td>
<td>$\chi^2=0.026$</td>
<td>0.610</td>
</tr>
<tr>
<td>Substance use disorder (F10–F19)</td>
<td>20 (6%)</td>
<td>6 (3%)</td>
<td>$\chi^2=0.662$</td>
<td>0.416</td>
</tr>
<tr>
<td>Born in Sweden n (%)</td>
<td>249 (75%)</td>
<td>36 (62%)</td>
<td>$\chi^2=5.139$</td>
<td>0.023</td>
</tr>
<tr>
<td>Risk group according to COVR n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very low risk</td>
<td>191 (58%)</td>
<td>37 (63%)</td>
<td>$\chi^2=0.006$</td>
<td>0.940</td>
</tr>
<tr>
<td>Low risk</td>
<td>92 (28%)</td>
<td>13 (22%)</td>
<td>$\chi^2=0.361$</td>
<td>0.548</td>
</tr>
<tr>
<td>Average risk</td>
<td>37 (11%)</td>
<td>9 (15%)</td>
<td>$\chi^2=0.208$</td>
<td>0.648</td>
</tr>
<tr>
<td>High risk</td>
<td>7 (2%)</td>
<td>0 (0%)</td>
<td>$\chi^2=1.271$</td>
<td>0.260</td>
</tr>
<tr>
<td>Very high risk</td>
<td>4 (1%)</td>
<td>0 (0%)</td>
<td>$\chi^2=0.720$</td>
<td>0.396</td>
</tr>
</tbody>
</table>

* Mann–Whitney test (skeness 2.911).
Curve (AUC), which is reported together with the 95% confidence interval (CI). The range of the AUC is 0 to 1, where 0 equals a perfect negative relationship, 0.5 equals chance and 1 equals perfect positive prediction. The AUC can be interpreted as the relative frequency that violent patients had higher scores on COVR than the non-violent patients (Urbanik et al., 2008). It is argued that the ROC analysis should only be seen as one part of the validation process and that researchers all too often presents figures and numbers that are difficult to follow (Munro, 2004).

The proportion of patients with violent behaviour during the 20-week follow up among the five risk groups, together with the 95% CI for a proportion, are presented, along with the odds ratio (OR) with 95% CI from a logistic regression. The COVR assessment was treated as a categorical variable and as the COVR assessment includes many risk factors such as gender, age and co-morbid substance abuse etc., no more independent variables than the COVR assessment were used in the logistic regression. Positive predictive value was calculated as the ratio of true positive divided true negative plus false negative. Positive predictive value was calculated as the ratio of true positive divided true negative plus false negative.

3. Results

Eighty-six percent (n = 283) of the patients were classified by COVR as low or very low risk, 11% (n = 37) were classified as average risk, while 3% (n = 11) were in the two highest risk groups (see Table 1 and Fig. 1). All 11 patients in the two highest risk groups were followed up. Of the 331 patients with follow-up interviews, four (1%) had committed a violent crime during the follow-up. The corresponding figure for the 59 individuals who did not have a follow-up interview was two (3%), a non-significant difference.

3.1. Base rate of violent behaviour

The self reported base rate of violent behaviour was 4.8% (n = 16). Collateral information added one patient, giving a base rate of 5.2%. The criminal register added yet another two patients, totally 19 patients, giving a final base rate of 5.7%. The rate of violent behaviour was similar among females and males, 6.4% and 5.1%, respectively. Four of the 19 patients (3 of whom were males) had committed a violent crime. Thus, the other 15 patients had committed an act of violence that was not recorded in the criminal register.

3.2. Predictive validity of the COVR

The share of patients that committed violent acts during the follow-up was 2% (n = 4) in the very low risk group, 4% (n = 4) in the low risk group, 19% (n = 7) in the average risk group, 29% (n = 2) in the high risk group and 50% (n = 2) in the very high risk group (Table 2). A ROC-analysis shows that the AUC is 0.77*** (SE 0.06) with the 95% CI of 0.65 to 0.90. A logistic regression analysis reveals that the risk of violent behaviour was 47 times higher in the very high risk group compared to the very low risk group, although the 95% CI was wide (Table 2 and Fig. 2). True positive, false negative, true negative, false negative, positive predictive value and negative predictive value for violent behaviour can be found in Table 3.

Table 2

<table>
<thead>
<tr>
<th>Risk group according to COVR</th>
<th>Estimated risk of violent behaviour according to COVR</th>
<th>Violent behaviour n (%)</th>
<th>CI for a proportion OR CI for OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low risk</td>
<td>1%</td>
<td>4 (2%)</td>
<td>1.0 – 2</td>
</tr>
<tr>
<td>Low risk</td>
<td>8%</td>
<td>4 (48%)</td>
<td>2.1 – 10.1</td>
</tr>
<tr>
<td>Average risk</td>
<td>26%</td>
<td>7 (19%)</td>
<td>10.9 – 34.4</td>
</tr>
<tr>
<td>High risk</td>
<td>56%</td>
<td>2 (29%)</td>
<td>18.7 – 127</td>
</tr>
<tr>
<td>Very high risk</td>
<td>76%</td>
<td>2 (50%)</td>
<td>46.8 – 542</td>
</tr>
</tbody>
</table>

Total (331) – 19 (5.7%) – 20 weeks in the community with 95% CI for a proportion and odds ratio (OR) with 95% CI from logistic regression, in 331 general psychiatric patients in Sweden.

4. Discussion

4.1. Violent behaviour

One in twenty patients (5.7%) had committed an act of violence during the 20-week follow up. This is a considerably lower rate than the one reported from three other European studies on similar samples and follow-up periods (Walsh et al., 2001; Doyle and Dolan, 2006; Hodgins et al., 2007), but twice as high compared to a Finnish report with a considerably longer follow-up period (Honkonen et al., 2004). A Norwegian study shows that 12% of a cohort of general psychiatric patients had committed an act of physical violence, which was defined more broadly than in our study, during a period of one year in the community (Hartvig et al., 2006). These comparisons indicate that this Swedish study has targeted a group of general psychiatric patients who, in an international perspective, demonstrates a relatively low risk of violent behaviour, at least in the shorter, and clinically relevant, perspective.

There was a striking difference in the distribution of patients in risk categories between this sample and the original US study, with few Swedish patients assessed by COVR to be in the highest risk groups (Fig. 1). This divergence may reflect that COVR was not developed in a European context and therefore is not as able to identify the true high-risk patients. Alternatively, and more likely, since both criminal and non-criminal violence is less common in Sweden compared to the USA (van Wilsem, 2004) and the base rate of violent behaviour in the study from USA (Monahan et al., 2001) was three times higher than in this study, there are fewer high risk cases among Swedish patient populations compared to patient populations in the USA. This is true for non-clinical samples as well.

ROC-analysis is regarded as the state of the art technique to validate violence risk assessment methods and our ROC-analysis shows that COVR can significantly predict violent behaviour better than chance. However, AUC as an effect size may be interpreted too

Fig. 1. Distribution of risk groups according to COVR in a Swedish sample of psychiatric patients compared to a US sample (Monahan et al., 2001).

Fig. 2. Percent of violent patients in the different risk groups according to COVR in a Swedish sample of psychiatric patients compared to a US sample (Monahan et al., 2001).

optimistic and an AUC of 0.77 can be considered to be modest accuracy (Sjöstedt and Grann, 2002). This would imply that the predictive validity of COVR in a Swedish context is neither better nor worse than any other risk assessment methods, regardless of type (clinical, structured or actuarial) (SBU, 2005).

The prevalence of violent behaviour was higher in the groups estimated to possess a higher risk and the reverse. However, as there were very few patients in the two high risk groups, the large CI indicates that the finding that COVR can significantly predict violent behaviour is fragile. Most of the risk categories could not be separated from each other, in terms of the percent of violent patients, as the CIs overlapped. And also patients in the very low and low risk category counted for more than 40% of the recorded violence (Table 2). A logistic regression analysis demonstrates that the odds that the patients in the very high risk group had committed a violent act were considerably higher compared to the patients in the very low risk group (Table 2). Yet the CIs for the odds ratio are wide and only four of 19 (21%) violent patients belong to any of the two highest risk groups. Most violent acts were thus committed by patients in the low and average risk groups.

The predictive validity of COVR is modest, with wide CIs in the high risk groups. Yet, it has comparable effect size to other risk assessment methods such as the HCR-20, PCL and VRAG (SBU, 2005). When evaluating COVR in relation to other risk assessment methods, COVR is much faster – the mean administration time for COVR in this research was approximately 10 min, compared to an estimated several hours for the HCR-20 and several days for the VRAG – and can easily be used in clinical settings where background information is difficult to access. A further advantage of COVR is that it is partly relying on clinically relevant dynamic risk factors such as delusions, hallucinations, impulsivity, anger reaction and ongoing thoughts of hurting other people. This information is relevant in therapeutic contexts where continuous risk management is important.

4.2. Methodological considerations

The strengths of the study are the prospective design, the comparatively low attrition rate and the information on refusals and drop-outs. The internal validity of the findings is reinforced by the clinical alike conditions in which the base line interviews were conducted and the use of clinically experienced follow-up interviewers who were blind for the result of the baseline assessment. Further, the base line interviews were conducted after the patients were discharged and therefore the patients did not receive any treatment, caused by the results from the COVR assessment, which could have influenced the results of this study. The measurement of violent behaviour was trichotomised with self-reports, collaterals and information from the patients was forwarded to the responsible doctor, who could have influenced the result of this study. The confidential “fire-wall”, where no personal information from the patients was forwarded to the responsible clinician, lends the result credibility. It may have encouraged the patients to reveal problematic and incriminating behaviour which would perhaps not have happened in a clinical situation. Thus, some of the results in this study may have less clinical validity.

Two selection biases may have inflated the base rate of the violent behaviour. Firstly, the sample was hospital based, which means that they were in an acute phase of their illness. Secondly, all patients resided in Stockholm, which is a metropolitan city and it can be presumed that patients residing in non-metropolitan areas are less violent. Two other selection biases may have deflated the base rate of the violent behaviour; the attrition rate and the time of recruitment. Even though the attrition rate is comparable to, or somewhat lower than, other studies, there were some significant differences (diagnosis, duration of hospitalisation and non-Swedish background) between participants with and without follow-up interview data. The one third of the sample that was recruited from the emergency unit may be biased in terms of anti-sociality since patients that leave the emergency unit during night hours and weekends were never approached by the research assistants, and these may be different from the patients that leave during day time.

This study cannot answer how many patients that would have been violent should they not have been treated at all, and we did not control whether patients were provided with specific violence risk management plans, based on sound, evidence based risk assessments procedures. Thus we do not know to what extent the patients during the follow-up were subject to such outpatient treatment that may have affected the outcome. This shortcoming is unfortunately shared with most studies on risk assessment; it is often not clear whether the follow-up is based on patients that are properly looked after or not.

Declaration of interest

The authors received the usual 40% research discount from Psychological Assessment Resources (PAR), Inc., when purchasing COVR software.

Acknowledgements

The study was funded by grants from The National Board of Health and Welfare, Sweden, and Centre for Gender Medicine at Karolinska Institutet. We are indebted to John Monahan for his advice when the study was set up and for his reviews of drafts of this paper.

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