

## Article

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Predicting hospital aggression in secure psychiatric care

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## **Summary**

Risk assessment instruments have become a preferred means for predicting future aggression, claiming to predict long-term aggression risk. We investigate the predictive value over 12 months and 4 years of two commonly applied instruments (HCR-20, VRAG) in a secure psychiatric population with personality disorder. Focus was on aggression in hospital. The actuarial risk assessment (VRAG) was generally performing better than the structured risk assessment (HCR-20), although neither approach performed particularly well overall. Any value in their predictive potential appeared focused on the longer time period under study (4 years) and was specific to certain types of aggression. The value of these instruments for assessing aggression in hospital among personality-disordered patients in a high secure psychiatric setting is considered.

## **Declaration of interest**

Jane L. Ireland, Caroline Mulligan and Jennifer Kilcoyne are employed by the Trust where the data was collected. Jane L. Ireland and Carol A. Ireland are related. There are no further declarations of note.

## **Introduction**

Violence risk assessments are commonplace in psychiatric settings where psychiatrists are expected to conduct such assessments with attention to deemed best practice for predicting future aggression. Current approaches have focused on structured clinical risk assessments, such as the HCR-20 (Historical, Clinical and Risk Management Guide<sup>1</sup>), and actuarial risk

assessments such as the VRAG (Violence Risk Assessment Guide<sup>2</sup>). In recent years there has been a move away from actuarial risk assessments on the grounds that they do not predict individual but rather group risk<sup>3</sup>, although more recently it has been argued that violence risk instruments are essentially interchangeable<sup>4</sup>. The majority of research has focused on community-based follow-up of discharged patients, with studies beginning to raise questions over the predictive accuracy of risk instruments when applied to patients presenting with personality disorder and/or psychopathy<sup>5</sup>.

Our understanding of how well violence risk instruments can predict aggression occurring in psychiatric settings is limited, with research failing to assist forensic psychiatric services that manage the care of longer-term patients. Previous research has applied extremely limited follow-up periods (i.e. ranging from 24 hours to 12 months<sup>6-9</sup>), failed to report sensitivity with Area Under the Curve (AUC) values<sup>6-10</sup> or to control for psychiatric diagnosis<sup>6</sup>. Nevertheless, good predictive accuracy with both the VRAG and the HCR-20 has been reported for patients with intellectual disabilities<sup>8</sup>, whereas other studies suggest moderate levels of predictive accuracy of the HCR-20 over a 12-month period<sup>9</sup>. Findings are not consistent, with poorer predictive validity found for those presenting with mental illness and psychopathic disorder<sup>8</sup>, and poor accuracy for personality disorder, including those co-morbid with schizophrenia<sup>7</sup>.

We aimed to test the predictive accuracy of two instruments developed to assess risk of future aggression that are widely applied in clinical practice. The study does not claim to test predictions but rather to generate these for future studies. In addition, the value of these instruments to assessing aggression risk in hospital across an extended period of time (i.e. up to four years) has not been previously determined, certainly not for detained personality disordered patients. Clinicians need to be confident in their application of risk instruments considering the high stake decisions they have to make concerning placement, level of care

required to keep patients and staff safe and increasing mandatory requirements for the use of such risk instruments.

## **Method**

Participants were adult male psychiatric patients detained in a high secure hospital in Northern England housing patients with mental illness and/or personality disorder. The average age at the time of follow-up was 54.9 (*SD* 10.1; range 37 to 81). The sample was primarily Caucasian. Those convicted of a sex offence were excluded, with focus on general violence only. Only those detained on the personality disorder unit were included, resulting in 96 patients, all of which had the HCR-20<sup>1</sup> version 2 completed, with 75 of these also having the VRAG<sup>2</sup> completed. All had a diagnosis of personality disorder, with 25.3% *also* presenting with a definite diagnosis of major mental disorder at any time point in the past (i.e. *historically*, prior to data collection), and only 7.4% deemed to have a major mental disorder at the time of initial data collection<sup>a</sup>.

Each patient's care team completed the HCR-20, including the Responsible Clinician, and a single identified member of the care team completed the VRAG. Staff were trained by an author of the HCR-20. Participants were followed up at 12 months and four years within the hospital. Incidents of aggression were recorded using the hospital clinical recording system. This allowed for incidents to be recorded by staff in accordance to the type of aggression displayed. The study captured physical aggression, verbal aggression and threatening behaviour. Self-injurious behaviour was also recorded as a measure of self-directed aggression, again, using the staff reporting system. The HCR-20 is applied as an actuarial instrument for the purpose of the current study. The application of both instruments

to self-injurious behaviour and verbal aggression is novel since neither was originally designed to predict these.

Analysis was completed using SPSS for area-under-the-curve (AUC) and the regression analysis. MedCalc was used to compute sensitivity, specificity, Positive Predictor Values (PPV) and Positive Likelihood Ratio (PLR) values.

## **Results**

Table DS1 shows the predictive accuracy of the two instruments totals (HCR-20 and VRAG) using AUC, also reporting sensitivity<sup>11</sup>, PPV and PLR. Cutoffs for PPV were identified using sensitivity and specificity values. PLR values are included to accommodate for the lack of information on aggression prevalence in high secure settings, which arguably can lead to misleading interpretations of PPV since this is sensitive to prevalence rates. Both PPV and PLR values should consequently be accounted for in interpretation of the tables. Total scores were used to calculate AUC. The violence risk assessment literature generally considers AUC values of .8 to .9 as high and .6 to .8 as moderate<sup>12</sup>. AUCs are interpreted more strictly beyond this literature base, with values of .60 to .69 considered poor, .70 to .79 fair, .80 - .89 good and .90 + excellent. There is thus some noted differences in how AUC values are applied across studies and the current study recognises this.

<<Insert Table DS1 here>>

<<Insert Table DS2 here>>

If less stringent violence risk assessment interpretations of AUCs are applied, Table DS1 demonstrates moderate predictive validity, with AUC values closer to good (i.e. over .7)

for the VRAG, notably for patient self-harm at 12 months and four years, verbal aggression towards patients at four years, verbal aggression against staff at four years, and for total aggression (not including self-harm) at four years. VRAG performed reasonably well in relation to physical aggression toward staff at four years with this producing the largest Positive Likelihood Ratio (PLR), followed by verbal aggression against patients and total aggression at four years. The HCR-20 total produced only one AUC that was over .7 (staff verbal aggression at four years), although total aggression at four years produced an AUC of .69 (though the PLR was minimal). Both the HCR-20 and the VRAG appeared to perform better at four years than at 12 months. Neither discriminated between patients displaying other threatening behaviour.

Considering Table DS2 and using the AUC interpretations preferred in the risk assessment literature, only the historical components of the HCR-20 produced moderate AUCs and only in relation to self-harm, verbal aggression (staff and patient) and total aggression at four years. The clinical and risk management component also demonstrated moderate AUC values at four years for staff verbal aggression. These AUCs would, however, be considered poor if more stringent AUC cut-offs were applied. The only exception was the HCR-20 risk management component for 'other threats' to staff at 12 months, which produced an AUC of .83. This was, however, based on a small number of patients reported to demonstrate such behaviour (n = 6).

## **Discussion**

Our findings have implications for the use of the HCR-20 and VRAG in predicting aggression occurring within psychiatric hospitals. In keeping with recent research in community follow-up<sup>5</sup> it would appear that these instruments are not performing markedly

well across aggression types with those with a personality disorder detained in conditions of secure psychiatric care. Indeed, Positive Likelihood Ratio's generally ranged from minimal to small, with the only exception a moderate value in relation to the VRAG and its prediction of physical aggression against staff at four years, with verbal aggression against patients at four years closely following. The findings are broadly consistent with other research examining aggression occurring within hospitals, although previous research has used considerably shorter follow-up periods<sup>7,9</sup>. Nevertheless, there is evidence for lower predictive accuracy with participants with a personality disorder, particularly in relation to physical violence<sup>7</sup>, although the VRAG does seem to have some utility, particularly in relation to physical aggression against staff and with predicting patient self-harm.

Overall, it was the historical component of the HCR-20 that was presenting with some potential to accurately discriminate, even though this was limited to the four year follow-up and not producing Positive Likelihood Ratio's beyond small values. The marginal results for the historical components as a whole was perhaps supportive of the more favourable results indicated by the actuarial risk instrument, the VRAG. The VRAG does not include dynamic risk factors but a wider range of historical factors. It suggests that the more dynamic elements of risk assessment (HCR-20) are not contributing to aggression outcomes with this very specific population, and certainly not when longer time frames are being applied. Our results indicated that the more historical and static VRAG was a better predictor than the HCR-20. Interesting, the VRAG also demonstrated moderate (closer to good) discriminatory potential in identifying patients likely to self-harm across all time points (12 months and four years); it also performed moderately to good in terms of predicting verbal aggression towards patients and staff at four years, and total aggression at four years.

Our results do perhaps suggest some degree of caution in the application of risk assessment instruments to patient groups characterised by enduring challenges in personality



functioning. The difficulty for clinicians is that such difficulties are associated with an increased risk for aggression and yet the risk instruments more commonly applied do not seem to be discriminating beyond at least moderate with this patient group across the longer term. Our findings also suggest that actuarial assessments cannot be considered completely without merit<sup>3</sup> when focus is on hospital-based aggression.

The environment is also an important consideration. Although placement in a secure psychiatric setting is arguably a protective factor against the expression of overt aggression<sup>6</sup>, nothing is reliably known about how these risk instruments are converted, if at all, into clinical practice in the longer term in order to manage potential aggression risk<sup>10</sup>. The current study did not, for example, identify any means of reliably assessing the content or quality of risk management plans put in place following these assessments; such plans are varied and can be expected to change over time. This is an obvious limitation for a long term study. Examining this in future research, however, would be valuable and perhaps future revisions of risk assessment tools could consider a rating centred on the quality of risk plans put in place *following* such assessments, to what extent they were implemented and how such strategies could be evaluated effectively over time. Research has not comprehensively addressed these issues; the limited research to date has focused on very brief time periods (e.g. 24 hours follow up<sup>13</sup>) and not used all components of structured risk assessments (e.g. only considering the clinical component of the HCR-20<sup>14</sup>). Thus it would be a valuable direction for future research to pursue in more detail over longer time periods.

Psychiatrists who are required to complete violence risk assessments need, however, to be mindful of the debates and associated potential limitations in using risk instruments with clients with a primary diagnosis of personality disorder in high secure psychiatry populations. Further research needs to expand on these issues by going beyond what the current study was able to provide and examining the impact of medication, incorporating

neuroimaging variables, and comorbid conditions of potential interest such as epilepsy. Indeed, we recognise that the current sample is a highly specialised one, namely a high secure sample with long standing issues relating to aggression; this does make it particularly challenging for any more generally validated risk assessment tool to predict aggression owing to the specifics of this population. The lack of generalizability outside of high secure settings is certainly acknowledged. There is also a need to expand the current research by considering the role of personality clusters in determining aggression risk. Although controlling for those individuals presenting with more than one cluster may be challenging among a sample where more than one personality disorder is common, it would still remain a valuable avenue to explore. Future research could examine the specific nature of individual PD traits and how they associate with aggression in more detail. It could also extend to considering the role of personality functioning, as promoted by DSM-V, and where functioning challenges may impact on aggression risk. This would represent a novel and valuable area of study to consider.

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Footnote

- a Regressions indicated that a history of, or current evidence of, a major mental disorder was not predictive of hospital violence in this sample at the 12 month (*past* diagnosis,  $t = .08$ ,  $p < .94$ ; *current* diagnosis,  $t = 1.62$ ,  $p < .11$ ), or four year follow up (*past* diagnosis,  $t = .19$ ,  $p < .85$ ; *current* diagnosis,  $t = 1.10$ ,  $p < .28$ ).

Table DS1

*Predictive accuracy of HCR-20 total and VRAG total across 12 months and four years (HCR-20 n = 96 at 12 months and n = 92 at four years; VRAG n = 75 at 12 months and 75 at four years)*

	12 months		4 years	
<b>Behaviour</b>	<b>HCR-20</b>	<b>VRAG</b>	<b>HCR-20</b>	<b>VRAG</b>
	<b>AUC</b>	<b>AUC</b>	<b>AUC</b>	<b>AUC</b>
	<b>Sig/SE (CI sig*)</b>	<b>Sig/SE (CI sig*)</b>	<b>Sig/SE (CI sig*)</b>	<b>Sig/SE (CI sig*)</b>
	<b>[Sensitivity %: 95% CI]</b>	<b>[Sensitivity %: 95% CI]</b>	<b>[Sensitivity %: 95% CI]</b>	<b>[Sensitivity %: 95% CI]</b>
	<b>[Positive Predictor Value %: 95% CI]</b>	<b>[Positive Predictor Value %: 95% CI]</b>	<b>[Positive Predictor Value %: 95% CI]</b>	<b>[Positive Predictor Value %: 95% CI]</b>
	<b>(Positive Likelihood Ratio: 95% CI)</b>	<b>(Positive Likelihood Ratio: 95% CI)</b>	<b>(Positive Likelihood Ratio: 95% CI)</b>	<b>(Positive Likelihood Ratio: 95% CI)</b>
<b>Self-harm</b>	NS (.39 - .76)	.76	NS (.46 - .74)	.72
		.007/.06 (.64 - .89)		.005/.06 (.61 - .84)
		[28.6%: 14.6% - 46%]		[51.4%: 33.9% - 68.6%]

		[100%: 69.1 – 100%] (n/a)		[100%: 81.5 – 100%] (n/a)
<b>Physical aggression against patients</b>	NS (.50 - .79)	NS (.41 - .87)	.64 .05/.07 (.50 - .79) [27.8%: 16.5% - 41.6%] [78.9%: 54.4 – 93.9%] (2.92: 1.04 – 8.14)	.66 .04/.08 (.51 - .81) [34.3%: 19.1% - 52.2%] [66.7%: 40.9 – 86.7%] (2.29: 0.96 – 5.45)
<b>Physical aggression against staff</b>	NS (.54 - .92)	NS (.58 - .98)	.68 .04/.07 (.53 - .82) [27.8%: 16.5% - 41.6%] [78.9%: 54.4 – 93.9%] (2.92: 1.04 – 8.14)	.69 .03/.08 (.54 - .84) [34.3%: 19.1% - 52.2%] [85.7%: 57.2 – 98.2%] (6.86: 1.65 – 28.6)
<b>Verbal aggression against patients</b>	NS (.47 - .79)	NS (.43 - .77)	.64 .03/.06 (.52 - .76) [40.7%: 27.6% - 54.9%] [70.9%: 51.9 – 85.8%]	.72 .002/.06 (.60 - .84) [57.1%: 39.3% - 73.7%] [80%: 59.3 – 93.2%]

			(1.90: 0.98 – 3.69)	(4.57: 1.92 – 10.90)
<b>Verbal aggression against staff</b>	.65 .02/.06 (.54 - .77) [42.6%: 29.2% - 56.8%] [76.7%: 57.7 – 90.1%] (2.56: 1.21 – 5.38)	.67 .02/.07 (.53 - .81) [42.9%: 26.3% - 60.6%] [68.1%: 45.1 – 86.1%] (2.45: 1.13 – 5.31)	.72 .0001/.06 (.61 - .84) [48.1%: 34.3% - 62.2%] [76.5%: 58.8 – 89.2%] (2.53: 1.28 – 5.00)	.71 .0003/.06 (.58 - .83) [57.1%: 39.3% - 73.7%] [71.4%: 51.3 – 86.8%] (2.86: 1.44 – 5.66)
<b>Threatening patients</b>	NS (.27 - .78)	NS (.28 - .53)	NS (.38 - .73)	NS (.50 - .82)
<b>Threatening staff</b>	NS (.54 - .92)	NS (.32 - .95)	NS (.43 - .77)	NS (.38 - .82)
<b>Total aggression (not self-harm)</b>	.63 .03/.06 (.52 - .74) [46.3%: 32.6% - 60.4%] [67.6%: 50.2 – 81.9%] (1.62: 0.93 – 2.83)	.64 .04/.07 (.51 - .77) [51.4%: 33.9% - 68.6%] [66.7%: 46.0 – 83.5%] (2.29: 1.18 – 4.42)	.69 .001/.05 (.58 - .80) [61.1%: 46.9% - 74.1%] [71.7%: 56.5 – 84.0%] (1.97: 1.20 – 3.25)	.77 .0001/.05 (.67 - .88) [77.1%: 59.9% - 89.6%] [75%: 57.8 – 87.9%] (3.43: 1.88 – 6.26)

\*Asymptotic significance; NS = not significant with CI in ( ).



Table DS2

*Predictive accuracy of HCR-20 historical, clinical and risk management scales across 12 months and four years (HCR-20 n = 96 at 12 months and n = 92 at four years).*

	12 months			4 years		
<b>Behaviour</b>	<b>HCR</b>	<b>HCR</b>	<b>HCR</b>	<b>HCR</b>	<b>HCR</b>	<b>HCR</b>
	<b>Historical</b>	<b>Clinical</b>	<b>Risk</b>	<b>Historical</b>	<b>Clinical</b>	<b>Risk</b>
	<b>AUC</b>	<b>AUC</b>	<b>AUC</b>	<b>AUC</b>	<b>AUC</b>	<b>AUC</b>
	<b>Sig/SE (CI sig<sup>1</sup>)</b>	<b>Sig/SE (CI sig<sup>1</sup>)</b>	<b>Sig/SE (CI sig<sup>1</sup>)</b>	<b>Sig/SE (CI sig<sup>1</sup>)</b>	<b>Sig/SE (CI sig<sup>1</sup>)</b>	<b>Sig/SE (CI sig<sup>1</sup>)</b>
	<b>[Sensitivity %:</b>	<b>[Sensitivity %:</b>	<b>[Sensitivity %:</b>	<b>[Sensitivity %:</b>	<b>[Sensitivity %:</b>	<b>[Sensitivity %:</b>
	<b>95% CI]</b>	<b>95% CI]</b>	<b>95% CI]</b>	<b>95% CI]</b>	<b>95% CI]</b>	<b>95% CI]</b>
	<b>(Positive Predictor</b>	<b>(Positive Predictor</b>	<b>[Positive Predictor</b>	<b>[Positive Predictor</b>	<b>[Positive Predictor</b>	<b>[Positive Predictor</b>
	<b>Value %: 95% CI)</b>	<b>Value %: 95% CI)</b>	<b>Value %: 95% CI]</b>	<b>Value %: 95% CI]</b>	<b>Value %: 95% CI]</b>	<b>Value %: 95% CI]</b>
	<b>[Positive Likelihood</b>	<b>[Positive Likelihood</b>	<b>(Positive Likelihood</b>	<b>(Positive Likelihood</b>	<b>(Positive Likelihood</b>	<b>(Positive Likelihood</b>
	<b>Ratio: 95% CI]</b>	<b>Ratio: 95% CI]</b>	<b>Ratio: 95% CI)</b>	<b>Ratio: 95% CI)</b>	<b>Ratio: 95% CI)</b>	<b>Ratio: 95% CI)</b>
<b>Patient self-harm</b>	NS (.46 - .77)	NS (.31 - .68)	NS (.35 - .70)	.67 .02/.06 (.55 - .80)	NS (.35 - .63)	NS (.36 - .66)

				[26.4%: 15.3% - 40.3%] [77.8%: 52.4 – 93.6%] (2.84: 1.01 – 8.00)		
<b>Patient physical aggression</b>	NS (.46 - .77)	NS (.49 - .75)	NS (.38 - .74)	NS (.47 - .72)	NS (.49 - .78)	NS (.45 – 74)
<b>Staff physical aggression</b>	NS (.53 - .83)	NS (.39 - .96)	NS (.52 - .86)	NS (.52 - .76)	NS (.49 - .78)	NS (.42 - .76)
<b>Patient verbal aggression</b>	NS (.47 - .79)	NS (.46 - .76)	NS (.33 - .65)	.65 .01/.06 (.54 - .77) [41.5%: 28.1% - 55.9%] [70.9%: 51.9 –	NS (.44 - .68)	NS (.43 - .68)

				85.8%] (1.98: 1.02 – 3.85)		
<b>Staff verbal aggression</b>	NS (.50 - .73)	NS (.47 - .70)	.62 .05/.06 (.50 - .74) [37.3%: 25.0% - 50.8%] [73.3%: 54.1 – 87.7%] (1.72: 0.86 – 3.46)	.67 .008/.06 (.56 - .77) [47.2%: 33.3% - 61.4%] [73.5%: 55.6 – 87.1%] (2.25: 1.18 – 4.30)	.66 .009/.06 (.55 - .77) [45.4%: 31.9% - 54.4%] [73.5%: 55.6 – 87.1%] (2.07: 1.09 – 3.95)	.68 .004/.06 (.56 – 80) [38.9%: 26.5% - 52.5%] [67.67%: 49.5 – 82.6%] (1.31: 0.73 – 2.36)
<b>Threatening patients</b>	NS (.46 - .76)	NS (.19 - .78)	NS (.19 - .64)	NS (.39 - .70)	NS (.34 - .69)	NS (.37 - .70)
<b>Threatening staff</b>	NS (.33 - .76)	NS (.41 - .89)	.83 .007/.05 (.72 - .94) [10.2%: 3.8% - 20.8%] [100%: 54.1 –	NS (.39 - .70)	NS (.41 - .77)	NS (.40 - .78)

			100%] (n/a)			
<b>Total aggression</b>	NS (.50 - .73)	NS (.45 - .68)	NS (.46 - .69)	.69 .002/.05 (.58 - .79) [60.4%: 46% - 73.5%] [69.6%: 54.2 – 82.3%] (1.85: 1.14 – 3.00)	NS (.49 - .71)	NS (.49 - .72)

<sup>1</sup>Asymptomatic significance

## **Contribution**

*Jane L. Ireland, PhD*, contributed to the conception, design, analysis and interpretation, as well as leading with the writing of the article. *Lee Priday, MSc.* contributed to the conception, design and intellectual content of the paper, as well as leading with the data collection. *Carol A. Ireland, PhD* and *Simon Chu PhD*, contributed to the conception, design, interpretation and paper revisions. *Jennifer Kilcoyne, DClin.* and *Caroline Mulligan, MBChB, FRCPsych* contributed to the conception and design of the project and reviewed drafted articles.

## **Addresses at time of study completion**

*Jane L. Ireland* was employed by Mersey Care NHS Trust and the University of Central Lancashire. *Lee Priday, Carol A. Ireland* and *Simon Chu* were employed by the University of Central Lancashire. *Jennifer Kilcoyne* and *Caroline Mulligan* were employed by Mersey Care NHS Trust.

## **Research ethics**

Ethical approval was obtained from NRES Committee NW – Liverpool Central on 05.04.2013 under reference 13/NW/0200, with CAG (Confidential Advisory Group) approval under reference CAG 2-07(b)/2013 obtained on 28.06.2013.