ASSESSING THE RISK OF VIOLENCE IN PSYCHIATRIC OUTPATIENTS: THE PREDICTIVE VALIDITY OF THE HCR-20 RISK ASSESSMENT SCHEME

by

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B.A. (Honours, First Class), Simon Fraser University, 1994

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the Department

of

Psychology

SIMON FRASER UNIVERSITY

December, 1996

ISBN 0-612-16863-8

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Assessing the Risk of Violence in Psychiatric Outpatients:

The Predictive Validity of the HCR-20 Risk Assessment

Scheme

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TITLE OF THESIS: Assessing the Risk of Violence in Psychiatric Outpatients: The Predictive Validity of the HCR-20 Risk Assessment Scheme.

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Abstract

Although a large proportion of psychiatric patients display violent behaviour after release from hospital, there currently are no validated violence risk assessment schemes which are applicable to civil psychiatric settings. Under most civil committment legislation, individuals only can be released from psychiatric institutions if they do not need to be detained for the protection of others. The present research sought to validate the HCR-20 Risk Assessment Scheme, which is a broad-band violence risk assessment tool with applicability to a variety of settings. This instrument possesses subscales which measure Historical, Clinical, and Risk Management correlates of violence. The HCR-20 was compared to the Psychopathy Checklist: Screening Version (PCL:SV), and a Violence Screening Tool (VST) designed originally to assess risk for psychiatric inpatient violence. Participants were 200 involuntarily committed patients who were followed into the community and whose violence was measured by criminal records and rehospitalizations involving violence. Using receiver operating characteristic analyses and the areas under their curves as indexes of predictive accuracy, and multiple regression analyses to determine the relative contributions of these scales to violence, it was found that the HCR-20 produced larger and more consistent relationships to violence than the PCL:SV The VST was unrelated to violence. Subscales of the HCR-20 which measure Historical and Risk Management factors were the most consistent and strongest of all subscale predictors. It is concluded that there is support for the use of the HCR-20 in a civil psychiatric setting for assessing the risk of post-release violence.

Acknowledgments

I am grateful to Jim Ogloff for his endless high quality supervision, for the depth of scholarship which he attains and encourages, and for the many doors he has helped me to open.

I am also grateful to Chris Webster, who sparked my interest in risk assessment and has been generous in providing me with numerous opportunities, and to Steve Hart, for being a constant source of ideas and support.

The work of Tonia Nicholls was vital to this project and is very much appreciated. Thanks also to Grant Burt and Lindsay Jack for their hard work, and to Sharon Agar, Rebecca Dempster, Lynne Sullivan, Maureen Olley, and Karen Whittemore for their contributions.

To my wife Paola, thank you for being patient, supportive, and understanding when I disappear into the office until the middle of the night, on so many nights.

Finally, to my mom, who I still regard as the best "teacher" I have had, to my sisters, who always have been supportive of me, and to the rest of my family -- thanks!

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Introduction

Violence is a salient public health issue. Clinicians are being called upon more frequently than in the past to forecast the likelihood of future violence in persons released from correctional and psychiatric facilities (see, generally, Douglas, Macfarlane, & Webster, 1996; Monahan & Steadman, 1996). One context in which risk assessments frequently are called for is the release of patients from civil psychiatric hospitals. All jurisdictions in Canada and the United States require that to be released from confining psychiatric facilities, persons must not require hospitalization for their own protection or the protection of others (see, for example, British Columbia Mental Health Act, 1979; Miller, 1992). Although at the time of release from hospital, each person is deemed not to need detainment for the protection of others, rehospitalization rates -- often with violence as part of the reason for readmission -- can be as high as 53% (Appleby, Desai, Luchins, Gibbons, & Hedeker, 1993) or 64% (Haywood et al., 1995). Preliminary data from the large-scale MacArthur project on risk assessment in the United States (Monahan & Steadman, 1994a, b; Steadman et al., 1994) indicate that some 43% of psychiatric patients are violent in the community, and approximately 17% are seriously violent (Steadman, Mulvey, & Robbins, 1996). In a well-designed study, Lidz, Mulvey, and Gardner (1993) found that 45% of 714 emergency room psychiatric patients were violent in the community at follow-up. Swanson, Borum, Swartz, and Hiday (1996) reported a similar figure of 45% of inpatients having acted violently in the four months prior to hospitalization.

These realities form the basis of concerted research efforts during the past two decades to improve predictive acumen. It was not so long ago that evidence suggested that predictions of violence were more often wrong than right (Cocozza & Steadman, 1976; Ennis & Litwack, 1974; Monahan, 1981; Steadman & Cocozza, 1974). Since that time, perhaps spurred by Monahan's (1981; 1984; 1988; 1992) calls for better research,

predictive accuracy -- or at least the ability of researchers to detect it statistically -- has improved (Mossman, 1994a; Otto, 1992), albeit modestly (Hart, Webster, & Menzies, 1993).

It is now the case that certain risk factors (i.e., psychopathy, acute psychotic symptoms, anger, substance abuse, impulsivity) for violent behaviour are quite well documented (see, generally, Douglas & Webster, in press; Monahan & Steadman, 1994b). Likewise, several so-called "schemes" for the prediction of violence have emerged which integrate individual correlates of violence (Andrews, 1982; Andrews & Bonta, 1995; Harris, Rice, & Quinsey, 1993; Kay, Wolkenfeld, & Murrill, 1988; McNiel & Binder, 1994a; Webster, Eaves, Douglas, & Wintrup, 1995; Webster, Douglas, Eaves, & Hart, in press; Webster, Harris, Rice, Cormier, & Quinsey, 1994). Perhaps surprisingly, these devices tend not to be applicable to psychiatric populations. Rather, they are applicable to correctional and forensic samples because they have been normed on such samples, and they often presuppose past violent offences. One such device, however, the HCR-20 Scheme (Webster et al., 1995; in press), is an instrument designed to be potentially applicable to a variety of populations. The present research will assess the predictive validity of the HCR-20 and compare it to other applicable and relevant instruments which have been used to evaluate risk for violence in psychiatric patients.

Risk Markers for Violence

There has been a plethora of research geared toward the identification of variables which may bear some link to violence. A conventional way to categorize these factors is to divide them into two groups: (1) "historical/static", and; (2) "clinical/dynamic." The synopsis below will rely upon this distinction, but will include a third category of variables which may be defined as future-oriented, situational "risk management" factors. Given the focus of the research in this thesis, the literature to be covered will be comprised primarily

of studies which have used samples of persons with mental disorders, although many of the risk markers predict violence in other settings (see Douglas & Webster, in press).

The first category of risk markers to be discussed, the so-called historical or static factors, have been found to have stronger empirical support for their connection to violence than the others. The division between historical and clinical factors stems from the long-standing demarcation between clinical and actuarial clinical decision-making first brought clearly to light in psychology by Meehl (1954). Certainly, research places actuarial predictions of violence above clinically-based decisions in terms of predictive acumen (Dawes, Faust, & Meehl, 1989; Harris et al., 1993; McNiel, Binder, & Greenfield, 1988; Monahan, 1981; 1984). Yet, an important distinction must be made between the clinical versus actuarial *decision-making* issue on the one hand, and the clinical versus static *risk marker* issue on the other. It is most accurate to argue that actuarial predictions fare better than clinically-based global opinions of violence potential, and not that clinical constructs, when measured carefully and reliably, are weakly linked to violent outcome. To illustrate this distinction, Webster et al. (in press) point out that the construct of psychopathy, which has a long clinical tradition (Cleckley, 1941), since having been refined and subjected to reliable measure by Hare (1991), finds its place among other historical factors. Clinical constructs such as anger (Novaco, 1994), impulsivity (Barratt, 1994), and psychiatric symptomatology (Douglas & Hart, 1996) have been shown to link to violence. It is worth continued efforts to measure these and other clinical constructs and investigate their potential connections to violence.

Historical Variables

Factors which fall into this category are defined by their static nature. They refer to behaviours carried out, events experienced in the past, as well as characteristics of persons which tend not to change. Within this category of risk markers, it is possible to sub-divide

further into (1) characteristics and past behaviours of individuals, (2) diagnoses, and (3) previous family, peer, employment, and romantic relationships and experiences.

Characteristics of individuals and past behaviour. Factors such as male gender (Bartels, Drake, Wallach, & Freeman, 1991; Pearson, Wilmot, & Padi, 1986; Wessely, Castle, Douglas, & Taylor, 1994) and minority ethnic status (Noble & Rodger, 1989; Shaffer, Waters, & Adams, 1994; Wessely et al., 1994) have been shown to predict violence. Young age either at time of assessment or at time of first violence appears consistently to predict violent behaviour (Asnis, Kaplan, van Praag, & Sanderson, 1994; Bartels, Drake, Wallach, & Freeman, 1991; Cirincione, Steadman, Robbins, & Monahan, 1992; Harris et al., 1993; Karsen & Bigelow, 1987; Kay et al., 1988; Phillips & Dickie, 1991; Sepejak, Menzies, Webster, & Jensen, 1983; Steadman & Felson, 1984; Swanson, 1994; Tardiff, 1981; 1984; Wessely et al., 1994). The presence of previous acts of violence also is apt to increase the odds of future violence occurring (Ball, Young, Dotson, Brothers, & Robbins, 1994; Binder & McNiel, 1990; Cocozza, Melick, & Steadman, 1978; Convit, Jaeger, Lin, Meisner, & Volavka, 1988; Cooper & Werner, 1990; Dickerson, Ringel, Parente, & Boronow, 1994; Edwards, Jones, Reid, & Chu, 1988; Janofsky, Spears, & Neubauer, 1988; Karsen & Bigelow, 1987; Klassen & O'Connor, 1988a; 1989; Kozol, Boucher, & Garofalo, 1972; McNiel, & Binder, 1989; 1994a; 1994b; McNiel et al., 1988; Menzies & Webster, 1995; Menzies, Webster, McMain, Staley, & Scaglione, 1994; Phillips & Dickie, 1991; Swanson, 1994). Failures on previous conditional releases and (attempted) escapes have been found to elevate the probability of future violence (Ball et al., 1994; Cooper & Werner, 1990; Harris et al., 1993).

Diagnoses. Certain diagnostic categories relate to violence in a global sense. Some findings have shown that major mental disorders, particularly psychotic ones such as schizophrenia and mania, elevate a person's chance for acting violently (Asnis et al., 1994; Beck & Bonnar, 1989; Binder & McNiel, 1988; Blomhoff, Seim, & Friis, 1990; Douglas

& Hart, 1996; Inada, Minagawa, Iwashita, & Tokui, 1995; Karson & Bigelow, 1987; Lindqvist & Allebeck, 1990; Lowenstein, Binder, & McNiel, 1990; McNiel & Binder, 1994a; 1994b; Noble & Rodger, 1989; Pearson, Wilmot, & Padi, 1986; Rossi et al., 1986; Swanson, 1994; Wessely et al., 1994). Abusing or being dependent on alcohol or other drugs has been found to elevate the chance for violence (Bartels et al., 1991; Blomhoff et al., 1990; Haywood et al., 1995; Klassen & O'Connor, 1988a; Swanson, 1994). Psychopathy (Hare, 1991; 1993; 1996) has been shown to be very strongly linked to violent outcome in samples of adult offenders (Serin, 1991; 1996; Serin & Amos, 1995), young offenders (Forth, Hart, & Hare, 1990), and sex offenders (Quinsey, Rice, & Harris, 1995). Psychopathy also predicts violence both in forensic samples (Harris et al., 1993; Harris, Rice, & Cormier, 1991; Hill, Rogers, & Bickford, 1996; Rice & Harris, 1995) and psychiatric inpatient samples (C. Klassen, 1996). Finally, the diagnosis of any personality disorder has been shown to relate to future violence (Harris et al., 1991; 1993). Epidemiological studies from Canada (Bland & Orn. 1986) and the United States (Robins, Tipp, & Przybeck, 1986) further demonstrate the connection between violence and antisocial personality disorder.

Previous family, peer, employment, and romantic experiences. Childhood abuse or neglect predicts violence during adulthood (Blomhoff et al., 1990; Convit et al., 1988; Klassen & O'Connor, 1989; Yesavage, 1983a). So too does maladjustment during elementary school years, such as failing grades, fighting at school, or being suspended from school (Harris et al., 1991; 1993; Rice & Harris, 1992). In one study, separation of a child under 16 years of age from his or her parents was found to elevate the probability of the occurrence of violence as an adult (Harris et al., 1993). People who experience unstable or conflictual non-platonic relationship patterns may be prone to acting violently outside of relationships (Harris et al., 1991; 1993; Klassen & O'Connor, 1988b; Shaffer et al., 1994). Similarly, the presence of unstable employment patterns predicts violence

(Klassen & O'Connor, 1988c; Menzies & Webster, 1995; Shaffer et al., 1994; Wessely et al., 1994).

Clinical Variables

These are dynamic (potentially changeable) qualities of persons which may fluctuate over time, both in the short and long-term. Although research evidence does not provide as much support for the connection between these variables and violence as it can for the link between historical markers and violence, several clinical constructs have received enough support to demonstrate that they do relate to violence. These factors can be divided roughly into those which seem to stem directly from mental illness, and those which do not necessarily have their origins in mental illness.

Variables stemming from mental illness. Acute positive psychotic symptoms, such as delusions, hallucinations, and disorganized thought, tend to predispose one to violent behaviour more so than do mere diagnoses, non-psychotic psychiatric diagnoses, or negative symptoms (Bartels et al., 1991; Douglas & Hart, 1996; Janofsky et al., 1988; Link, Andrews, & Cullen, 1992; Link & Steuve, 1994; Noble & Rodger, 1989). Many studies have found that persons who score high on certain indexes of the Brief Psychiatric Rating Scale (BPRS; Overall & Klett, 1972), such as hallucinatory behaviour, disorganized thought, and odd beliefs, are more likely to act violently than persons who do not score high (Dickerson et al., 1994; Krakowski & Czobor, 1994; Lowenstein et al., 1990; Tanke & Yesavage, 1985; Yesavage, 1983a; 1983b). "Threat/control-override" (TCO) psychotic symptoms (Link & Steuve, 1994), defined by the characteristics of being threatening to the subjective sense of safety and self-control of people who experience them (e.g., others control one's thoughts and behaviours; people are out to do harm to or are following one) have been found to be correlated highly with violence (Link & Steuve, 1994; Swanson, Borum, Swartz, & Monahan, submitted). Suicidiality and self-injurious behaviour also

may precipitate violence toward others (Asnis et al., 1994; Convit et al., 1988; Hillbrand, 1995).

Variables not stemming necessarily from mental illness. Apart from symptoms which stem directly from mental illness, other clinically-oriented factors bear some link to aggressive behaviour. For example, impulsivity, or the inability to regulate behaviour, may contribute to violence (Barratt, 1994; Hollander & Stein, 1995), as may states of anger (Kay et al., 1988; Novaco, 1994; Selby, 1984; Welsh & Gordon, 1991) and hostility (Kay et al., 1988; Lowenstein et al., 1990; Menzies & Webster, 1995). Further, irrational beliefs, hostile biased perceptions of others, or cognitive mediation of others' behaviour or intentions as hostile, may provoke aggressive responses (Dodge, Price, Bachorowski, & Newman, 1990; Ford, 1991; Slaby & Guerra, 1988). As might be expected, sadistic and homicidal fantasies also are relevant to violence potential (MacCulloch, Snowden, Wood, & Mills, 1983).

Risk Management Variables

In the past, the issue of risk management, or the control of violence in the community rather than the mere prediction of violence, had received little attention (see, generally, Steadman et al., 1994). Yet, arguably, steps taken (or not taken) in the community to prevent violence, and the experiences of persons once released back into the community, are linked critically to whether some persons will act violently. A related issue -- "conditional prediction" -- was put forth by Mulvey and Lidz (1995). This concept highlights situational aspects of a person's community adjustment with the goal of specifying precise environmental conditions which may either elevate or attenuate violence risk. Understanding the post-release factors which seem either to mitigate or aggravate the risk for violence potentially will increase predictive acumen and reduce violent behaviour in the community.

Noncompliance with medication likely will lead to decompensation and, therefore, may result in violence or rehospitalization (Bartels et al., 1991; Haywood et al., 1995). The absence of a comprehensive and feasible plan for post-release which entails the patient support and supervision of family members and professionals may put one at increased risk for violence (Estroff & Zimmer, 1994). In a sample of released patients with schizophrenia, those who experienced high levels of difficulty in basic social tasks such as sustaining adequate housing, finances, and meals were most likely to act violently (Bartels et al., 1991). Draine and Soloman (1994) determined that ratings of poor quality of living by patients who had been released was related to general recidivism, as was too few case management services. Estroff and Zimmer (1994) reported that perceiving hostility in family interactions and behaviours by ex-patients may elevate the chance for aggression, as may being financially dependent upon family members. Similarly, Klassen and O'Connor (1988a; 1988b; 1988c; 1989) noted that patients who felt dissatisfied with siblings and parents, and had frequent arguments with family members, were at greater risk for violence than patients without these experiences. Perhaps as a result of the above factors, stress experienced by people released into the community may rise, which in turn may lead to violence (Guerra, Huesmann, Tolan, Van Acker, & Eron, 1995; Hall, 1987; Klassen & O'Connor, 1994).

Risk Assessment Schemes

Although the link between individual variables and violence is important, the integration of such factors into risk assessment measures or "schemes" promises to yield more comprehensive and accurate predictions than the consideration of single markers. While several such schemes have been advanced, their applicability to psychiatric samples is questionable. For example, the Violence Risk Assessment Guide (VRAG; Harris et al., 1993; see also Webster et al., 1994, for the Violence Prediction Scheme, which

incorporates the VRAG), includes 12 variables[1] and performed quite well in predicting violence (Mult R =.46). Yet, this scheme is based on a forensic sample of mentally and personality disordered offenders, and several of its 12 items presume the presence of an index offence (i.e., victim injury, female victim index offence).

Klassen and O'Connor (1988a, 1988b, 1988c, 1989), though not developing a scheme with a particular name, have identified through multiple regression analyses and cross-validation studies several domains of variables[2] which prospectively relate to violence. Using this measure, 75.8% of patients were correctly classified as violent or non-violent during community follow-up, which represents a 13% improvement over chance. This value, while reflecting a statistically significant classification scheme, is relatively small. The multiple correlation of the variables with violence was .32, which, although of moderate strength (Cohen, 1992), is weaker than Harris et al's. value of .46. In contrast to the work by Harris et al. (1993), the research by Klassen and O'Connor involved psychiatric patients. However, participants in their studies were chosen if they had histories of violence or if a relatively high likelihood of violence was determined a priori. Although the coding procedures and precise definitions of predictor variables are not given by Klassen and O'Connor, their domains of variables overlap to some degree with the HCR-20.

McNiel and Binder (1994a), in a study more directly applicable to the present one in terms of sample characteristics, provided a simple, five-item[3] risk assessment screening

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[1] These are: (1) Psychopathy Checklist score; (2) elementary school maladjustment; (3) DSM-III diagnosis of personality disorder; (4) age at index offence [negatively related]; (5) separated from parents under age 16; (6) failure on prior conditional release; (7) non-violent offence history; (8) never married; (9) DSM-III diagnosis of schizophrenia [negatively related]; (10) victim injury [negatively related]; (11) alcohol abuse; and, (12) female victim index offence [negatively related].

[2] These are: (1) early family quality; (2) current intimate relationships; (3) arrest history; (4) admissions history; (5) assault in the presenting problem (Klassen and O'Connor; 1989).

[3] These are: (1) history of physical attacks and/or fear inducing behaviour within two weeks prior to admission; (2) absence of suicidal behaviour, threats, gestures, ideation, etc; (3)

tool for identifying psychiatric patients who would be violent during their hospitalization. The items are scored dichotomously as being present or absent, and are based on previous studies by these investigators and their colleagues (see, for example, Binder & McNiel, 1988; Lowenstein et al., 1990; McNiel & Binder, 1989, 1991; McNiel et al., 1988). Limiting the dependent measure to physical attacks in the hospital (as opposed to including threats, etc.), the statistical indexes associated with the model were as follows: (1) sensitivity, 55%; (2) specificity, 64%; (3) false positive rate, 67.9%; (4) false negative rate, 18%; (5) positive predictive value, 41.1%; and (6) negative predictive value, 82.1%. The total predictive value was 61.8%, and a likelihood ratio of 1.52 was obtained, meaning that a positive score on the model (score of three or more) increased the likelihood of violence by 1.52 times. The relative improvement over chance was 25%. Although this model was based on a similar sample to the one used in the present study, it limited its dependent measure to violence while hospitalized. It could be applied quite easily, as well, to violence post-release.

The Revised Psychopathy Checklist (Hare, 1991) and the Psychopathy Checklist: Screening Version (PCL:SV; Hart, Cox, & Hare, 1996) are not risk assessment schemes, but rather are measures of the construct of psychopathy. A fortunate characteristic of these schemes, however, is that they do predict violence very well (as reviewed above) and are applicable to diverse populations, including mentally ill persons. In fact, failing to include one or the other of these instruments in a risk assessment study would be a questionable methodological strategy. As such, these instruments should be considered and included in risk assessment research.

The HCR-20 has yet to be tested for its predictive merit in a psychiatric outpatient sample. This is a necessary step in its development, as it is construed as a broad-band

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diagnosis of mania or schizophrenia; (4) male gender; and (5) currently married or living together.

instrument with potential applicability to a variety of settings. The logic of the HCR-20 is to acknowledge the research body which places actuarial judgments and correlates of risk above clinical ones in terms of predictive ability (Dawes et al., 1989; McNiel et al., 1988). As shown in Figure 1, it does so by allotting 10 of its 20 items to such historical factors. There are five clinical items which are included to reflect their potential contribution to assaultiveness, as well as five factors which relate to the future community risk management of the individual. Borum (1996) recently has written about the HCR-20 that "the promise of this instrument lies in its foundation on a conceptual model or scheme for assessing dangerousness; its basis in the empirical literature; [and] its operationally defined coding system" (p. 950).

Figure 1

The Organization of the HCR-20

Historical (Past)	Clinical (Present)	Risk (Future)
H1) Previous Violence	C1) Lack of Insight	R1) Lack of Plan Feasibility
H2) Young Age at First Violent Act		
H3) Early Maladjustment	C2) Negative Attitude	R2) Access
H4) Relationship Instability		
H5) Employment Instability		
H6) Alcohol or Drug Abuse	C3) Psychiatric Symptoms	R3) Lack of Support
H7) Major Mental Disorder		
H8) Personality Disorder	C4) Instability	R4) Non-compliance
H9) Psychopathy		
H10) Prior Release or Detention Failure	C5) Unresponsive to Treatment	R5) Stress

Several small-scale studies have been conducted using the HCR-20. In a retrospective chart review of a sample of 72 incarcerated federal inmates, Douglas, Webster, and Wintrup (1996) found that the interrater reliability of the H and C combined scores was .80.[4] Correlations between the number of previous violent charges and the H scale, C scale, and their combination ranged from moderate to large.[5] The Historical scale correlated at r=.52 with previous violence (with the "previous violence" item removed from the H scale), the Clinical scale at r=.31, and the combined total at r=.44. In this study, the VRAG of Harris et al. (1993) also was coded and PCL-R (Hare, 1991) scores were retrieved from file. The VRAG correlated at r=.44 with previous violence, and the PCL-R's correlation with past violence was r=.34. Clearly the HCR-20 was competitive with these other scales, and the H scale tended to outperform both. The C scale of the HCR-20 fared less well than the H scale in terms of the size of the relationship with past violence. Whether this stems from the fact that most of the individuals in the sample were not mentally ill, because these items were not scored with the assistance of an interview and hence may have been underestimated,[6] or simply because they bear a less strong relationship to violence can only be determined with more research.

In a forensic psychiatric sample, Wintrup (1996) observed, in her retrospective chart review study of 80 men remanded to a secure forensic facility, that both the HCR-20 and the PCL-R averaged correlations just below r=.30 with several measures of later community violence. The HCR-20 was quite strongly related to subsequent re-admissions

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[4] It was not possible to code the R variables in this study because most of the individuals comprising the sample were still incarcerated.

[5] According to Cohen (1992), a moderate size correlation is r=.30, and a large correlation is r=.50. Sample size is chosen a priori based on the number of predictors or groups to be used in analyses, and the desired size of effect to be detected.

[6] The clinical items may be underestimated if an interview is not possible as part of the assessment procedure. The items may not be directly commented upon in files, and must therefore be assessed in person. As such, the items may have to be scored 0 not because they do not exist, but because little information directly relating to them is included in files.

to the forensic hospital (r=.38) and to psychiatric hospitalizations (r=.45). The relationship of the PCL-R to these same outcomes was not as strong, at r=.25 and r=.36, respectively. However, whether these re-hospitalizations involved violence was not determined.

More relevant to the present study in terms of sample participants, Klassen (1996) investigated the link between the H variables of the HCR-20 and psychiatric inpatient violence. The PCL:SV (Hart et al., 1996) also was used as a predictor. The H scale averaged an approximate correlation of r=.30 with various measures of inpatient violence. The PCL:SV performed similarly (r=.26).

Rationale and Research Questions

These small-scale studies demonstrate that the HCR-20 and its scales may bear a moderate to strong relationship to violent behaviour. As such, there are two reasons to estimate its predictive validity in a sample of psychiatric outpatients: (1) no validated risk assessment scheme exists which is applicable to psychiatric outpatient populations, and; (2) the HCR-20 was constructed to be applicable to a variety of populations, and hence its predictive validity in this particular sample should be investigated. Rather than testing the HCR-20 in isolation, an arguably stronger approach is to compare its ability to predict community violence with other measures which already have demonstrated their relationship to violence and are applicable to this population. The measures which meet these criteria are McNiel and Binder's (1994a) five-item scale,[7] the PCL-R (Hare, 1991) and the PCL:SV (Hart et al., 1996). Given that the present study is based on chart reviews rather than interviews, and involves a civil psychiatric rather than forensic psychiatric sample, the PCL:SV is the more appropriate of the psychopathy measures.

The primary purpose of this research, then, is to determine how well the HCR-20 fares in terms of its relationship to outpatient violence in comparison to these other

[7] Although this scale has only been validated for inpatient violence, some of its items do predict violence in other settings, and it easily can be applied to outpatient violence.

schemes. It also would be possible to compare these measures to the relationship between violence and the sample's characteristics (i.e., diagnoses, psychiatric symptoms, demographics, criminal histories, childhood histories, etc). However, the relationship between these variables and violence, by definition, already is optimized or maximized because the predictor variables come from the same sample as the dependent measures. In effect, any set of variables which relates to violence, determined through some statistical technique such as multiple regression, may be valid only for that (calibration) sample. The HCR-20, PCL:SV, and McNiel and Binder's (1994a) scheme are predetermined measures which are being validated in this sample. As such, no comparisons between these measures and models derived from the data-set itself will be carried out.

This study has the following goals: 1) to assess the accuracy of the HCR-20 to predict violence in a sample of psychiatric patients who have been released into the community, and; 2) to compare the predictive utility of the HCR-20 to other relevant schemes (PCL:SV and McNiel and Binder's scheme). A step which is preliminary to these two goals is to estimate the descriptive characteristics of the HCR-20 in a psychiatric sample (central tendency, dispersion, percentile).

Method

Participants

Participants are 200 involuntarily hospitalized psychiatric inpatients from Riverview Psychiatric Hospital who, in 1994, had requested a review panel hearing in accordance with the Mental Health Act (1979). According to the Act, patients who are detained in mental health facilities as involuntary admissions may request a review panel hearing under section 21 (4) to determine whether they may continue to be detained. If patients do not apply for review panels, they cannot be released until the director of the mental health facility, or a physician authorized by him or her, determines that they are no longer certifiable (section 21), meaning that they do not meet the criteria of being mentally disordered, in need of treatment, and in need of "care, supervision and control" for their own protection or the protection of others (section 20 [3]).

The sample represents a subset of all 287 involuntary patients who had requested review panels in 1994. Patients who applied for review panels were chosen to maximize the probability that enough patients would be released to the community to complete the study. Files were drawn randomly from the list of patients. The only stipulation was that the files of patients who had been released were retrieved by hospital staff before the files of patients who had not yet been released. Voluntary patients were not used in this research because the bulk of the research corpus uses involuntarily committed patients, and because there were fewer than 100 such patients who had been admitted during 1994. Further, in light of the involuntary admission criteria in the British Columbia Mental Health Act, the assessment of patients' potentials for harm is an important part of release consideration. Riverview Hospital has a catchment area that includes the province of British Columbia, as transfers often are made from general hospitals throughout the province to Riverview.

Power

The sample size should ensure adequate power for the analyses to be performed. From prior research, a medium outcome effect size (correlation of .3 or Multiple R of .36 -- Cohen, 1992) can be expected, although some research (see, for example, Harris et al., 1993, who found a Mult R of .46, and Douglas et al., 1996, who found a correlation of .52) suggests that large effect sizes (correlations of .5 or Mult R of .51 -- Cohen, 1992) may be obtained. According to Cohen (1992), to detect a medium effect with power = .8 and $\alpha = .05$ in a multiple regression design[8] with six predictors[9] a total sample size of 97 is required. To detect a medium effect at $\alpha = .01$, 134 participants are necessary. Thus, there is adequate power to detect a medium-sized relationship between the predictors and the outcome variables.

Procedures

This research is a retrospective archival study. All files were coded by Masters or Ph.D. level graduate students in psychology as part of a larger project. All coders were trained in the rating of the PCL:SV and HCR-20. One rater coded the majority of files and was blind to outcome. A different rater coded all outcome data. Information necessary to the present research was extracted by the principal researcher from the coding sheets of the files. For patients with more than one admission to Riverview in 1994, only the latest was coded. Outcome measures were obtained from British Columbia Correctional Client History Forms, which record every contact a person has with the Courts and correctional institutions of B.C., re-admission records from Riverview Hospital, and admission records

[8] Although several types of statistical analyses are being used, power calculations are based on the multiple regression procedure because it is with this procedure that the largest number of predictors will be used simultaneously in one analysis.

[9] These are, componentialized: the H, C, and R scales from the HCR-20, Part 1 and Part 2 from the PCL:SV, and McNiel and Binder's scheme.

from general hospitals around the province of British Columbia.[10] The follow-up period ranged from a minimum of 312 days to a maximum of 1053 days (M = 690.26; SD = 184.31), depending on when in 1994 each participant was released from hospital.

Although the follow-up procedure does not include collateral sources (e.g., family or friends) or interviews with the patients in the community, which would be preferable, it includes multiple sources which should suffice for detecting an adequate base rate of post-release violence. Harris et al. (1993) employed purely archival means of detecting follow-up violence, and the base rate of violence in their study was 31%. Menzies and Webster (1995), also using archival means to measure violence, found that after one year, 35% of their sample had been violent, and after three years, 52%. Although these studies used samples of forensic psychiatric patients, which may be expected to yield greater base rates of violence than psychiatric patients, they demonstrate that archival means of measuring violence are not necessarily doomed to fail. In the research by McNiel, Binder, and colleagues, which employs psychiatric patients, the base rates for physical assaultiveness in the two weeks prior to hospitalization are typically 20-25%, and for physical assaultiveness and threatening behaviour combined, 50%. Similar prevalence rates are observed in the hospital. Research by Steadman et al. (1996), Swanson et al. (1996), and Lidz et al. (1993) places community violence by psychiatric patients in various cities in the United States at approximately 45%. Post-release arrest rates for violent offences in the present sample can be expected to be relatively low. Klassen and O'Connor (1988b), whose sample was selected in part because of past violence or because of an a priori presumption of high violence risk, found that 19 of 239 (13%) patients were arrested for violent offences after release from hospital. In the present study this rate likely will be lower, because participants are not selected as a function of past violence. However,

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[10] A list of which hospitals were contacted, and which complied with a request made under the Freedom of Information and Protection of Privacy Acts for access to personal

rehospitalization rates are expected to be high, and many of these likely will involve aggression in the presenting problem (based on McNiel and Binder's work -- 20-50%). So, although forensic samples may produce greater levels of violence than psychiatric samples, the particular outcome measures to be used in the present research are expected to yield base rates which will not hamper dramatically the performance of statistical tests.

Measures

The three main measures were the HCR-20 (Webster et al., 1995), the PCL:SV (Hart et al., 1996), and McNiel and Binder's (1994a) scale. All items on the HCR-20 and the PCL:SV are coded 0 (*available information contraindicates the presence of the item*), 1 (*available information suggests the* possible *presence of the item*), or 2 (*available information indicates the presence of the item*). Both schemes leave the rater with the option of omitting items if there is insufficient information to make an informed judgment. In such cases, a total score can be pro-rated. The items in McNiel and Binder's (1994a) scheme are scored 0 (*the item is absent*) or 1 (*the item is present*). For each patient, information about the following domains also was collected: (1) childhood maladjustment and maltreatment; (2) criminological history; (3) psychiatric history; (4) psychiatric diagnostic information from the index admission; (5) mental status and psychiatric symptomatology from index admission at admission and discharge; (6) life situation; (7) behaviour during current hospitalization; and, (8) past and current substance abuse. The variables which comprise these domains are included in the coding protocol in Appendix B.

Concerning the dependent or outcome measure, violence was defined in a similar manner to McNiel and Binder's definition (see McNiel et al., 1988). This includes a demarcation between physical and non-physical aggression. Physical aggression refers to any attacks on persons. Non-physical aggression includes threats to harm a person, verbal attacks on persons, and "fear-inducing" behaviour such as attacks on objects. Violent

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information of patients can be found in Appendix A.

crime was coded separately to allow for separate analyses, although typically it would also be coded as physical violence. Violent offences were defined as offences which are defined by harm to other persons (assaults, sexual offences) or the potential harm to others (weapons offences, robbery). Appendix C contains coding procedures for dependent measures.

Statistical Analyses

The main statistical procedures employed were receiver operator characteristics (ROCs) and the areas under their curves (AUC), survival analyses, and multiple regression analyses. Since the first two of these procedures are used with less frequency in psychology than regression models are, they will be described here.

Receiver operator characteristics. ROCs have been used in the area of radiology (Lusted, 1978), radar signal detection, and sensory psychology since the 1950s and 1960s (Metz, 1984). Mossman (1994a, 1994b) and Rice and Harris (1995) suggest the use of ROCs in the area of risk assessment because they are less dependent on the base rate of the criterion variable in the sample (in the present case, violence) than are traditional measures of predictive accuracy derived from 2 x 2 contingency tables (such as false positives and false negatives). Since the size of correlations diminish with departures from base rates of 50%, and because in risk assessment research the base rate of violence is often less than 50%, correlational techniques typically are not the most effective means to estimate the predictive efficiency of a risk assessment instrument (Rice & Harris, 1995).

A decided advantage of ROCs is the separation of two decision-making tasks which typically are confounded by other measures of prediction: (1) the ability of the predictor to discriminate between groups; and, (2) the trade-off between specificity and sensitivity which the decision maker must decide upon (Metz, 1984). ROCs also allow for the comparison of various thresholds on the predictor measures for offering predictions of violence, an overall index of accuracy which accounts for all possible thresholds, the

simple identification of the optimal threshold, and the comparison of two or more predictors (Hsiao, Bartko, & Potter, 1989; Lusted, 1978; Metz, 1984; Mossman, 1994a; 1994b; Mossman & Somoza, 1991).

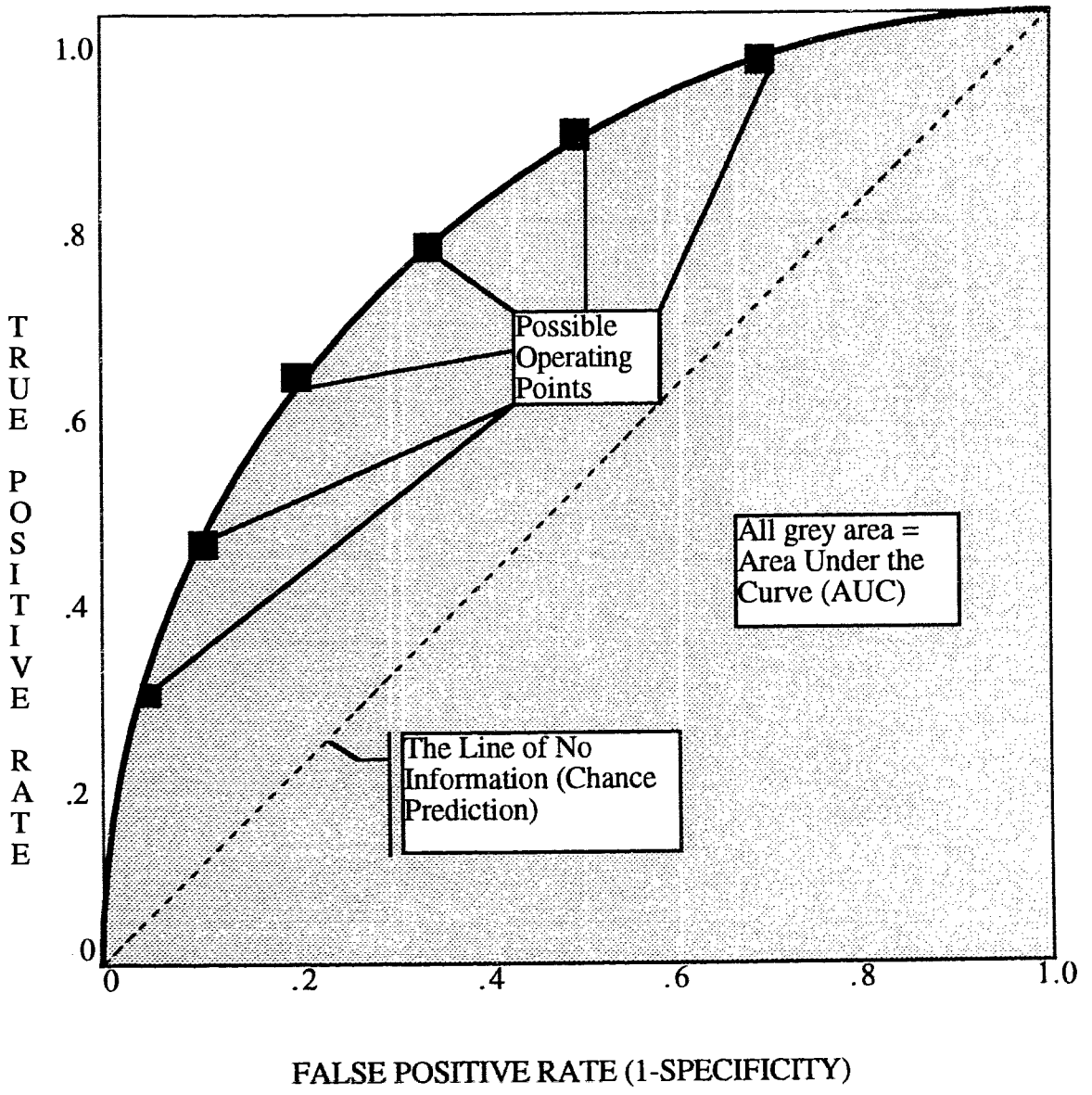
The term "receiver operator characteristic" took its name because it describes the detection, or prediction, "characteristics" of the test, and the "receiver" of the data can "operate" at any given point on the curve (Metz, 1978). ROCs are meant to be applied to data which are comprised of a continuous predictor variable and a dichotomous dependent measure. They take the form of a figure (see Figure 2 for an example) with the sensitivity (true positive rate [TPR]) of the predictor plotted as a function of the false positive rate (FPR [1-specificity]) (Mossman & Somoza, 1991). The "receiver" can then understand the predictive performance across all possible thresholds on the predictor measure in terms of the trade-off between the TPR and FPR. For any given level of specificity, the receiver knows the sensitivity. Each point on the curve (which corresponds to a cut-off on the predictor) represents a different trade-off between sensitivity and specificity (Metz, 1984). Predictions can then be made which optimize either index. Alternatively, a threshold can be chosen which optimizes neither index but which minimizes errors in both domains (i.e., minimizes the proportion of actually violent people who are not defined as such, and minimizes the proportion of actually nonviolent persons who are classified as violent). Typically, the point which lies closest to the upper left corner of the figure is considered to represent the threshold which accomplishes this (Mossman & Somoza, 1991). The decision about which cut-off to choose is at least partially determined by the nature of the prediction being made, the costs involved with both types of errors, and any policy issues which may surround it. For the present purposes, both types of errors are considered equally costly, and hence the "best" cut-off will be defined as the one which minimizes both types of errors as much as possible.

The AUC can be taken as an index for interpreting the overall accuracy of the predictor. Areas can range from 0 (perfect negative prediction), to .50 (chance prediction), to 1.0 (perfect positive prediction). The interpretation of the AUC is as follows. A given area represents the probability that a randomly chosen person who scores positive on the dependent measure (in this study, is actually violent) will fall above any given cut-off on the predictor measure, and that an actually non-violent person will score below the cut-off (Mossman & Somoza, 1991). Thus, an area of .75 means that there is a 75% chance that an actually violent person would score above the cut-off for violence on the predictor, and an actually non-violent person would score below the cut-off.

Survival curves. This type of analysis takes its name from the studies which originally employed it -- life expectancy studies of cancer patients (Streiner, 1995). Survival curves can be used to compare the performance of two or more groups in terms of (a) whether the members of the groups are positive on the dependent measure (i.e., are violent), and (b) the time it takes members of the groups to become positive (i.e., time passed until first violent incident). In contrast to ROC analysis, the predictor measure in survival analysis is categorical (i.e., either above or below a threshold on a prediction instrument), and the dependent measure of time to first violent incident is continuous. The probability of violence can be calculated for each group by dividing the number of people who were violent by the total number per group (Streiner, 1995). One can test for differences between the curves with the "Mantel-Cox chi-square" test, which involves determining the number of people in each group who would be expected to be violent given that the predictive test had no predictive ability, and then comparing these expected values with the observed differences in values between the two groups (Streiner, 1995). The "Cox proportional hazards model" essentially does the same analysis, but also adjusts for specified covariates (Streiner, 1995).

Figure 2

A Sample ROC Curve



Analyses for Preliminary Research Question

These analyses apply to the HCR-20, PCL:SV, and McNiel and Binder's scheme only. Distribution of scores was determined with histograms. Indexes of central tendency included arithmetic mean, median, and mode. Dispersion was estimated with standard deviation, interquartile range (IQR), and range. Stability of the test scores was established by calculating standard errors. Percentiles of scores also were calculated.

Analyses for Research Question One: "To assess the accuracy of the HCR-20 to predict violence in a sample of psychiatric patients who have been released into the community"

This set of analyses applies only to the HCR-20. The first analyses were conducted with dichotomous outcomes (violent versus not violent). Separate ROC analyses were performed using HCR-20 total score as the predictor, with any violence, physical violence, and violent crime as dependent measures. Then, scores from the H, C, and R scales were included in separate ROC analyses in order to determine their predictive characteristics. For all ROC analyses, the AUC was determined using the statistical program ROCFIT (Metz, Shen, Wang, & Kronman, 1989).

The next set of analyses centered around continuous outcome measures. Survival analysis was used to compare the performance of two groups: (1) those who scored at or above the threshold of the HCR-20 total scores determined with ROC analysis, and (2) those who fell below it. The best cut-off score of the HCR-20, or "threshold", was defined as the score which corresponds to the point on the ROC curve which is closest to the upper-left corner of the ROC space. Regression analyses were performed to determine which of the three HCR-20 scales contributed most to the HCR-20's relationship with violence. The H, C, and R scale scores were entered into multiple linear regressions as predictors of number of violent acts and rate of violence for any violence, physical violence, and violent crime.

Analyses for Research Question Two: "To compare the predictive utility of the HCR-20 to the PCL:SV and McNiel and Binder's scheme"

The first set of analyses used HCR-20 total scores, PCL:SV total scores, and McNiel and Binder scores as predictors of violence in ROC analyses. For a finer gradient of analysis, the H, C, and R scales, Parts 1 and 2 of the PCL:SV, and McNiel and Binder's scheme were entered into ROC analyses.

These ROC analyses were coupled with multiple regression analyses. First, total scores from the HCR-20, PCL:SV, and McNiel and Binder's scheme were used as predictors of the number and rate of (1) any violence, (2) physical violence, and (3) violent crime. Then, the H, C, and R scale scores, Parts 1 and 2 from the PCL:SV, and McNiel and Binder's scheme were used as predictors, again, of the number and rate of any violence, physical violence, and violent crime.

Inter-rater Reliability

Inter-rater reliability was assessed by having a second coder rate 20 (10%) randomly chosen files which originally were coded by the main coder. Reliability was conducted only for the HCR-20, PCL:SV, and McNiel and Binder's instrument because the remainder of the coding was objective (i.e., had/did not have delusions, past violence, substance abuse, etc.). The Pearson correlation co-efficient for the HCR-20 full scale score between raters was 0.82, for the PCL:SV, 0.85, and McNiel and Binder's tool, 0.81. Concerning subscales, for the H scale the co-efficient was 0.89, for the C scale (at discharge) it was 0.72, and for the R scale, 0.81. For Part 1 of the PCL:SV, the correlation between raters was 0.74, and for Part 2 it was 0.79. These co-efficients, though somewhat less than preferable (i.e., 0.90), are acceptable.

Results

Preliminary Research Question

Sample Characteristics

As shown in Table 1, the sample was 62.0% male, with an average age at discharge of approximately 38. Most participants had never been married or common-law, and the vast majority (92.5%) were not employed at admission, nor had they been employed for the past five years. Many participants had criminal histories (41.0%), and most had previous psychiatric hospitalizations (90.5%). The most frequent discharge diagnosis was schizophrenia (37.5%), followed by mood disorders (21.5%).

Base Rates of Violence in the Follow-Up

Of the 200 participants, 60 (30%) were identified as having performed "any violent act" in the community during the follow-up. Thirty-three (16.5%) participants were physically violent, and 19 (9.5%) committed violent criminal acts.

Characteristics of the Predictive Instruments

These analyses describe the distributions, central tendencies, dispersions, and stabilities of the three main predictors and their components. Percentile scores also were calculated. The distributions of the HCR-20 total scale and its three sub-scales are shown in Figures 3 through 7. Distributions are displayed for Clinical Scale at admission (Figure 5) and at discharge (Figure 6). As can be seen, The HCR-20 total scores (using the C Scale from discharge) appear to be distributed approximately normally (Figure 3), as do the H Scale scores (Figure 4). The skew of the Clinical Scale changes from negative to positive between admission (Figure 5) and discharge (Figure 6), respectively. The R Scale scores approximate a normal distribution (Figure 7).

Table 1

Demographic and Diagnostic Characteristics of Sample

Characteristics	N (%) or Mean (SD)
Gender	
Male	124 (62.0)
Female	74 (37.0)
Age at Discharge	38.35 (14.91)
Length of Index Hospitalization (Days)	168.2 (441.87)
Range	3-5578
Ethnicity	
Caucasian	158 (79.0)
Aboriginal	10 (5.0)
Asian	5 (2.5)
Black	3 (1.5)
Other	18 (9.0)
Unknown	6 (3.0)
Highest Educational Level (Grade)	10.25 (2.18)
Marital Status	
Married or Common-Law	27 (13.5)
Never Married or Common-Law	129 (64.5)
Divorced or Separated	37 (18.5)
Widowed	7 (3.5)
Children (N/% Yes)	62 (31.0)
Employed at Admission	15 (7.5)
Has not Sustained Stable Employment for Five Years	129 (64.5)
Criminal History	82 (41.0)
Violent Offences	56 (28.0)
Sexual Offences	6 (3.0)
Property Offences	55 (27.5)
Disturbing the Peace/Mischief	31 (15.5)
Breach of Legal Conditions	32 (16.0)
Other	39 (19.5)

Aggression in the Two Weeks Preceding Admission	105 (52.5)
Physical Aggression	46 (23.0)
Verbal Aggression; Threatening Behaviour	94 (47.0)
Previous Psychiatric Hospitalizations	181 (90.5)
Only One Past Hospitalization	7 (3.5)
Two to Four Past Hospitalizations	45 (22.5)
Five to Nine Past Hospitalizations	67 (33.5)
Ten or More Past Hospitalizations	59 (29.5)
Substance Abuse (Lifetime)	152 (75.5)
Past Abuse (More than One Year Ago)	146 (73.0)
Present Abuse (At Time of Index Hospitalization)	105 (52.5)
History of Suicide Attempts	88 (44.0)
Psychiatric Symptoms at Admission	
Any Psychotic Symptoms	170 (85.0)
Delusions	160 (80.0)
Paranoid	118 (59.0)
Grandiose	84 (42.0)
Reference	33 (16.5)
Other	99 (49.5)
Hallucinations	99 (49.5)
Visual	31 (15.5)
Auditory	89 (44.5)
Command	19 (9.5)
Threat/Control-Overide (TCO) Symptom	86 (43.0)
Axis I Primary Discharge Diagnosis	
Schizophrenia	75 (37.5)
Paranoid	50 (25.0)
Undifferentiated	19 (9.5)
Other	6 (3.0)
Mood	43 (21.5)
Bipolar/Manic	35 (17.5)
Major Depression	5 (3.0)
Other	3 (1.5)
Schizoaffective	31 (15.5)
Organic	15 (7.5)
Substance Abuse	10 (5.0)
Other	21 (10.5)
No Diagnosis	6 (3.0)
Axis II Primary Discharge Diagnosis	
Personality Disorder Traits	30 (15.0)
Antisocial Personality Disorder	10 (5.0)
Borderline Personality Disorder	6 (3.0)
Other DSM Personality Disorder	5 (2.5)
Other Non-DSM Personality Disorder	19 (9.5)
Other	14 (7.0)
No Diagnosis	116 (58.0)

Figure 3
Distribution of HCR-20 Total Scores

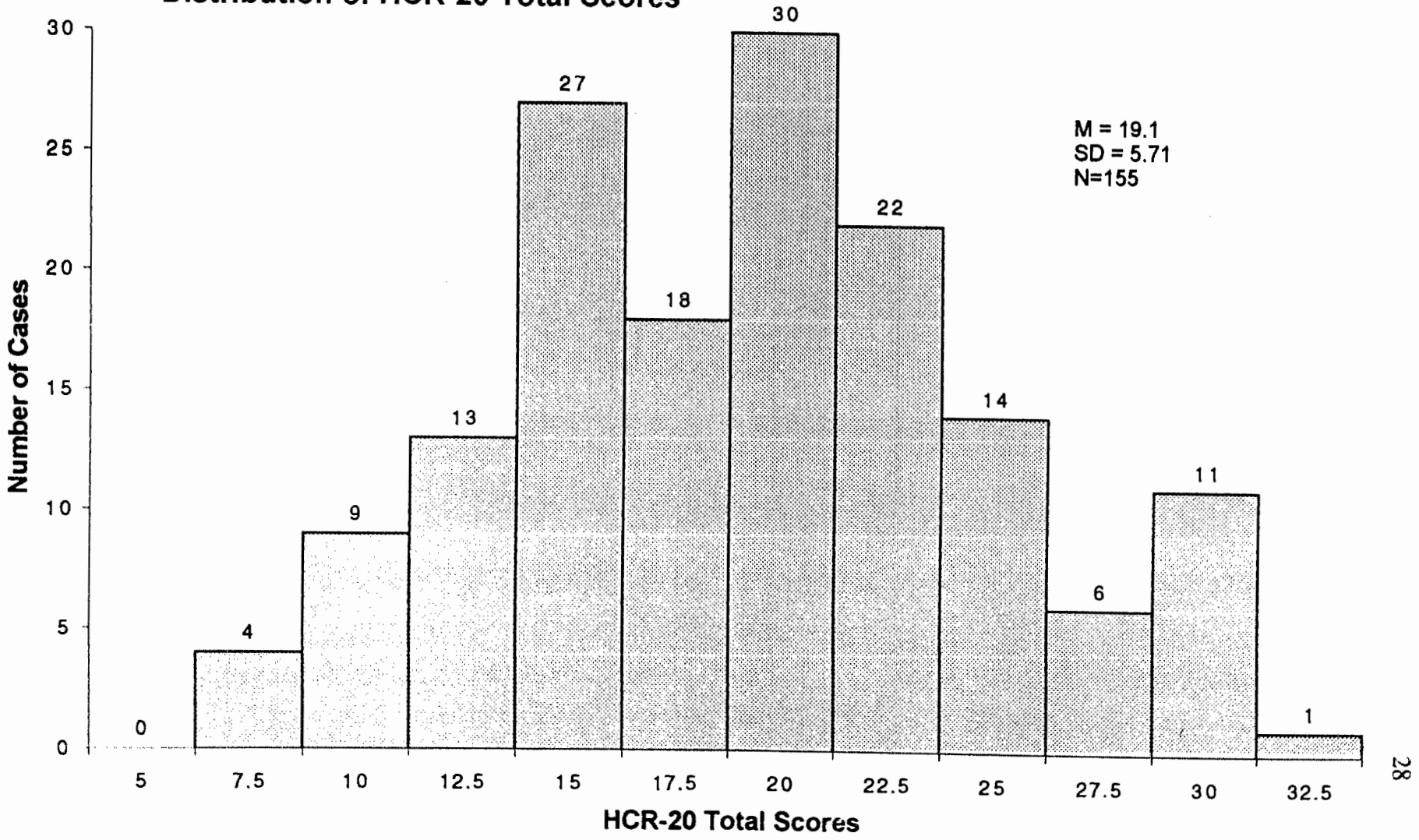


Figure 4
Distribution of HCR-20 H Scale Scores

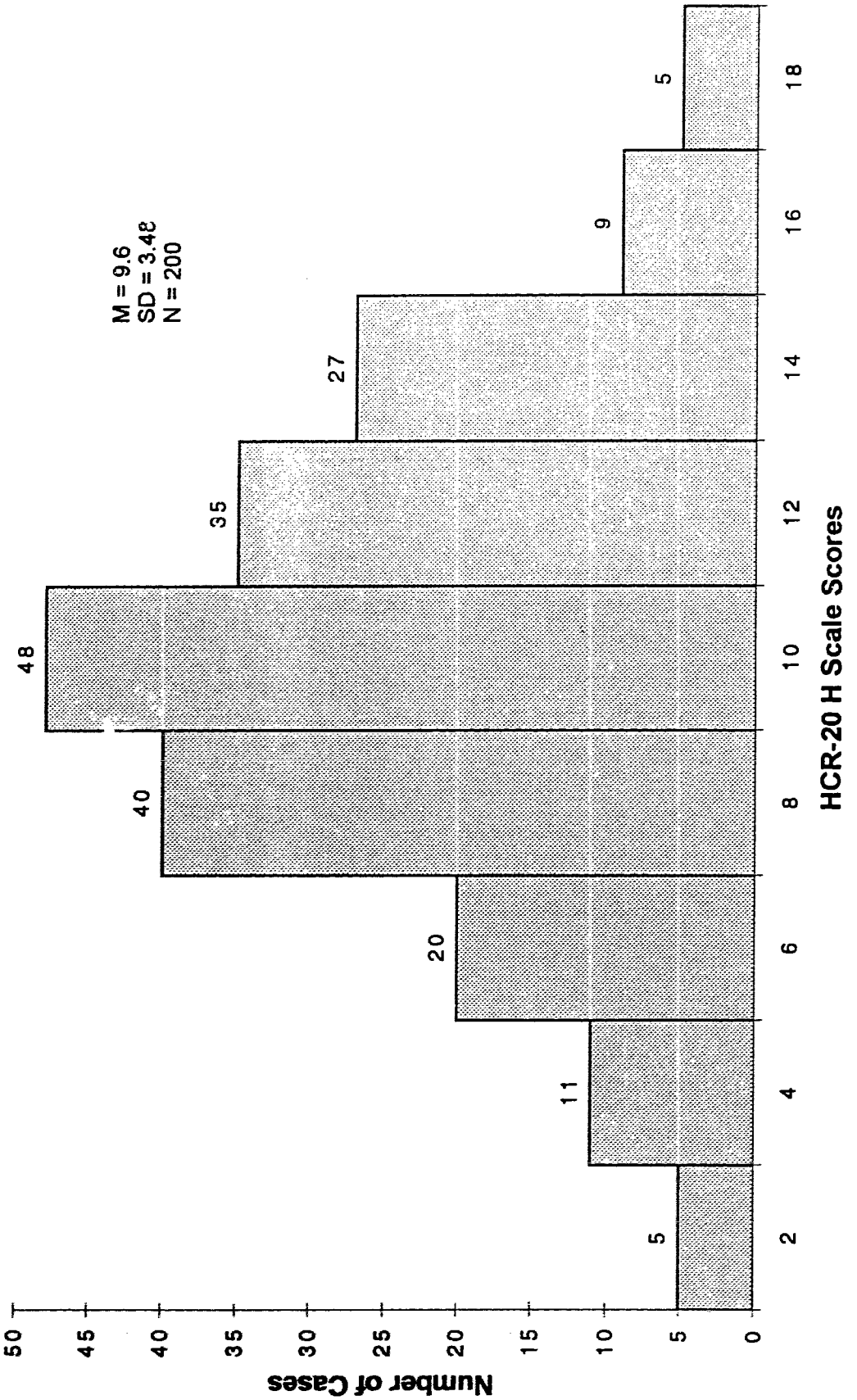


Figure 5
Distribution of HCR-20 C Scale Scores (Adm)

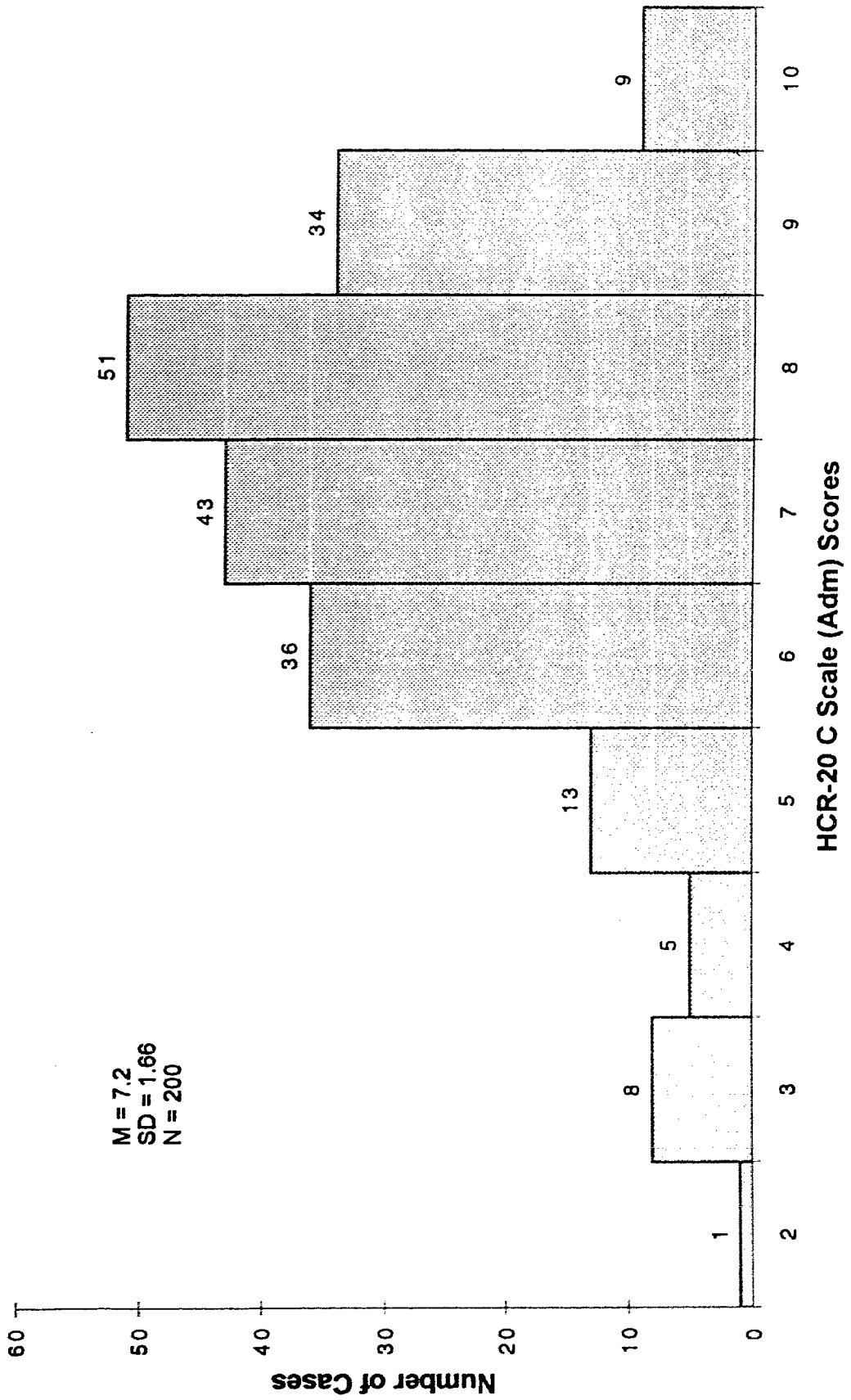


Figure 6
Distribution of HCR-20 C Scale Scores (Dis)

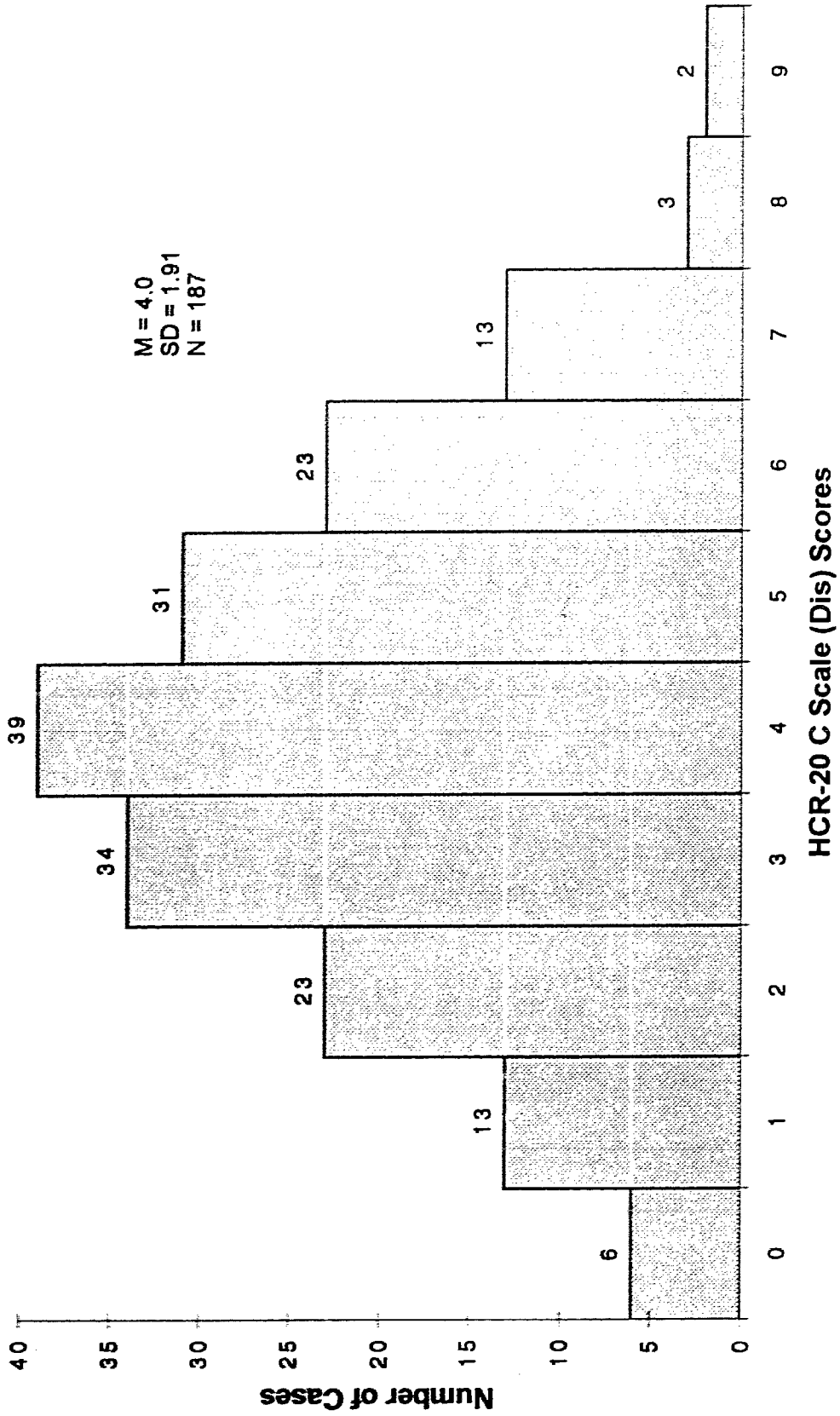
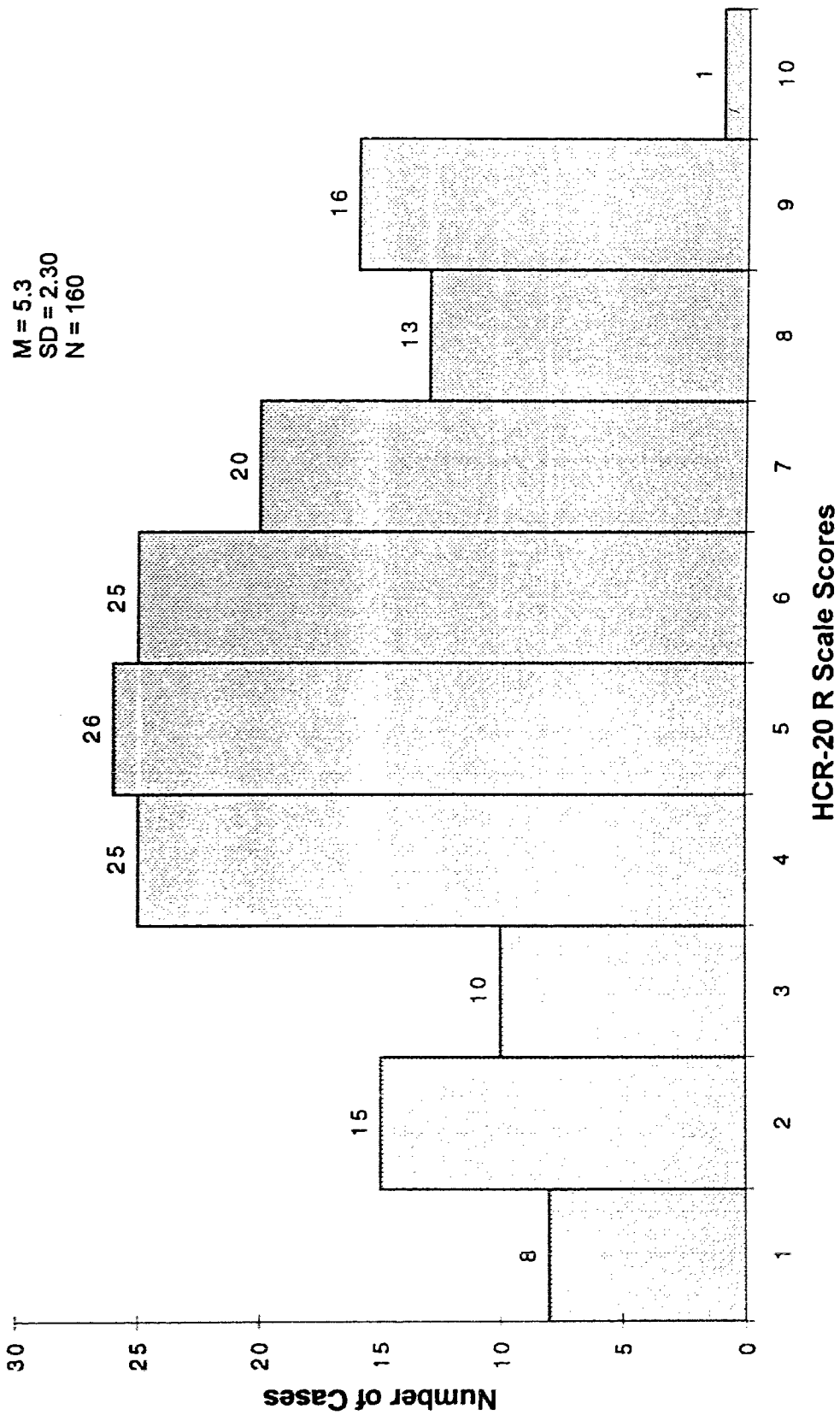


Figure 7
Distribution of HCR-20 R Scale Scores



Figures 8 through 10 display the distributions of the PCL:SV total scores (Figure 8), PCL:SV Part 1 scores (Figure 9), and PCL:SV Part 2 scores (Figure 10). Total scores cluster around the low end of the scale, indicating positive skew. This pattern also is evident for Part 1 scores. Part 2 scores more closely represent a normal distribution. Finally, the distribution of scores on the screening tool of McNiel and Binder are presented in Figure 11. This distribution is negatively skewed, although not greatly.

The means, medians, modes, standard errors (of the means), standard deviations, ranges, and inter-quartile ranges (IQR) for each predictor and its components are displayed in Table 2. The percentile ranks for the HCR-20 and PCL:SV are presented in Table 3. For McNiel and Binder's tool, the percentile ranks which attach to the five possible scores are as follows: (1) score of 5, 100.0; (2) score of 4, 99.0; (3) score of 3, 71.5; score of 2, 38.0; (4) score of 1, 16.5; (5) score of 0, 4.5.

Figure 8
Distribution of PCL:SV Total Scores

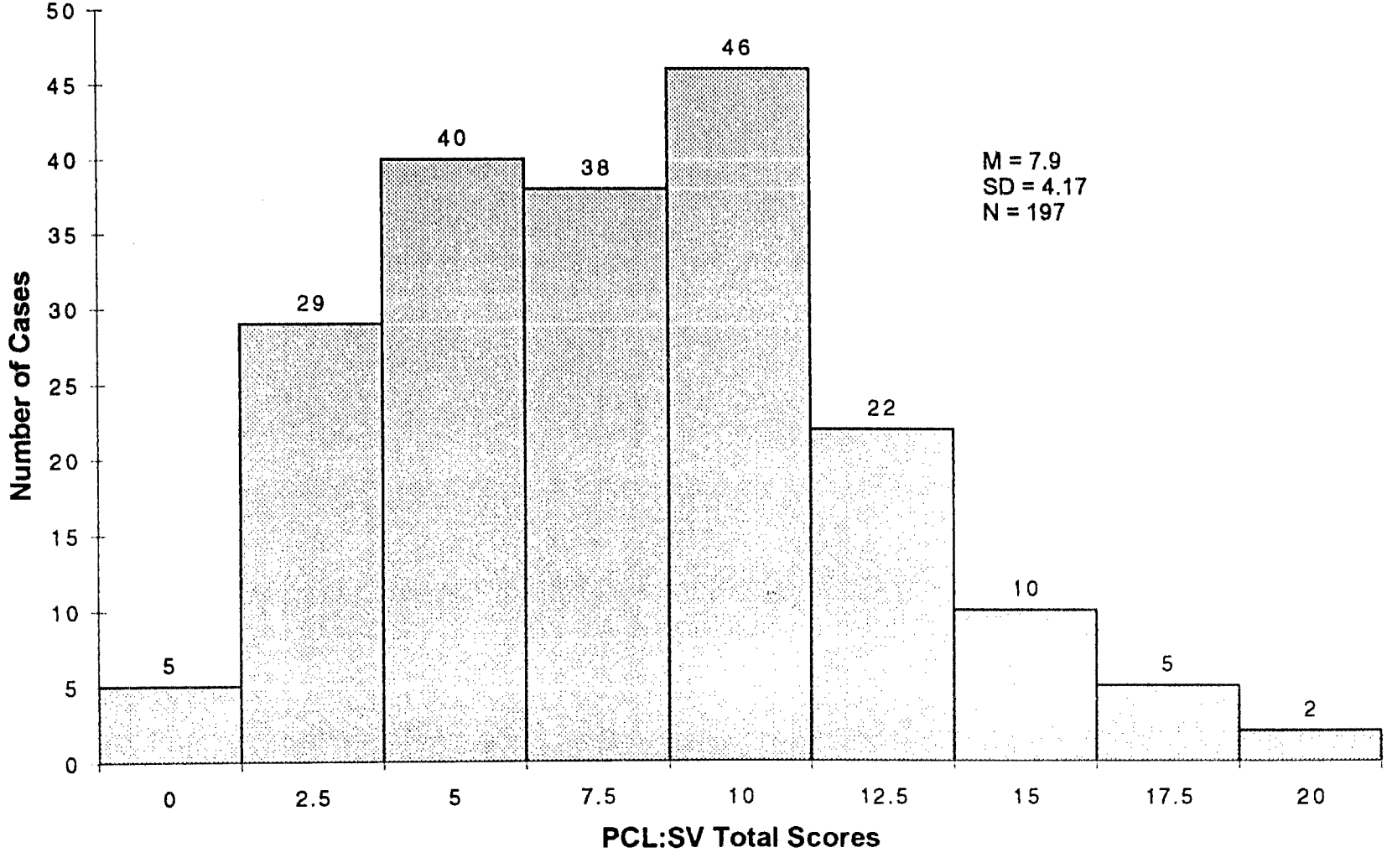


Figure 9
Distribution of PCL:SV Part 1 Scores

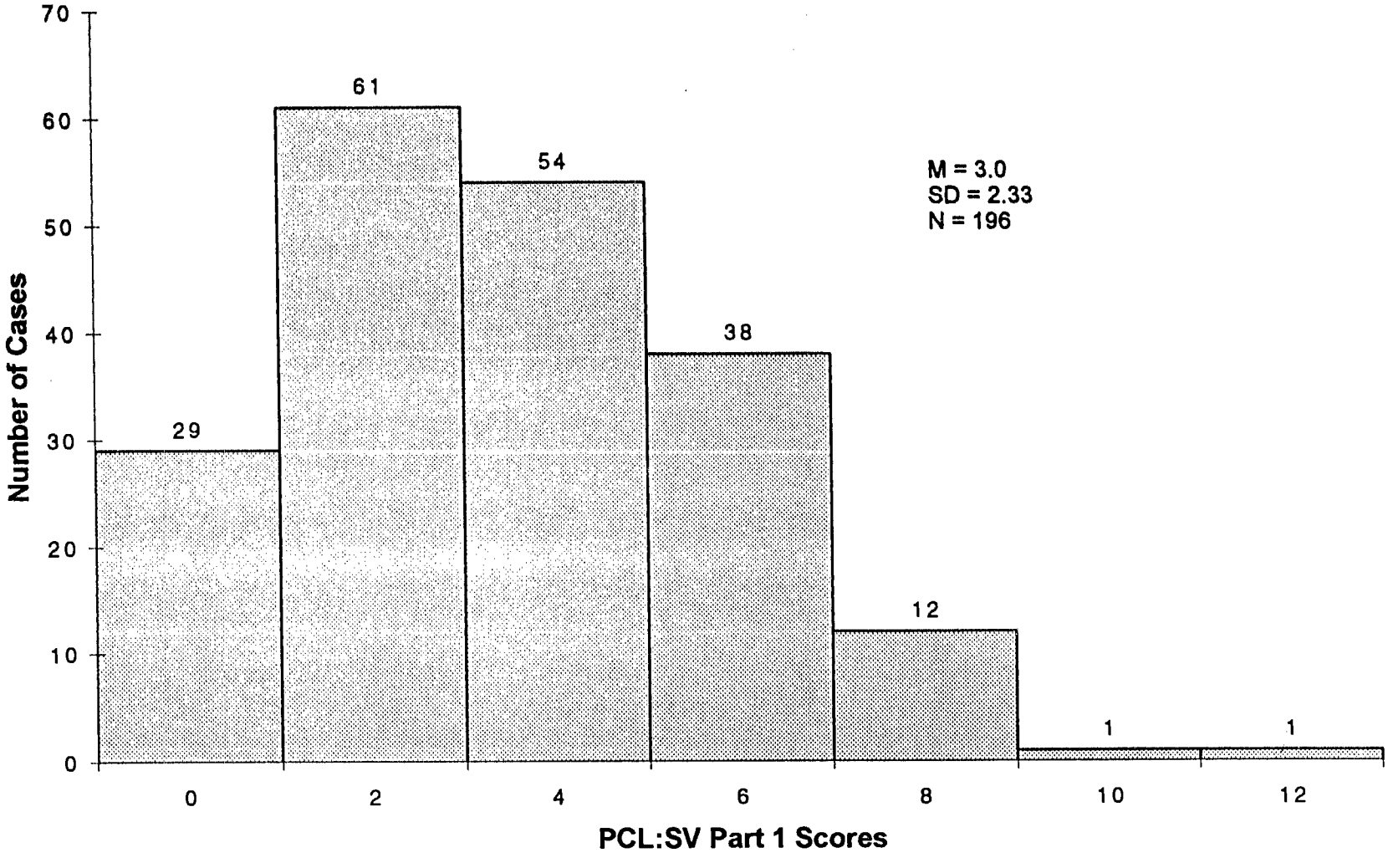


Figure 10
Distribution of PCL:SV Part 2 Scores

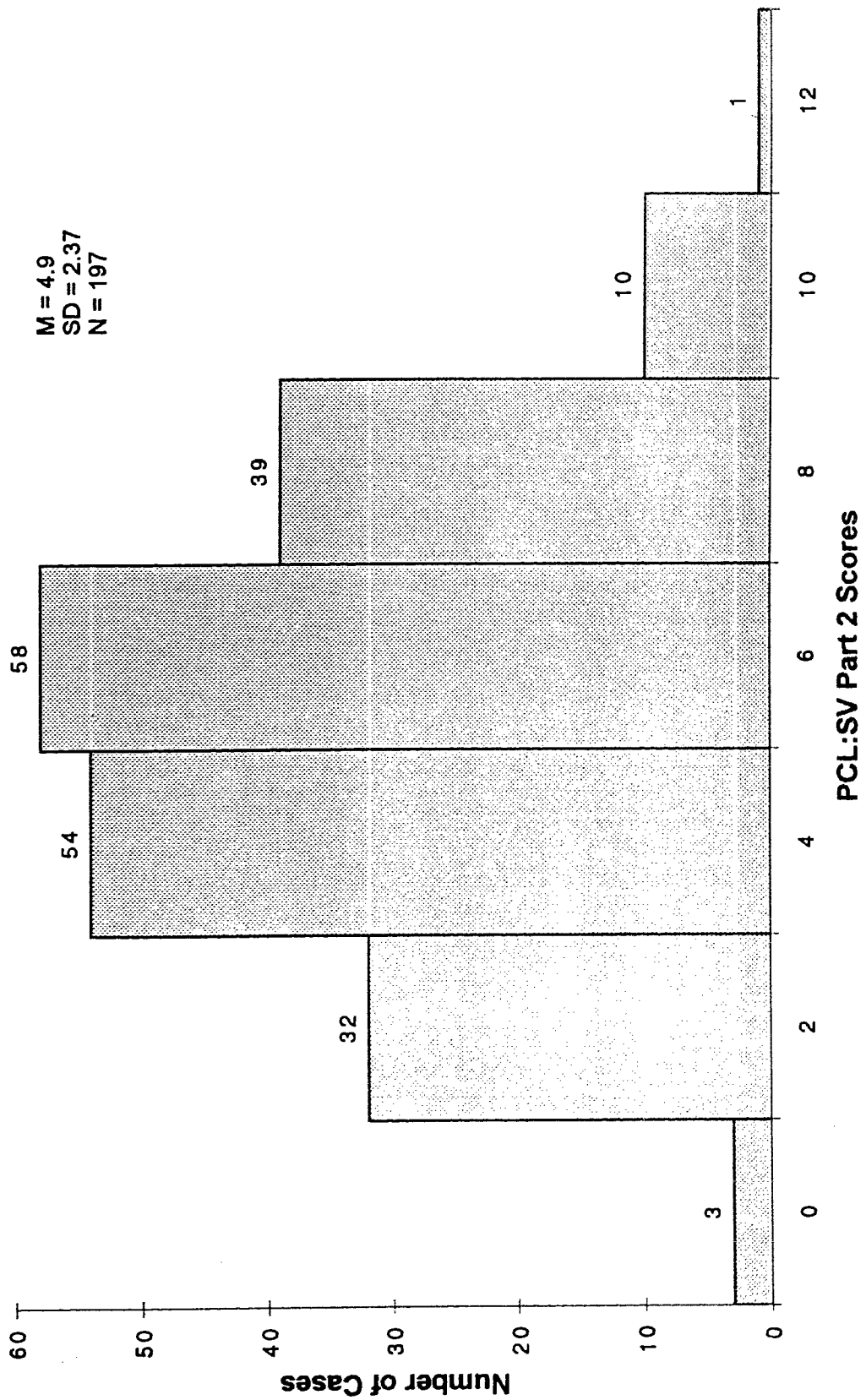


Figure 11
Distribution of M + B Screening Tool Scores

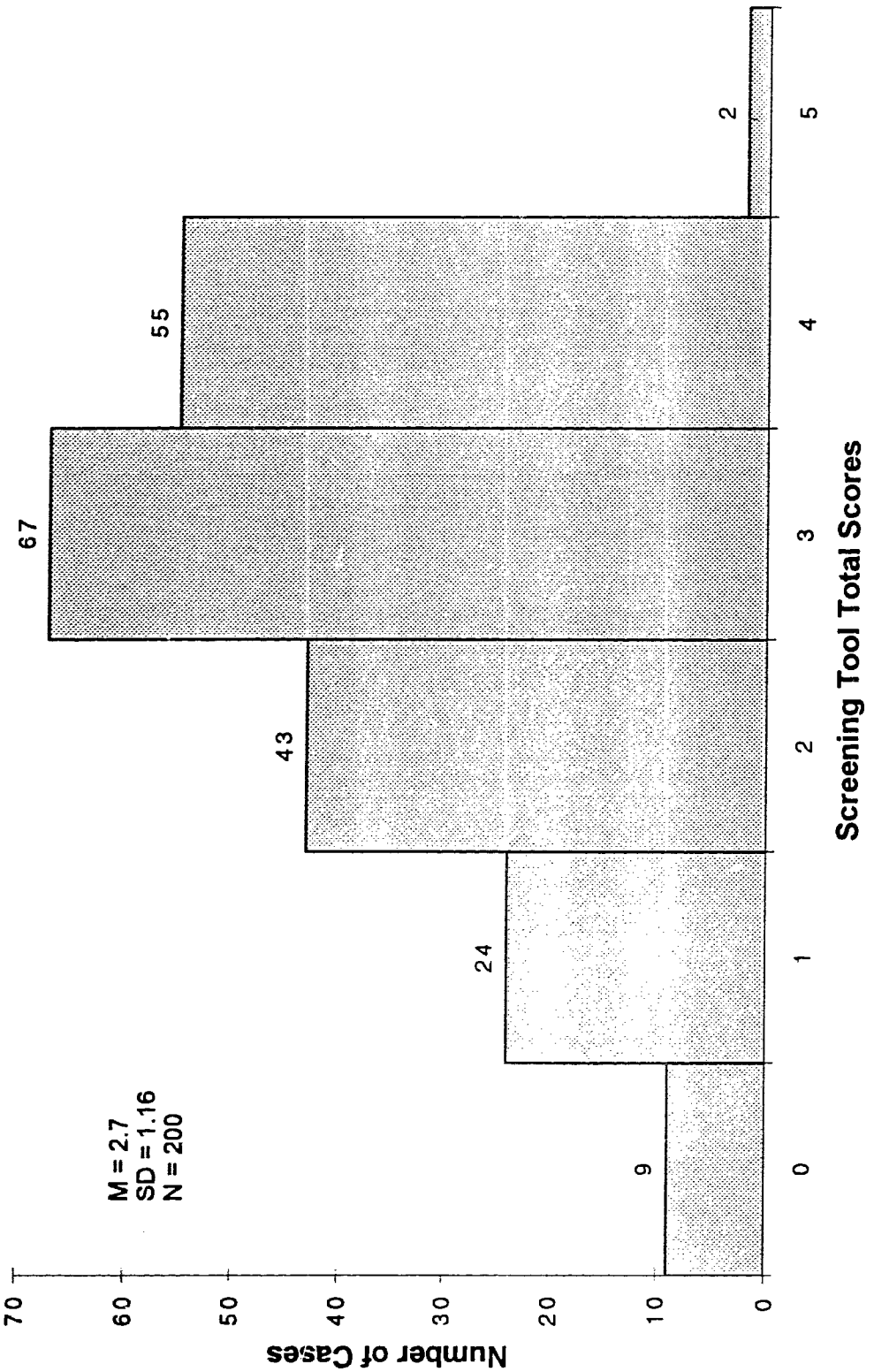


Table 2

Central Tendencies, Dispersions, and Stabilites of the HCR-20, PCL:SV, and McNiel and Binder's Tool

Measure	Mean	Median	Mode	Standard Error	Standard Deviation	Range	IQR
HCR-20 (0-40; N=156)	19.07	19.0	19.0	0.46	5.71	27.0 (6-33)	8.0 (15-23)
H Scale (0-20)	9.60	9.5	9.0	0.25	3.48	16.0 (2-18)	6.0 (7-12)
C Scale (Adm.; 0-10)	7.16	7.0	8.0	0.12	1.66	8.0 (2-10)	2.0 (6-8)
C Scale (Dis.; N=187)	3.97	4.0	4.0	0.14	1.91	9.0 (0-9)	2.0 (3-5)
R Scale (0-10; N=160)	5.29	5.0	5.0	0.18	2.30	10.0 (0-10)	3.0 (4-7)
PCL:SV (0-24; N=197)	7.91	8.0	9.0	0.30	4.17	21.0 (0-21)	6.0 (4.5-5.5)
Factor 1 (0-12; N=196)	3.01	3.0	1.0	0.17	2.33	12.0 (0-12)	4.0 (1-5)
Factor 2 (0-12; N=197)	4.86	5.0	3.0	0.17	2.37	11.0 (0-11)	4.0 (3-7)
McNiel and Binder (0-5)	2.71	3.0	3.0	0.08	1.16	5.0 (0-5)	2.0 (2-4)

Note. Ranges of values in parentheses beside the measures' names indicate the full range of the measures' potential scores. N=200 unless otherwise noted. HCR-20 total scores calculated with clinical scale from discharge.

Table 3

Percentile Ranks for the HCR-20 and PCL:SV

	HCR-20				PCL:SV		
Score	Scales				Scales		
	Total	H N=200	C N=187	R N=160	Total N=197	Part 1 N=196	Part 2 N=197
34-40							
33	100.0						
32							
31	99.4						
30	98.1						
29	96.2						
28	92.3						
27	91.0						
26	88.5						
25	85.9						
24	84.6				100.0		
23	79.5				100.0		
22	71.8				100.0		
21	65.4				100.0		
20	60.9	100.0			99.5		
19	55.1	100.0					
18	46.2	100.0			99.0		
17	39.7	99.0			98.5		
16	34.6	97.5			96.4		
15	27.6	95.0			94.9		
14	23.1	93.0			92.9		
13	17.3	85.5			91.4		
12	11.5	79.5			85.8	100.0	100.0
11	9.0	68.5			80.2		100.0
10	6.4	62.0	100.0	100.0	75.1	99.5	99.5
9	3.8	50.0	100.0	99.4	67.5		96.4
8	3.2	28.0	98.9	89.4	56.9	99.0	94.4
7	2.6	27.0	97.3	81.3	47.7	96.4	85.3
6	0.6	18.0	90.4	68.8	37.6	92.9	74.6
5	0.0	12.5	78.1	53.1	33.5	84.2	59.9
4	0.0	8.0	61.5	36.9	24.9	73.5	45.2
3	0.0	4.5	40.6	21.3	17.3	60.7	32.5
2	0.0	2.5	22.5	15.0	8.1	45.9	17.8
1	0.0	0.0	10.2	5.6	2.5	33.7	7.1
0	0.0	0.0	3.2	0.6	0.5	14.8	1.5

Note. HCR-20 Total and C Scales were calculated from discharge.

Research Question One

Receiver Operating Characteristic Analyses

HCR-20 Total Scale. These analyses apply only to the HCR-20. ROC analyses and the AUC were used to determine the extent to which the HCR-20 and its scales are able to predict violence. The first set of analyses centre around the relationship between the total score of the HCR-20 (with the clinical scale coded from discharge) and three dichotomous indexes of violence: (1) any violence; (2) physical violence; (3) violent crime. The number of cases for these analyses (n=156) is smaller than the total sample size of 200. This primarily is due to the fact that 40 R Scale total scores were not coded for patients who were transferred to other hospitals at discharge. For these patients, there was an absence of information pertaining to community release plans, even for straightforward information such as place of residence. Figures 12 through 14 present the ROCs and AUCs for each of these indexes, respectively. Each ROC which is presented was calculated from the set of cut-points which maximized the AUC. However, other sets of possible cut-points, and their respective AUCs, are presented in the notes of the Figures. Under each Figure is a table which lists the True Positive Rate (TPR or sensitivity; the proportion of actually violent persons who were predicted to be violent), False Positive Rate (FPR; the proportion of nonviolent persons who were predicted wrongly to be violent), specificity or True Negative Rate (TNR; the proportion of nonviolent persons who were predicted to be nonviolent), Positive Predictive Power (PPP; the accuracy of positive predictions), Negative Predictive Power (NPP; the accuracy of negative predictions), and odds ratio for each cut-off used in the analysis.

As is evident from the figures, the HCR-20 performed well with each index of violence, and particularly well with violent crime. The AUCs for any violence and physical violence were 0.73, and the AUC for violent crime was 0.78. These AUCs are respectably sized. For instance, in Figure 14, the AUC of 0.78 can be interpreted as the probability

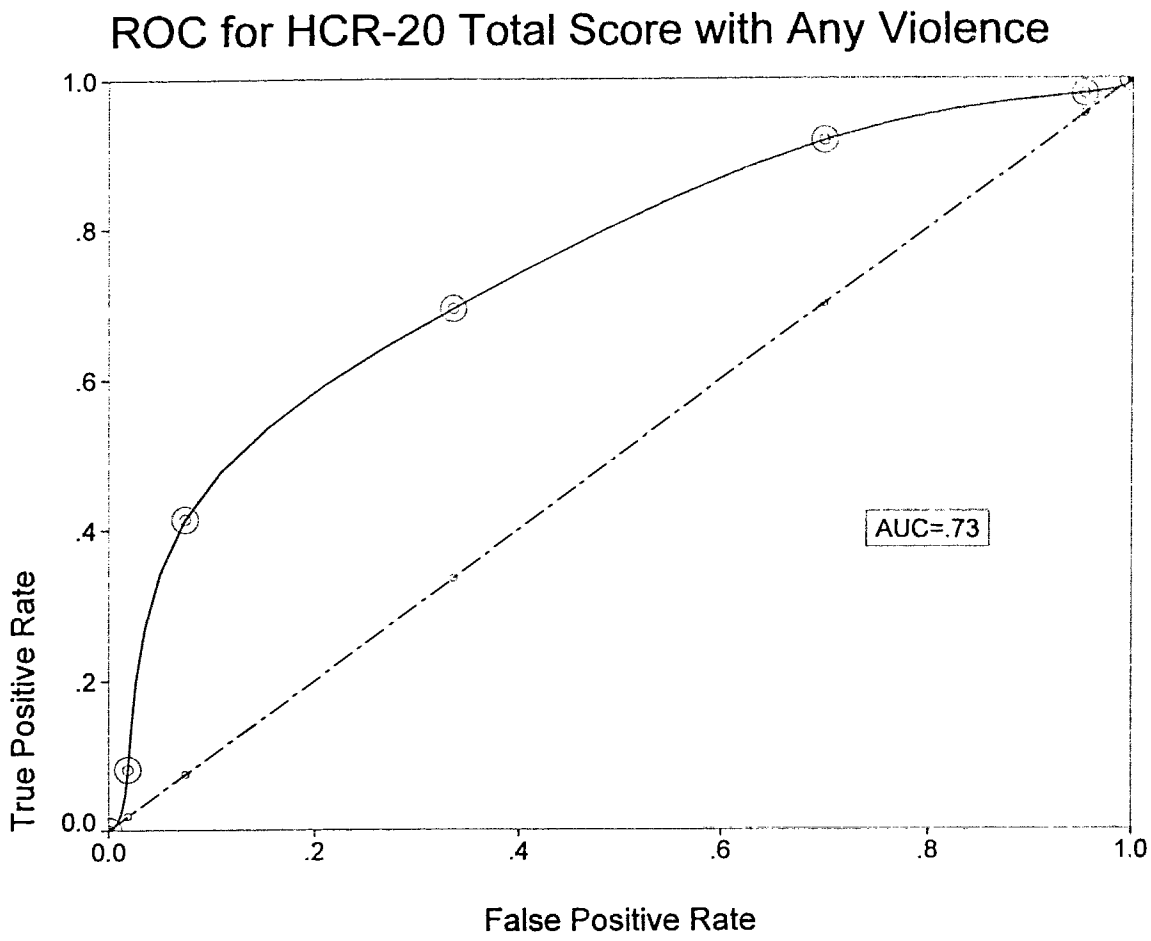
that a randomly selected, actually violent person will have a greater HCR-20 score than a randomly selected, non-violent person.

As is usually the case, trade-offs exist between the various indexes of accuracy which attach to each potential cut-off. For instance, as sensitivity increases, specificity decreases. Using the table under Figure 14 as an example, it can be determined that using a relatively low cut-off of 15/40 as the "threshold" for making a violence prediction will, in fact, accurately detect some 93% of violent persons (TPR). However, this comes at the expense of correctly classifying only about 25% of non-violent persons (specificity), and misclassifying nonviolent persons as violent at a rate of approximately 75% (FPR, the corollary of specificity).

A notable trend in these indexes across the analyses is the relatively low PPP, but high NPP. This can be interpreted to mean that the likelihood of a prediction of violence being correct is less than the likelihood of a prediction of nonviolence being correct. Referring again to the table under Figure 14, only 19% of predictions of violence made using a cut-off of 20 on the HCR-20 would be correct (this translates from 13 of 70 cases who scored at or above 20 who were violent in the follow-up). However, close to 98% of negative predictions of violence would be correct (84 of 86 persons falling below 20 did not commit a violent crime during the follow-up). Despite the low PPP, 87% of violent persons (13 of 15) would be correctly classified by using a cut-off of 20 (TPR, or sensitivity).

It is interesting to note that the HCR-20 total score, using the clinical scale from admission, produced larger AUCs for the three indexes of violence in comparison to the HCR-20 which included the C scale coded from discharge. For any violence, the AUC was 0.74, for physical violence it was 0.76, and for violent crime, it was 0.85. This may stem from the fact that the admission scores were higher, and hence could have "bumped" some persons who had acted violently into the next category (i.e., from 20-29 to 30-40).

Figure 12

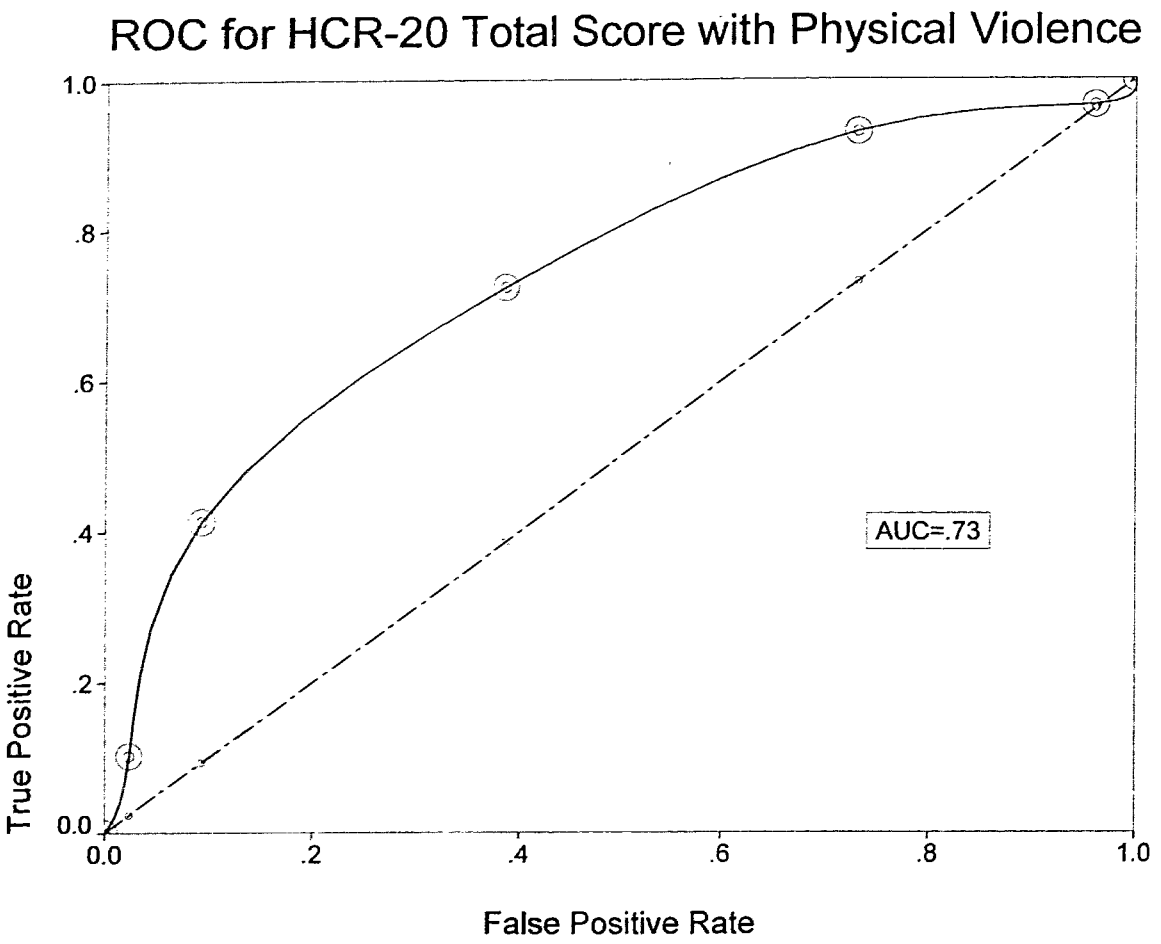


Notes. For the cut-points used for this ROC and AUC, the following statistical indexes of predictive accuracy apply.

Cut-off	TPR	FPR	Spec.	PPP	NPP	Odds
5	1.00	1.00	0.0	31.4%	0.0%	NA
10	.980	.953	.047	32.0%	83.3%	2.35
15	.918	.701	.299	37.5%	88.9%	4.80
20	.694	.336	.664	48.6%	82.6%	4.47
25	.327	.075	.925	66.7%	75.0%	6.00
30	.082	.019	.981	66.7%	70.0%	4.67
35	.000	.000	1.00	0.0	68.6%	NA

For cut-offs of 14 and 27, AUC=.73. For cut-offs of 10, 20, and 30, AUC=0.72. For cutoffs of 8, 16, 24, and 32, AUC=0.72.

Figure 13

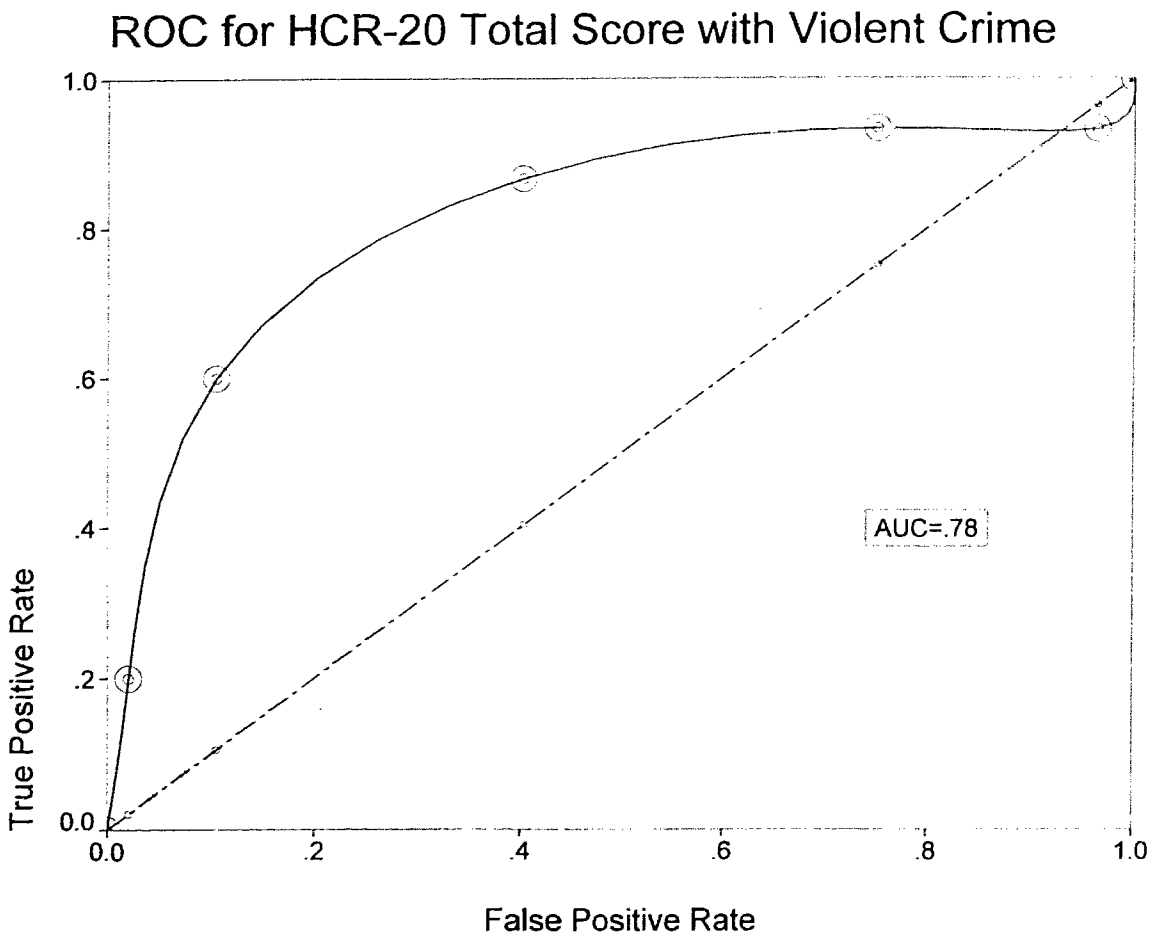


Notes. For the cut-points used for this ROC and AUC, the following statistical indexes of predictive accuracy apply.

Cut-off	TPR	FPR	Spec.	PPP	NPP	Odds
5	1.00	1.00	0.00	18.6%	0.0%	NA
10	.966	.961	.039	18.7%	83.3%	1.15
15	.931	.732	.268	22.5%	94.4%	4.94
20	.724	.386	.614	30.0%	90.7%	4.18
25	.414	.094	.906	50.0%	87.1%	6.76
30	.103	.024	.976	50.0%	82.7%	4.77
35	0.00	0.00	1.00	0.0%	81.4%	NA

For cut-offs of 14 and 27, AUC = 0.70. For cut-offs of 10, 20, and 30, AUC = 0.70. For cutoffs of 8, 16, 24, and 32, AUC = 0.70.

Figure 14



Notes. For the cut-points used for this ROC and AUC, the following statistical indexes of predictive accuracy apply.

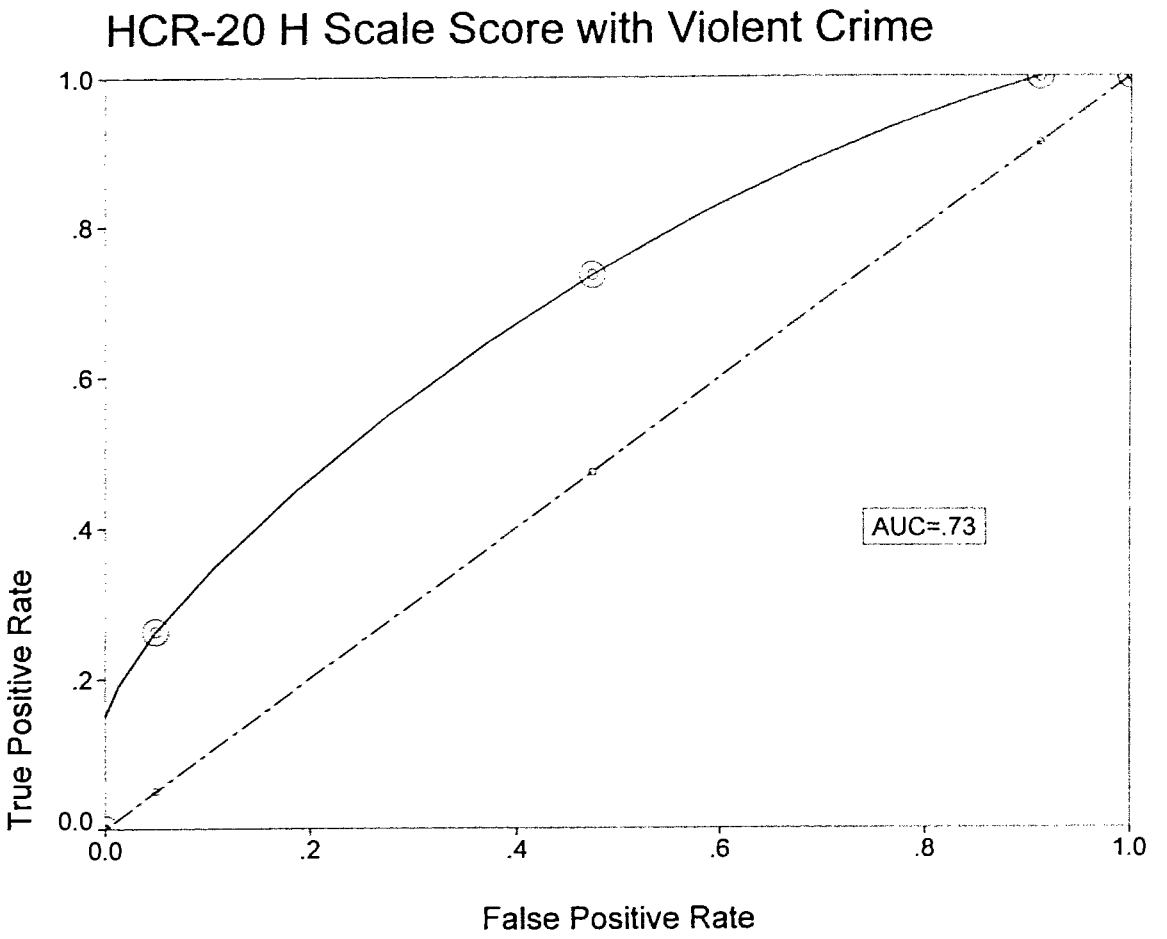
Cut-off	TPR	FPR	Spec.	PPP	NPP	Odds
5	1.00	1.00	0.0	9.0%	0.0%	NA
10	.933	.965	.035	9.3%	83.3%	0.51
15	.933	.752	.248	11.7%	97.2%	4.62
20	.867	.404	.596	19.0%	97.7%	9.58
25	.600	.106	.894	37.5%	95.5%	12.6
30	.200	.021	.979	50.0%	91.9%	11.4
35	.000	.000	1.00	0.0%	90.4%	NA

For cut-offs of 14 and 27, AUC=.77. For cut-offs of 10, 20, and 30, AUC=0.76. For cutoffs of 8, 16, 24, and 32, AUC=0.73.

HCR-20 H, C, and R Scales. The individual H, C (from discharge), and R scale ROCs and AUCs are portrayed in Figures 15 through 17, respectively. The number of cases for the H, C, and R analyses are 200, 187, and 160, respectively. The ROCs and AUCs which are displayed are those which contain the largest AUC for each scale, regardless of type of violence. As it turns out, the largest AUC for each scale was for violent crime. As with the previous Figures for the HCR-20 total scores, the AUCs for other ROC analyses (i.e., derived from different cut-points) are noted as part of the Figures. Additionally, the ranges of AUCs for the other two indexes of violence (i.e., any violence and physical violence) are listed under the Figures.

It is evident that the R scale (AUC=.85) outperformed the C scale (AUC=.73) and the H scale (AUC=.73), despite the fact that the AUCs for these latter scales were not small. It also is apparent from the information described under the Figures that all the scales performed better with violent crimes than with any violence or physical violence.

Figure 15



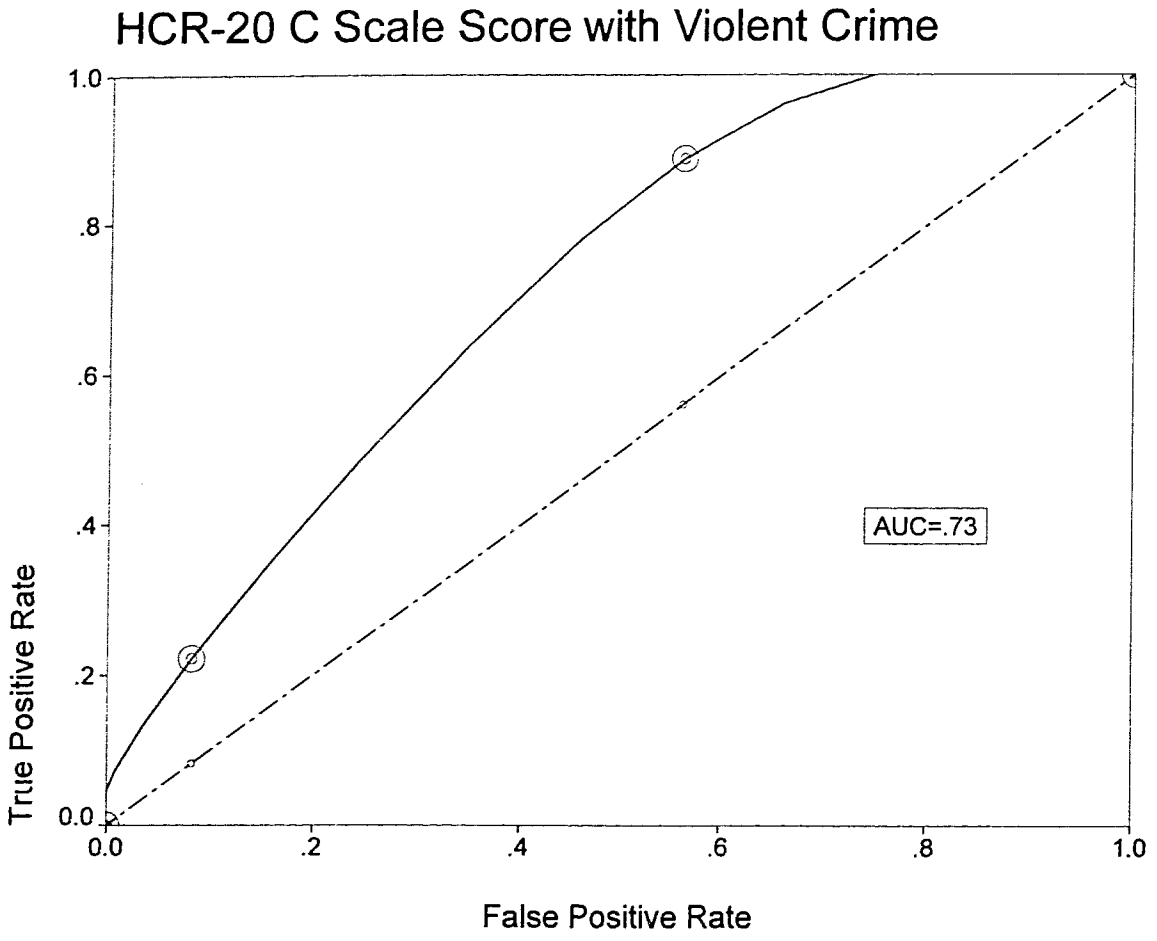
Notes. For the cut-points used for this ROC and AUC, the following statistical indexes of predictive accuracy apply.

Cut-off	TPR	FPR	Spec.	PPP	NPP	Odds
5	1.00	.912	.088	10.3%	100.0%	3.89
10	.737	.475	.525	14.0%	95.0%	3.09
15	.263	.050	.950	35.7%	94.5%	9.56

For cut-offs of 7 and 14, AUC = 0.72. For cut-offs of 4, 8, 12, and 16, AUC = 0.72.

For any violence, the largest AUC was 0.71(range = 0.63, 0.70, 0.71). For physical violence, the largest was 0.68 (range = 0.65, 0.66, 0.68).

Figure 16



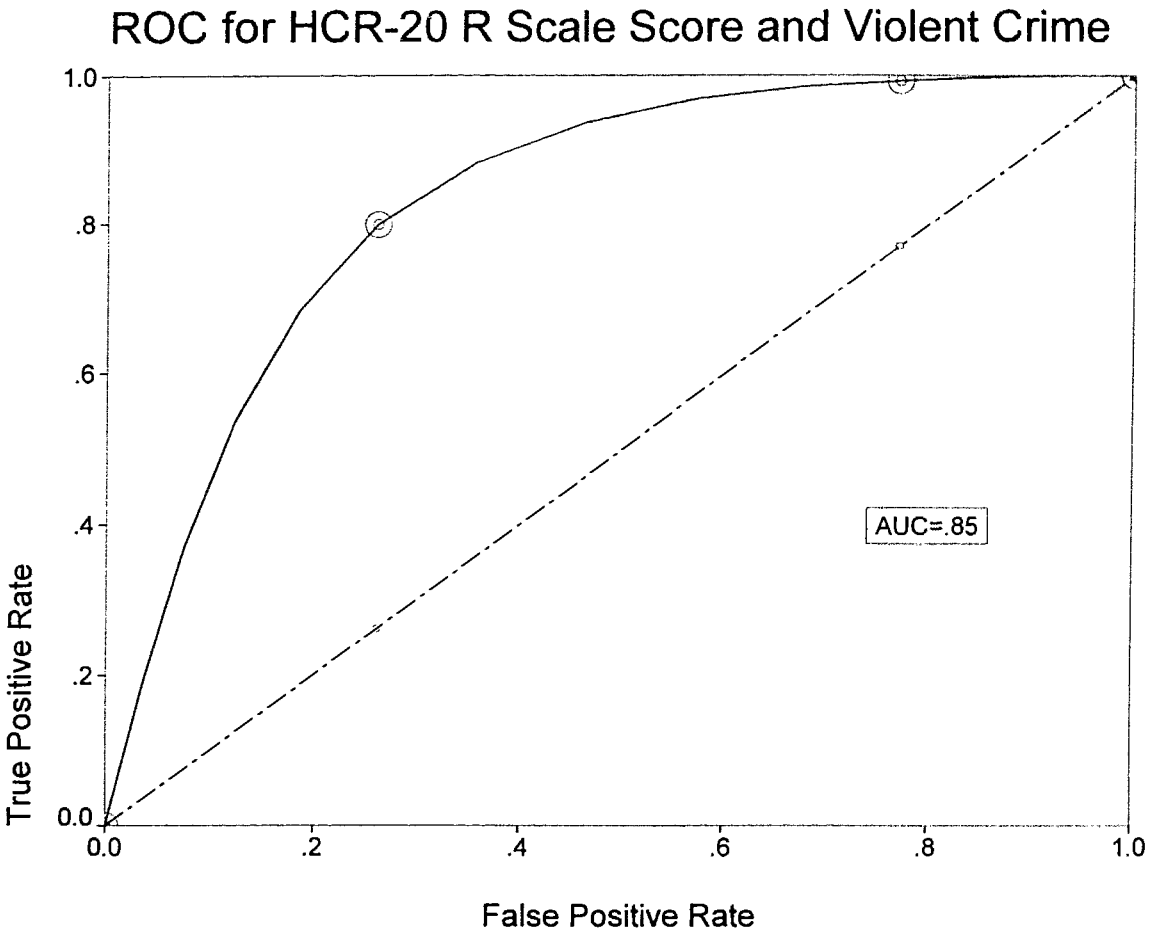
Notes. For the cut-points used for this ROC and AUC, the following statistical indexes of predictive accuracy apply.

Cut-off	TPR	FPR	Spec.	PPP	NPP	Odds
4	.889	.562	.438	14.4%	97.4%	6.23
7	.222	.083	.917	22.2%	91.7%	3.16

For cut-offs of 2, 5, and 8, AUC = 0.64. For cut-offs of 3, 5, 7, and 9, AUC = 0.68.

For any violence, the largest AUC was 0.61 (range = 0.59, 0.60, 0.61). For physical violence, the largest was 0.63 (range = 0.53, 0.59, 0.63).

Figure 17



Notes. For the cut-points used for this ROC and AUC, the following statistical indexes of predictive accuracy apply.

Cut-off	TPR	FPR	Spec.	PPP	NPP	Odds
4	.933	.772	.228	11.1%	97.1%	4.13
7	.800	.262	.738	24.0%	97.3%	11.26

For cut-offs of 2, 5, and 8, AUC = 0.77. For cut-offs of 3, 5, 7, and 9, AUC = 0.77.

For any violence, the largest AUC was 0.73 (range = 0.72, 0.72, 0.73). For physical violence, the largest was 0.80 (range = 0.75, 0.77, 0.80).

Survival Analyses

Survival analyses were carried out for the HCR-20 total scores. The point of these analyses was to illuminate the findings of the ROC analyses by investigating whether groups of persons, defined as high or low on the HCR-20 on the basis of some reasonable cut-off, differ in terms of their "survival" in the community -- time violence-free. Based on the ROC analyses which preceded, persons who scored at or above 20 on the HCR-20 were defined as belonging to the "high" group, and those who scored below this cut-off were defined as falling in the "low" group. The cumulative proportion of persons in the low group who survived, or remained violence-free (any violence), in a 312[11] day follow-up, was 0.907, or 90.7% (78 of 86 persons). In the high group, 0.60 (60.0%) of persons (42 of 70) remained violence-free. The standard errors of the cumulative survival proportions for the low and high groups, respectively, were 0.031 and 0.059. The difference between the two survival proportions (0.307) is greater than either standard error, which implies a substantial degree of separation. The results of this analysis are displayed in Figure 18.

Similar results were obtained using time to first physically violent act as the time-dependent measure. Of the low group, 96.5% (83 of 86) had not acted violently by the end of the 312 day follow-up. In the high group, 78.6% (55 of 70) of patients remained violence-free. The respective standard errors of the cumulative proportion of survival were 0.02 and 0.05, for the low and high groups, respectively. Figure 19 displays these findings. Finally, as Figure 20 demonstrates, a similar pattern emerged using violent crime as the dependent measure. However, the separation between groups is much less marked (98.8% versus 90.0%) than in the previous two analyses because there were fewer people

[11] The follow-up period for survival analyses is less than the average time at risk for study participants, the mean of which is 690.26 days (range = 96 to 957), in order to equate time at risk among participants.

who committed violent crimes compared to other acts of violence. The standard errors for the cumulative proportion surviving for the low and high groups were 0.01 and 0.04, respectively.

Figure 18

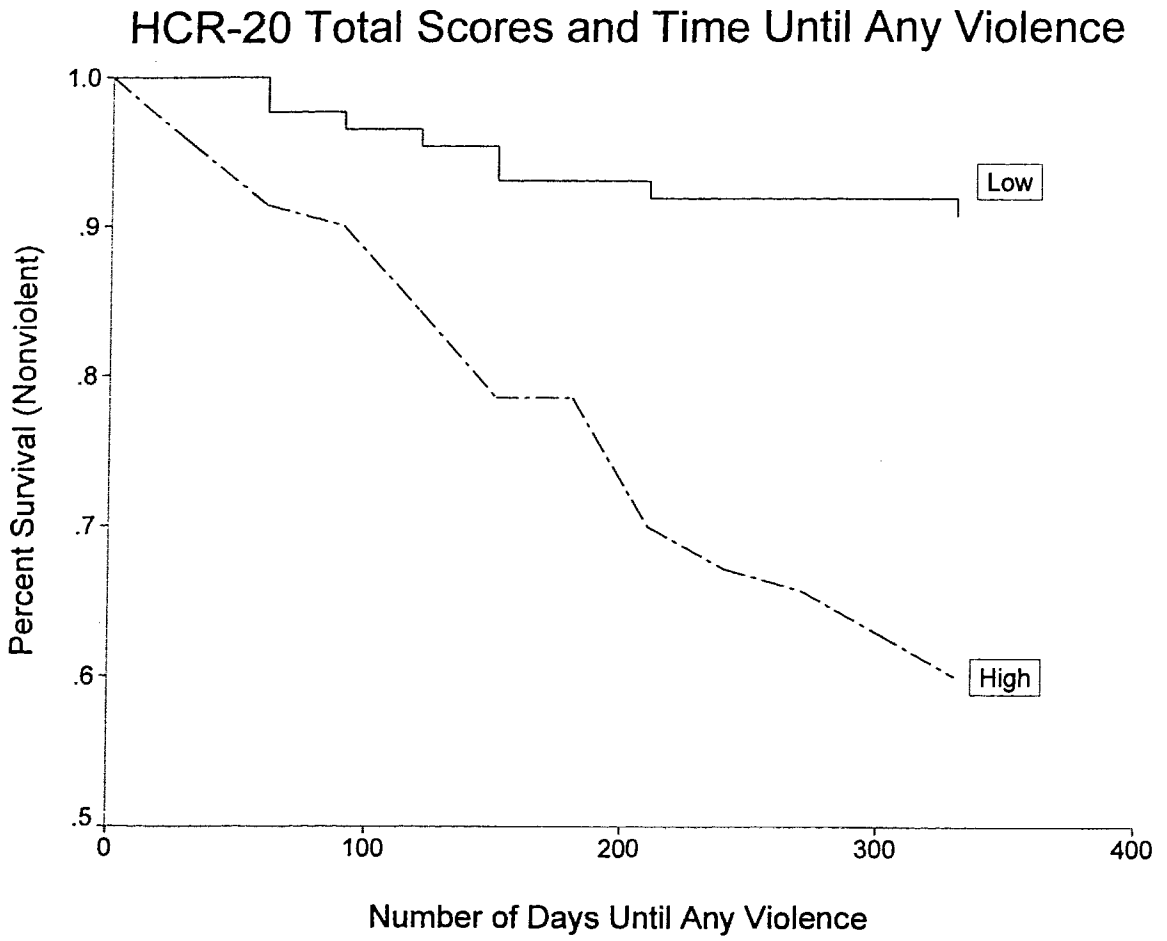

HCR-20 Total Scores and Time Until Any Violence
1.0
.9
.8
.7
.6
.5
Percent Survival (Nonviolent)
Low
High
0
100
200
300
400
Number of Days Until Any Violence

Figure 19

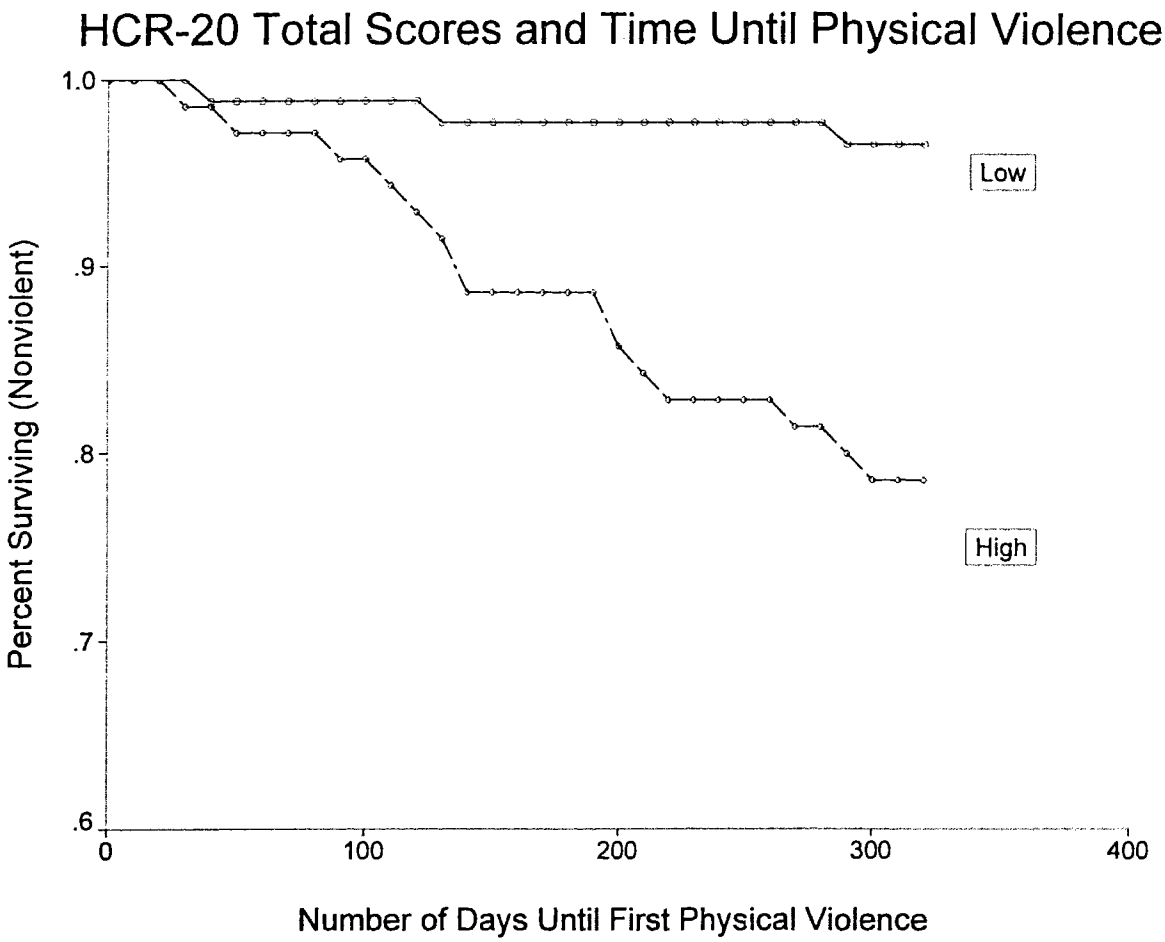
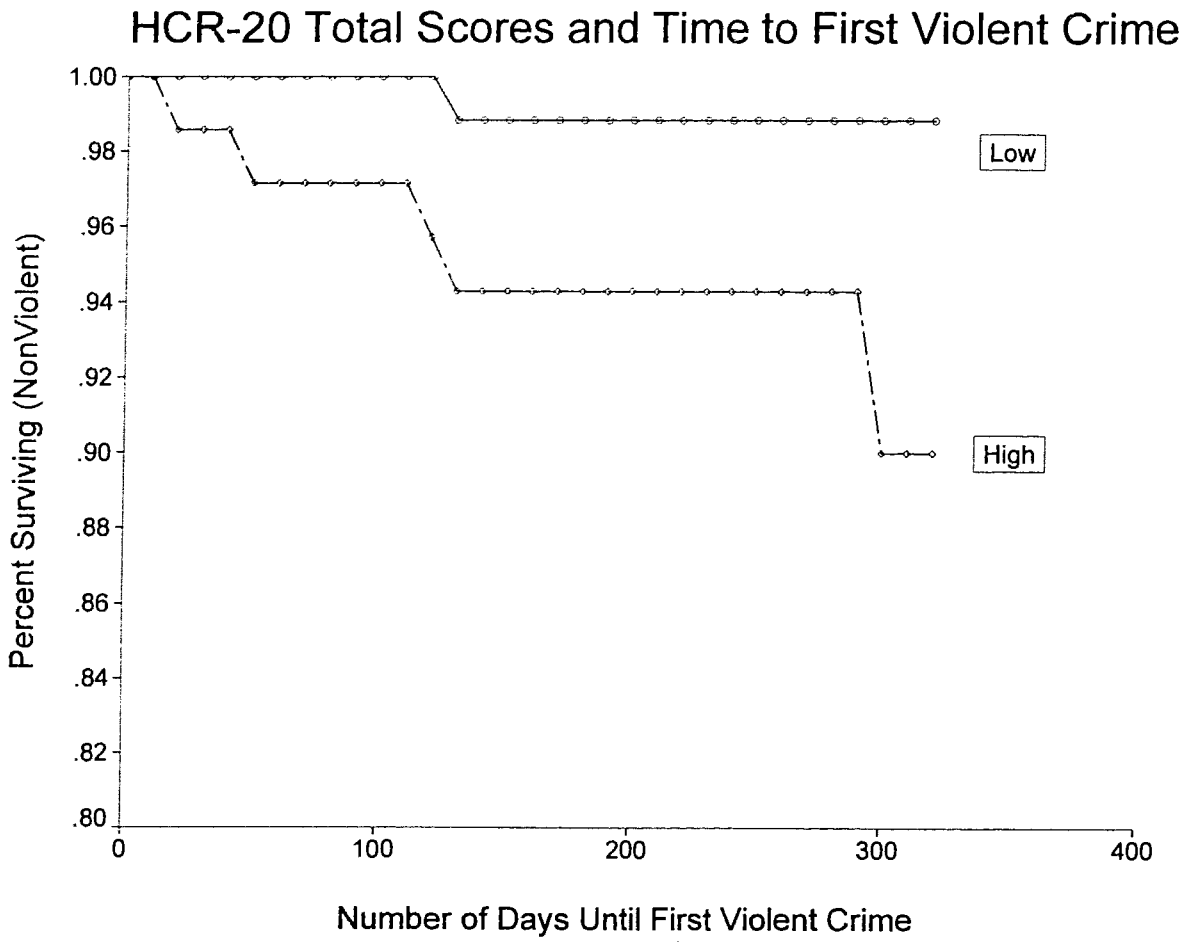

HCR-20 Total Scores and Time Until Physical Violence
1.0
.9
.8
.7
.6
Percent Surviving (Nonviolent)
Low
High
0
100
200
300
400
Number of Days Until First Physical Violence

Figure 20


HCR-20 Total Scores and Time to First Violent Crime
Percent Surviving (NonViolent)
1.00
.98
.96
.94
.92
.90
.88
.86
.84
.82
.80
0
100
200
300
400
Low
High
Number of Days Until First Violent Crime

Regression Analyses

While the ROC and survival analyses provided meaningful and interpretable findings concerning the relationship between the HCR-20, its scales, and violence, they did not help (at least statistically) to determine the extent to which the three scales contributed to the HCR-20's relationship to violence. For this reason, several multiple linear regression analyses were performed to determine the independent contribution of the H, C, and R scales to the HCR-20's relationship to violence. Three families of three analyses were carried out. For this reason, α was set at .05/3 = .02 for each set or family of analyses.

All analyses were conducted using the forward stepwise entry method for predictor variables. For the first analysis, the number of (any) violent acts was the dependent measure. The H and R scales emerged as significant predictors (Mult R = .41, F (2, 153) = 15.3, $p < .001$). For the H scale, $\beta = .26$, and for the R scale, $\beta = .25$. For the model, $R^2 = .166$, and Adj. $R^2 = .155$. The same solution was obtained for number of physically violent acts as the dependent measure. H and R produced a Mult R of .31 (F (2, 153) = 8.27, $p < .001$). The model's $R^2 = .098$, and Adj. $R^2 = .186$. Independently, the R scale ($\beta = .20$) and the H scale ($\beta = .19$) contributed equally to the model. Finally, for the number of violent arrests, only the H scale contributed to the regression model (Mult R = .29, F (1, 154) = 14.4, $p < .001$). For the model, $R^2 = .085$, and Adj. $R^2 = .079$.

A similar pattern of results emerged when these same predictor variables were entered into multiple regression analyses using dichotomized dependent variables. For any violence, both H and R contributed to the model (Mult R = .41, F (2, 153) = 15.5, $p < .001$). For physical violence, H and R were again both related to violence (Mult R = .39, F (2, 153) = 13.5, $p < .001$). These two predictors also formed the regression model for violent crime (Mult R = .34, F (2, 153) = 10.0, $p < .001$).

It is interesting to note that the sizes of the Mult Rs decreased between any violence and violent crime, despite the fact that the ROCs and AUCs indicated that it was violent crime which was best predicted by the HCR-20. This may relate to the substantially lower base rates of violent crime (9.5%) and physical violence (16.5%) in comparison to any violence (30.0%).

One problem with using the raw number of violent acts, or, alternatively, a dichotomized coding for violence, is that the same number for any two given people is equivalent in statistical terms, while it may not be so in "real" terms. That is, while two people both may have committed three acts of violence, one of these people could have been at risk in the community for 800 days, and the other for 80. To resolve this problem, the rate of violence was calculated by dividing the number of violent acts by the number of days at risk. This rate acted as the dependent variable for the next set of regression analyses.

As with absolute number of (any) violent acts, the H and R scales predicted the rate of (any) violence (Mult R = .37, F (2, 153) = 12.2, p < .001). The H scale (β = .28) was somewhat more strongly related to violence than the R scale (β = .18). For the model, R^2 = .138, and Adj. R^2 = .127. For the rate of physical violence, the Mult R of .26 was smaller than that for any violence (F (1, 154) = 10.7, p < .002). Only the H scale contributed to this regression model, which had an R^2 of .065, and Adj. R^2 = .059. Similarly, only the H scale predicted the rate of violent crime (Mult R = .26, F (1, 154) = 11.4, p < .002). The R^2 was .069, and Adj. R^2 = .063. Again, for this set of analyses, the Mult Rs for rates of violent crime and physical violence (.26) were notably smaller than that for the rate of any violence (.37). For physical violence and any violence, only the H scale was related to violence, but for any violence, both R and H were.

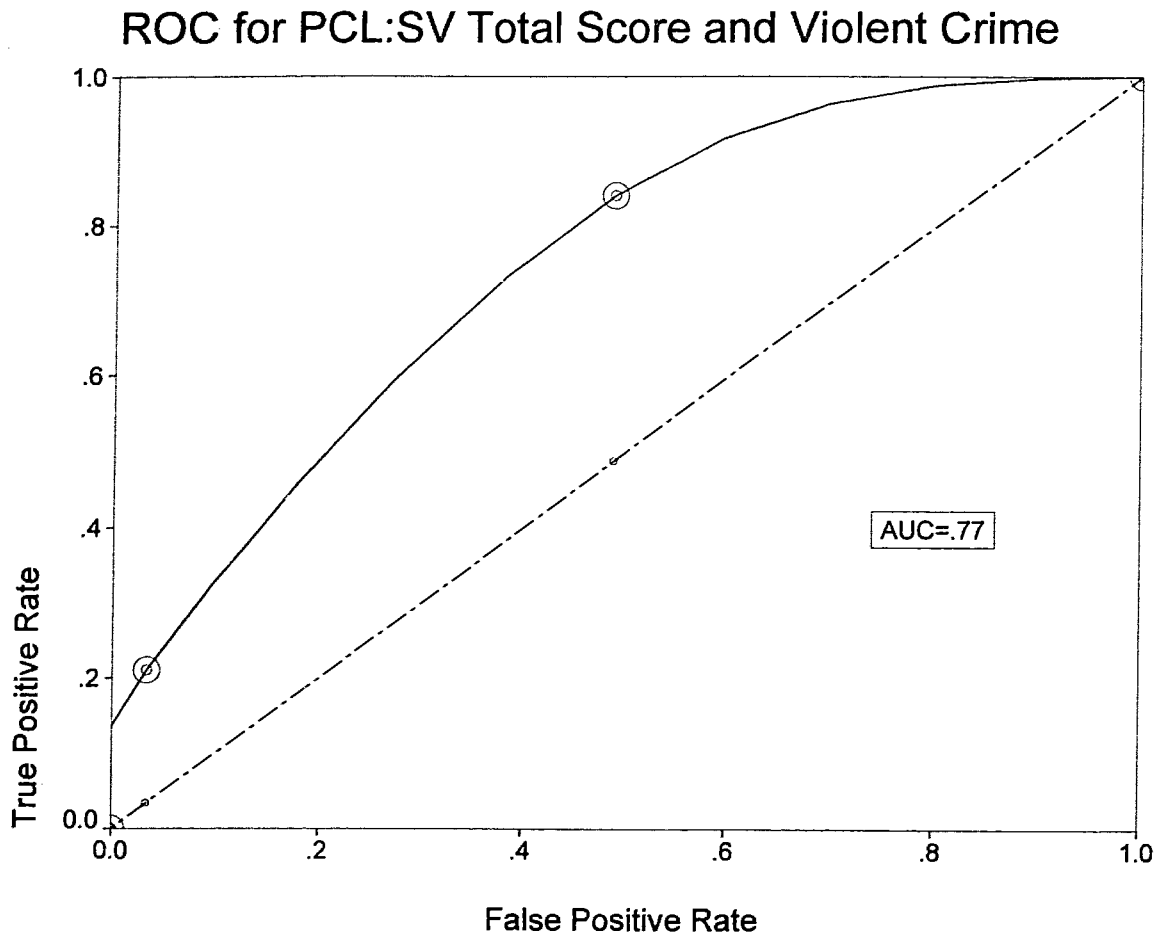
Research Question Two

While the goal of the previous section was to describe the predictive characteristics of the HCR-20 and its constituent parts, the purpose of this section is to compare the HCR-20 to the PCL:SV and McNiel and Binder's Screening Tool. This will be accomplished first by presenting the ROCs for the PCL:SV and McNiel and Binder's instrument, then by presenting the ROCs for Parts 1 and 2 of the PCL:SV, and then by regression analyses. The ROCs which produced the largest AUCs will be presented graphically. As in the previous section, the AUCs for other potential cut-points and for other indexes of violence will be listed under the Figures.

Full Scale Scores

Concerning the PCL:SV, the largest AUC obtained was for violent crime (AUC=0.77). This is displayed in Figure 21. For McNiel and Binder's instrument, the largest AUC was 0.50. No figures are offered for this instrument, as they tend to approximate a straight line (i.e., the line of no information). The AUCs for McNiel and Binder's tool range from a high of 0.50 to a low of 0.42. As it turns out, with the present sample at least, McNiel and Binder's instrument does predict violence, but *negatively*, and only slightly.

Figure 21



Notes. For the cut-points used for this ROC and AUC, the following statistical indexes of predictive accuracy apply.

Cut-off	TPR	FPR	Spec.	PPP	NPP	Odds
8	.842	.489	.511	15.5%	96.8%	5.58
16	.211	.034	.966	40.0%	92.0%	7.64

For cut-offs of 6, 12 and 18, AUC = 0.71. For cut-offs of 5, 10, 15, and 20, AUC = 0.73. For cut-offs of 4, 8, 12, 16, and 20, AUC=0.75.

For any violence, the largest AUC was 0.66 (range = 0.61, 0.61, 0.63, 0.66). For physical violence, the largest was 0.69 (range = 0.64, 0.65, 0.67, 0.69).

The AUC of the PCL:SV for violent crime (0.77) essentially is equal to that for the HCR-20 total scale (0.78). Table 4 is a summary of the AUCs for the HCR-20 and PCL:SV total scores. It presents the minimum, maximum, and mean AUC for these instruments for any violence, physical violence, and violent crime. As can be seen, although the HCR-20 and PCL:SV have very similar minimum, maximum, and mean AUCs for violent crime, the AUCs for all physical violence and for any violence tend to be larger for the HCR-20 than for the PCL:SV.

Table 4

A Comparison Summary of AUCs between the HCR-20 and PCL:SV Total Scores

Violence	Measures					
	HCR-20 AUCs			PCL:SV AUCs		
	Min	Max	M	Min	Max	M
Any	0.72	0.73	0.728	0.61	0.66	0.633
Physical	0.70	0.73	0.708	0.64	0.69	0.633
Crime	0.73	0.78	0.760	0.71	0.77	0.740

To determine the unique relationships of the three main predictors to violence, multiple regression analyses were used with the HCR-20, PCL:SV, and McNiel and Binder full scale scores as independent variables, and the number and rate of violent acts as dependent measures. To control for chance findings, $\alpha = .05/3 = .02$ for each of the three analyses in both of the sets of analyses. The first analysis used the number of any violent acts as the dependent variable, and revealed that only the HCR-20 contributed to the equation (Mult R = .37, F (1, 151) = 23.8, $p < .0001$). The R^2 for the model was .136,

and the Adj. R^2 was .130. Using the number of physically violent acts as the dependent measure, only the PCL:SV contributed to the equation (Mult R = .29, F (1, 151) = 13.4, p < .001). For this analysis, R^2 = .081, and Adj. R^2 = .075. Finally, for the number of violent crimes, again only the PCL:SV predicted violence (Mult R = .31, F (1, 151) = 16.2, p < .001). The R^2 for the model was .097, and the Adj. R^2 was .091.

As with prior analyses, the rate of violence was used as a dependent measure in the next set of analyses in order to control for time at risk. For the rate of any violence, only the HCR-20 emerged as a significant predictor (Mult R = .33, F (1, 151) = 18.23, p < .0001). For this analysis, R^2 = .108, and Adj. R^2 = .102. Using the rate of physical violence as the dependent measure again produced a one-variable solution, with the HCR-20 as the sole predictor (Mult R = .25, F (1, 151) = 10.4, p < .01). In this case, the R^2 was .065, and the Adj. R^2 dropped to .058. The HCR-20 also was the only significant predictor for rate of violent crime (Mult R = .26, F (1, 151) = 11.3, p < .01), with R^2 = .069, and Adj. R^2 = .063.

The HCR-20 turned out to produce the most consistent relationship with indexes of future violence. Although concerning the number of violent acts, it only predicted any violence, and did not enter the equation for physical violence or violent arrests, after taking the important step of controlling for time at risk, the HCR-20 was the only significant predictor of violence, and it was related to each of the three indexes of violence.

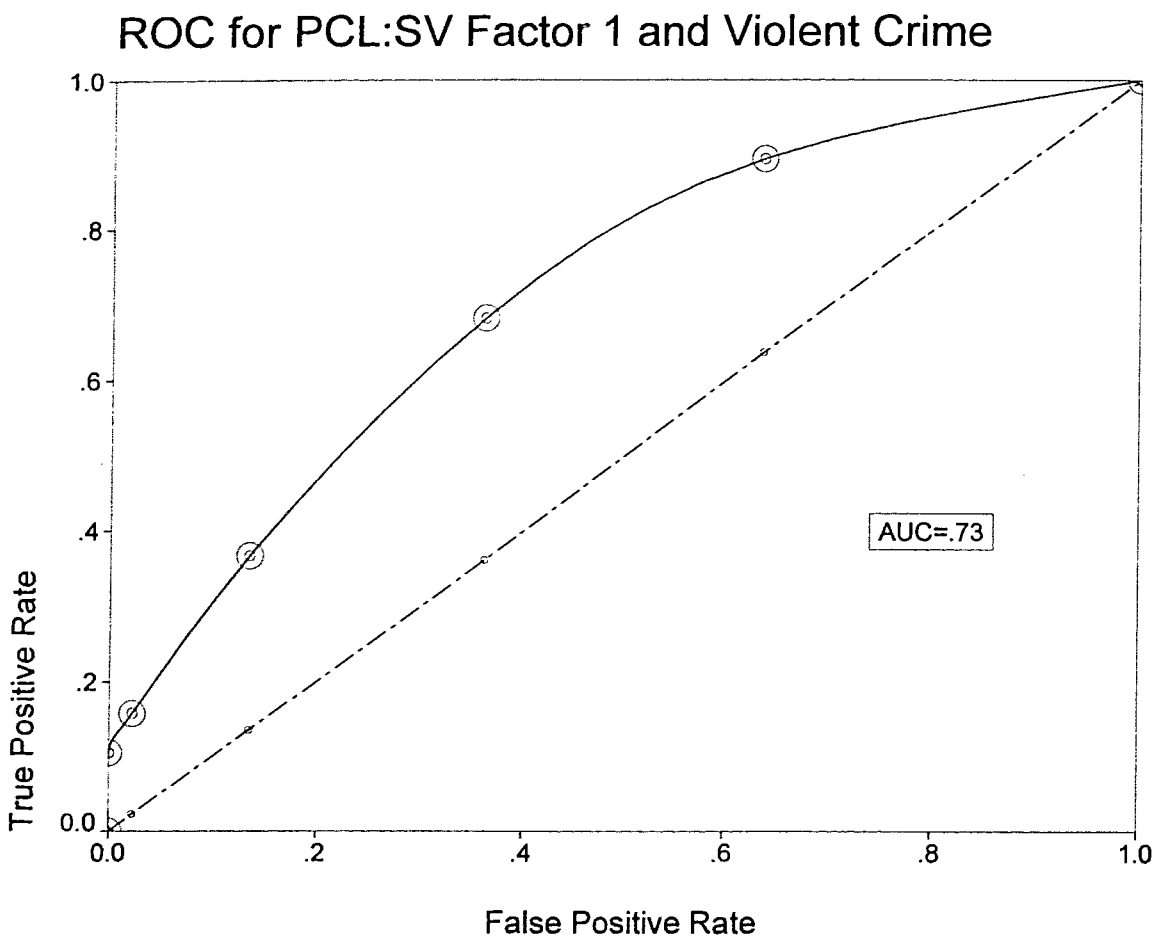
Subscale Scores

The following analyses will present the ROCs and AUCs for the PCL:SV Parts 1 and 2, and then compare these with the AUCs for the H, C, and R scales of the HCR-20. To be consistent with previous analyses, only the largest AUCs will be displayed for the PCL:SV Parts 1 and 2. Notes under the Figures explain the AUCs for other cut-offs and the other indexes of violence. Regression analyses using all subscale predictors as

independent variables and the three indexes of violence as dependent variables were used to estimate the relative relationships of the subscales to violence.

Figures 22 and 23 display the ROCs and AUCs for Parts 1 and 2 of the PCL:SV, respectively. As with previous analyses, the largest AUCs were obtained for violent crime. For Part 1 (Figure 22), the AUC was 0.73, and for Part 2 (Figure 23) it was 0.74. These figures compare to violent crime AUCs for the H, C, and R of 0.73, 0.73, and 0.85, respectively. Apart from the AUC for the R scale of 0.85, these indexes of accuracy are nearly identical. Table 5 presents the minimum, maximum, and mean AUCs for all of these subscale predictors. For any violence, the maximum and mean AUCs were greater for the H and R scales than for the C scale of the HCR-20, and Parts 1 and 2 of the PCL:SV. These three latter scales performed equivalently. For physical violence, the largest AUC was for the R scale (0.80). The other four scales produced similarly sized AUCs. For violent crime, again the R scale had the largest AUCs. The maximum AUCs for the other four scales were close to identical (0.73 - 0.74).

Figure 22



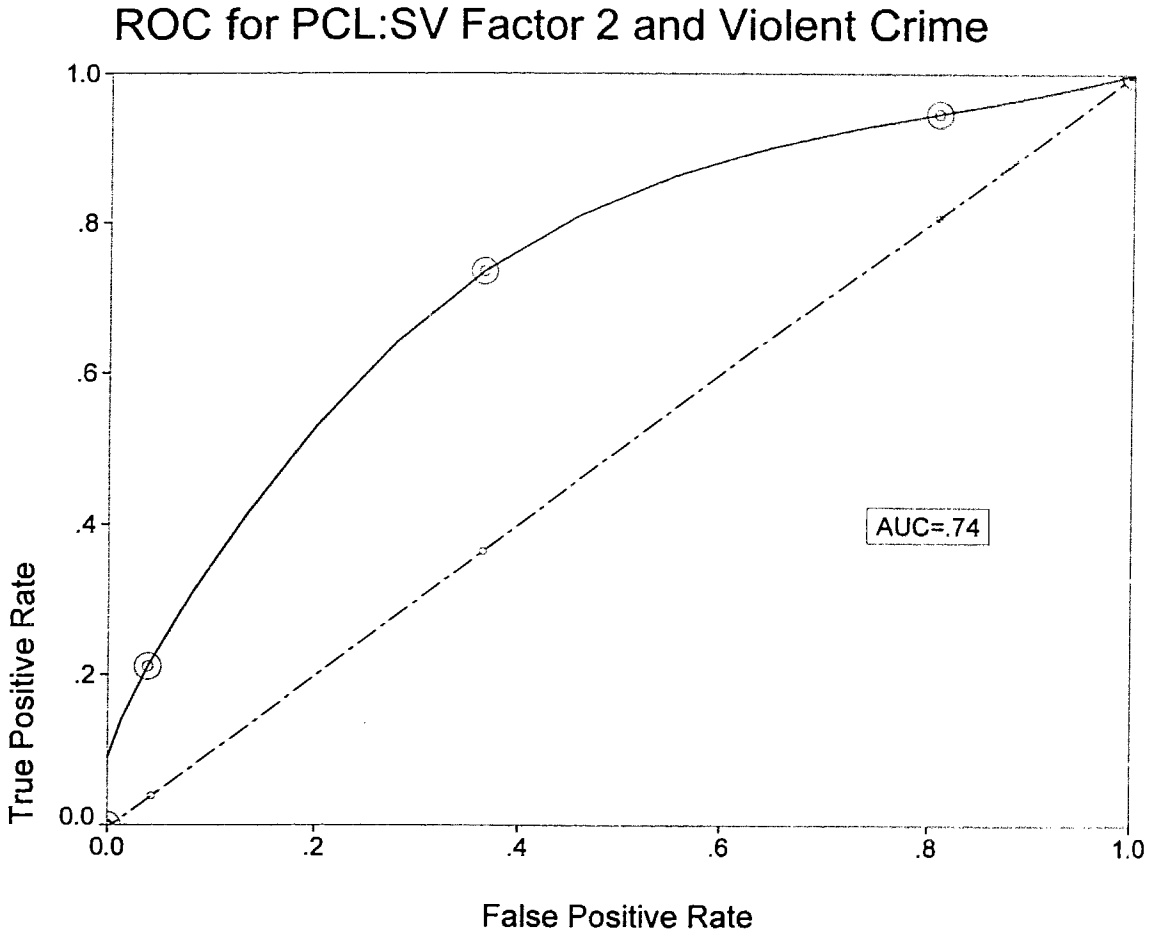
Notes. For the cut-points used for this ROC and AUC, the following statistical indexes of predictive accuracy apply.

Cut-off	TPR	FPR	Spec.	PPP	NPP	Odds
2	.895	.638	.362	13.1%	97.0%	4.81
4	.684	.362	.638	16.9%	94.8%	3.69
6	.368	.136	.864	22.6%	92.7%	3.72
8	.158	.023	.977	42.9%	91.5%	8.11
10	.105	0.00	1.00	100.0%	91.2%	50.7

For cut-offs of 4 and 8, AUC = 0.72. For cut-offs of 3, 6, and 9, AUC = 0.67.

For any violence, the largest AUC was 0.63 (range =0.60, 0.62. 0.63). For physical violence, the largest was 0.67 (range = 0.62, 0.65, 0.67).

Figure 23



Notes. For the cut-points used for this ROC and AUC, the following statistical indexes of predictive accuracy apply.

Cut-off	TPR	FPR	Spec.	PPP	NPP	Odds
3	.947	.809	.191	11.1%	97.1%	4.25
6	.737	.365	.635	17.7%	95.8%	4.87
9	.211	.039	.961	36.4%	91.9%	8.14

For cut-offs of 4 and 8, AUC = 0.70. For cut-offs of 2, 4, 6, 8, and 10, AUC = 0.70.

For any violence, the largest AUC was 0.62 (range = 0.60, 0.61, 0.62). For physical violence, the largest was 0.63 (range = 0.62, 0.63, 0.63).

Table 5

A Comparison Summary of AUCs between the HCR-20 H, C, and R Scales and PCL:SV Part 1 and Part 2

	Violence								
Scale	Any			Physical			Crime		
	Min	Max	M	Min	Max	M	Min	Max	M
H	0.63	0.71	0.680	0.65	0.68	0.663	0.72	0.73	0.723
C	0.59	0.61	0.600	0.53	0.63	0.583	0.64	0.73	0.683
R	0.72	0.73	0.727	0.75	0.80	0.773	0.77	0.85	0.797
PCL 1	0.60	0.63	0.617	0.62	0.67	0.647	0.67	0.73	0707
PCL 2	0.60	0.62	0.610	0.62	0.63	0.627	0.70	0.74	0.713

To determine the relative contributions of the individual HCR-20 and PCL:SV subscales and McNiel and Binder's instrument to the variance of the violence indexes, multiple regression analyses were carried out. As with previous analyses, $\alpha = .05/3 = .02$. For the number of any violent acts, the H and R scales of the HCR-20 were the only items to enter the equation and together produced a Mult R of .41, (F (2, 153) = 15.3, $p < .001$). For the H scale, $\beta = .26$, and for the R scale, $\beta = .25$. The R^2 for this model was = .166, and Adj. R^2 = .155. This solution literally is identical to the previous regression model which emerged when only the H, C, and R scales were entered as predictor variables of any violence. These two same variables also were the only predictors to enter the regression model which used the number of physically violent acts as the dependent measure (Mult R =.31, F (2, 149) = 8.0, $p < .01$). The βs for the R and H scales,

respectively, were .20 and .19. Overall, the model had an R^2 of .097, and Adj. R^2 = .85. Finally, for the number of violent crimes as the criterion variable, only the H scale predicted violence (Mult R =.30, F (1, 150) = 14.6, $p < .001$), with R^2 = .088, and Adj. R^2 = .082.

Turning to the rate of violence as the dependent measure, the H and R scales were the only two variables to enter the regression model for any violence (Mult R =.37, F (2, 149) = 11.9, $p < .001$). For the H scale, β = .28, and for the R scale, β = .17. Overall, the model produced an R^2 of .138, and Adj. R^2 = .127. For the rate of physical violence, only the H scale predicted violence (Mult R =.26, F (1, 150) = 10.6, $p < .01$). In this case, R^2 = .066, and Adj. R^2 = .060. For the final analysis, using the rate any violent crime as the criterion variable, again only the H scale entered the model (Mult R =.27, F (1, 150) = 11.5, $p < .01$). The R^2 was .071, and Adj. R^2 was .065.

To summarize this section of analyses, the full scale HCR-20 score was most consistently related to violence. In terms of the items of the full scale measures, only the H and R scales of the HCR-20 predicted violence. Of these two subscales, the H scale was the more consistent and strong predictor. Neither the C scale of the HCR-20, Parts 1 and 2 of the PCL:SV, nor McNiel and Binder's tool contributed to any of the regression equations.

Discussion

In recent years a considerable amount of research has been devoted to explicating the correlates of violent behaviour in correctional, forensic, and psychiatric samples. Many of these factors have been abstracted from the literature to form violence risk assessment schemes (Harris et al., 1993; Kropp, Hart, Webster, & Eaves, 1994; Webster et al., 1994). However, such risk assessment schemes tend not to be directly applicable to psychiatric samples. This situation is unfortunate because determinations of individuals' violence potentials are required before involuntarily detained psychiatric patients are released from hospital, and despite research demonstrating that up to 45% of psychiatric patients are violent to others after release from hospital (Steadman et al., 1996). The present research sought to validate a risk assessment scheme -- the HCR-20 (Webster et al., 1995) -- which is applicable to the context of community violence perpetrated by psychiatric patients after release from hospital. A further goal was to compare the HCR-20 to the PCL:SV (Hart et al., 1996) and a violence screening tool developed by Binder and McNiel (1994a) to assess for the risk of inpatient violence, both of which have been shown to predict violence by persons with mental disorders (for the PCL:SV, see Harris et al., 1993; Harris et al., 1991; Hill, Rogers, & Bickford, 1996; Rice & Harris, 1995).

Borum, in his 1996 American Psychologist article, recently wrote of the HCR-20 that "the field eagerly awaits new data on this instrument" (p. 950). The results of the current study indicate that the HCR-20 may hold some promise as a risk assessment tool that can be applied in a psychiatric outpatient context. Overall, analyses demonstrated that the HCR-20 consistently predicted the three indexes of violence employed in the present research -- any violence, physical violence, and violent crime, as well as the rate and number of violent acts. The nature of the performance of the HCR-20, as well as the PCL:SV and McNiel and Binder's tool, will be discussed as they pertain to the research questions posed by this study.

Preliminary Research Question

These descriptive analyses were conducted to estimate the psychometric properties of the HCR-20, PCL:SV, and McNiel and Binder's tool in a civil psychiatric sample. The HCR:20 total, H, and R scales were distributed approximately normally. The means for these indexes were close to the midpoints of the scales. The C scale at discharge was slightly positively skewed, as could have been anticipated given that psychiatric patients typically are less grossly psychotic and unstable at discharge from hospital in comparison to admission. In general, the distributions of the HCR-20 are adequate, in that there will tend to be enough persons in its low, medium, and high ranges (regardless of how these ranges are defined) to permit useful comparisons between groups. The percentile ranks of all HCR-20 scores were included in these analyses for the purpose of beginning to establish a normative database on the instrument.

The distribution of the PCL:SV was not normal, but was positively skewed. This skew was somewhat more pronounced for Part 1. This may stem from the fact that Part 1 of the PCL:SV measures the interpersonal and affective aspects of psychopathy. Ostensibly, these factors are more difficult to rate from files than are the more behavioural items of Part 2. Nonetheless, the distribution, central tendency, and dispersion of scores are consistent with such indexes published in the PCL:SV manual which were collected across four civil psychiatric samples (Hart et al., 1996).

Research Question One

This group of analyses only applied to the HCR-20 and was meant to describe its predictive characteristics as a free-standing instrument. ROCs and AUCs were used to estimate the predictive validity of the HCR-20 and the strength of its relationship to violence, and multiple regression analyses were employed to determine which of the three HCR-20 scales contributed uniquely to violence variance.

Full Scale HCR-20. Strong support was obtained for the predictive utility of the HCR-20. AUCs ranged between 0.73 and 0.78 for the full scale score as it was applied to the three violence indexes. The strength of these AUCs can be determined in a relative sense through comparison to the published literature. For instance, the AUC reported by Rice and Harris (1995) between violent arrest and the VRAG (Harris et al., 1993), an instrument which has attained a notable degree of popularity, not to mention controversy (Hart, 1996), was 0.76 after a seven-year follow-up.

Perhaps a better comparison is a meta-analyses by Mossman (1994a), who calculated ROC curves and AUCs for 58 violence prediction data sets. The findings of this study will be considered in some detail. The description of Mossman's findings should be prefaced with the caveat that in calculating the AUCs, he dichotomized the predictor variables. Strictly speaking, this violates the assumption of ROC analyses that a continuous predictor, or at least one with three categories, be used. How and whether this influenced the AUCs in Mossman's meta-analyses is unclear. It also should be noted that many of the data sets in Mossman's study were not validation samples but rather calibration samples. Although he does separate studies on this basis, the implication which follows is that the median and mean AUCs reported likely would be smaller if only validation studies were included in analyses, since calibration studies typically yield larger effect sizes than validation studies. One example of this which can be determined from Mossman's data comes from comparing the AUCs for studies by Klassen and O'Connor (1988a, b, 1989). For their two calibration studies (1988a, b), the AUCs ranged from an amazing 0.906 to 0.976. However, their validation study produced an AUC of 0.76. The final caveat pertaining to the interpretation of Mossman's data concerns the relevance of some of the data sets in his sample. For instance, some of the studies which produced seemingly large AUCs were investigating arguably obscure violence predictors such as "hand test indexes"

(Panek & Wagner, 1989), which have not received any sort of consistent study in the literature and which are not very relevant to the present study.

Notwithstanding these caveats, the median ROC determined by Mossman was 0.73, and the mean was 0.78. Some mean AUCs calculated as functions of select methodological criteria follow. For discriminant function validation studies, the mean AUC was 0.71. For all long-term (equal to or greater than one year of follow-up) discriminant function validation studies, the mean AUC was 0.71. For all clinically-based predictions, the AUC dropped to 0.67. In all, the average AUCs presented by Mossman in categories defined by methodological criteria ranged from 0.60 to 0.89. If one omits the AUC of 0.89 (based on retrospective calibration studies), the range is from 0.60 to 0.80.

Using these figures as rough guidance, the HCR-20's AUC of 0.78 compares quite favourably to the literature. The AUCs of 0.73, though somewhat smaller, are still respectable. It may be a fair statement to make that these AUCs are in the moderate/large to large size, or at least from moderate to moderate/large.

The AUCs of the HCR-20 can be interpreted as the performance of the measure in general (i.e., not at a specific cut-off). However, there are other indexes of accuracy such as the TPR, FPR, specificity, PPP and NPP which arise at the various cut-offs. The values of these indexes were displayed in tabular form under each of the ROC Figures. Arguably, it is the AUC which may be of guidance in the decision of whether to use a predictive instrument in the first place, and the comparison of these other indexes across various cut-offs which may be of greater assistance to the clinical decision-making task of whether to release a person from hospital.

A consistent pattern emerged in these latter indexes of accuracy across the various types of violence outcomes. In general, high values of TPR could be achieved (i.e., TPR = 0.867 for a cut-off of 20 on the HCR-20 for predicting violent crime; see Figure 14), though usually at the expense of moderately high FPRs (FPR = .404 for this same cut-off

and analysis). This means that, although almost every person who committed a violent crime was predicted to do so, many people who did not commit violent crimes also were predicted to do so. If one is willing to accept a lower TPR (i.e., 0.60), then a much lower FPR (.106) can be achieved (see Figure 14, cut-off of 25). This fact relates to the low PPPs obtained across cut-offs. That is, for the present example of a cut-off of 20 on the HCR-20 with violent crime as the criterion variable (Figure 14), PPP = 19.0%, meaning that only 19% of people who were predicted to be violent actually were violent.

An ostensibly stronger index which emerged consistently was NPP, or the accuracy of negative predictions. To continue with the same example, 97.7% of people who were predicted to be non-violent in fact were non-violent at follow-up. Only 2 of 86 people who scored below 20 on the HCR-20 committed a violent crime at follow-up. While this example may represent the extremes of the relative values of PPP and NPP, in that the PPP is higher and the NPP somewhat lower for any violence and physical violence, the basic pattern is PPP which is appreciably lower than NPP.

At a basic level, the HCR-20 seems to able to predict who will not be violent with excellent accuracy (NPP). It also can perform well in terms of identifying accurately those persons who were actually violent (TPR). Depending on the cut-off, the HCR-20 appears able to avoid classifying too high a number of non-violent persons as violent (FPR), although what is "too high" certainly is debatable. Hart et al. (1993) calculated the average FPR of seven studies summarized by Otto (1992) at 26%. For a cut-off of 20 on the HCR-20 with any, physical, and violent crime as dependent measures, the respective FPRs are 33.6%, 38.6%, and 40.4%. With cut-offs of 25, they are 7.5%, 9.4%, and 10.6%. As is always the case, however, these lower FPRs come coupled with lower TPRs. Similarly, the ability of the HCR-20 to predict accurately who will be violent is variable. For example, the PPPs at a cut-off of 20 for any, physical, and criminal violence were 48.6%,

30.0%, and 19.0%. Increasing the cut-off to 25, these PPPs also increased to 66.7%, 50.0%, and 37.5%.

Of course, the preceding discussion relates to choosing the "best" cut-off for the HCR-20 (or any other instrument). Simply put, there really is no one single best cut-off, for the decision depends on the purposes, preferences, and policy-related obligations of the decision-maker. If a decision-maker wishes to maximize the TPR, then a low cut-off should be used. If the goal is to minimize the FPR, then a higher cut-off should be used.

Further, these indexes of violence are dependent on the base rates of violence in the sample, which is the main reason that the AUC was used as the primary estimate of predictive utility in the present research. For example, Rice and Harris (1995) found that the PPP in their sample of released forensic psychiatric patients was 36% at a base rate of violence of 15%, but increased to 62% when the base rate increased to 43%. When an extrapolated base rate of 50% was used, the PPP was 70%. Similar changes in the accuracy of NPP, sensitivity, and specificity were obtained. However, the AUC nearly was invariant. These results imply that the indexes discussed above (i.e., TPR, FPR, PPP, NPP, specificity) will change dramatically with changes in the base rate of violence in the sample. However, the AUC will not. It is precisely for this reason that the AUC is taken as the estimate of the utility of the predictors in this research, and that the other indexes are presented to illustrate the specific realities of using the instruments, given the particular base rates of violence obtained in this research.

The H, C, and R subscales. Findings also support the predictive utility of the subscales. AUCs ranged from 0.73 for the H and C scales to an impressive 0.85 for the R scale. As with the full scale HCR-20, violent crime was predicted better than the indexes of physical violence or any violence. This pattern may be due to the violent crime index being a better or more representative index of violence than the any violence or physical violence categories. That is, it may be speculated that only the more serious types of physical

violence lead to legal proceedings. While it is certainly the case that persons in the any violence category did display violence to others, it also may be the case that this was less serious than violence leading specifically to criminal sanctioning. Nonphysical violence may be more a function of mental status decompensation and disorganization rather than proneness or willingness to do serious harm to other persons. Further, physical violence which does not lead to legal proceedings may be less serious, generally, than that which does. Although it was not possible to code precisely the type and severity of violence, when the information was available from hospital files, often it involved hitting, pushing, slapping, kicking, and other similar acts, and less frequently involved more serious acts such as stabbing, maiming, brutal beatings, or sexual assault. Because the HCR-20 was constructed to predict violence, it is conceptually logical that it may predict more serious types of violence better than less serious types. This possibility can and should be subjected to empirical investigation.

Concerning the unique contributions of each predictor to violence, the results of multiple regression analyses indicate that the H and R scales independently relate to violence. The C scale did not enter any regression models. Although multiple correlation co-efficients ranged from 0.25 to 0.41, which is in the moderate to moderate/large range, the strength of these effects sizes is not attached great weight, since the base rates of the criteria variables to which they relate are low (9.5%, 16.5%, and 30.0%), which necessarily deflates the magnitude of the co-efficients. For example, Rice and Harris (1995) reported that the correlational index used in their analyses (ϕ) was 0.25 at a base rate of 15.0%, 0.34 at 43.0%, and 0.40 at an extrapolated base rate of 50.0%. This represents a 37.5% increase in the size of the correlation co-efficient. This observation may also help to explain the apparent inconsistency between the AUCs and the multiple correlation co-efficients in terms of the relative size of the effects for violent crime, physical violence, and any violence. That is, the AUCs for violent crime consistently were greater than those for

any violence or physical violence. Yet, the multiple correlations consistently were greater for analyses of any violence. A likely reason for this discrepancy is that the regression co-efficients for violent crime were seriously deflated due to the base rate of 9.5% of violent crime in the sample, whereas the co-efficients for any violence were affected less so, as there was a base rate of 30.0% of any violence in the sample.

That the H scale predicted violence is not surprising. A good deal of research supports the constructs from which it was built (see Douglas & Webster, in press, for a thorough review). Concerning the C scale, although there is research in support of its items, perhaps when pitted against historical and situational factors, present mental status diminishes in importance. Although the H and C scales are conceptualized very differently, there may be a good deal of overlap between some of the items on the two scales. For example, a person with little insight and positive psychotic symptoms (C1 and C3) likely would receive points under the mental disorder item (H6). Similarly, somebody who is hostile, angry, expresses negative attitudes, and is impulsive (C2 and C4) also may receive points under the psychopathy and personality disorder items (H7 and H9). It may be that the quality of these factors which relates to violence is "picked up" by the H scale better than it is by the C scale. Interesting future research would include a more detailed investigation of the items of the HCR-20, how they relate to one another, to the subscales, to factors which may emerge through factor or principle components analyses, and to violence.

Another explanation for the failure of the C scale to predict violence may stem from methodological artifact. The logic of the C scale is that certain, *current* salient mental status factors may link to violence. The C scale was coded upon discharge, which, although being as close to the potential for community violence as was possible from the research design, was not contemporaneous with most violence that occurred in the community. In fact, although not reported in the results section, there were only three acts of any violence

in the first 30 days after discharge. Approximately half of the violence which occurred, as displayed in the survival analyses, occurred after 180 days post-release. To assume that the mental status of persons at 180 days is similar to at discharge may be incorrect.

The C scale may be best suited to assess risk of imminent harm, rather than long(er) term harm. To determine whether the C scale is related to community violence would require a more sophisticated research design than the one presently used, one in which persons' mental statuses could be assessed on a frequent and regular basis. This may include researchers being in contact with patients' group home or other residential workers, family members, and the patients themselves. In addition to probing for violence during these contacts, information relevant to the C scale could be collected. In this way, whether the items of the C scale relate to violence or not could be determined. An alternative approach would be to use persons who are confined in the hospital and to measure inpatient violence.

The performance of the R scale is encouraging and has important implications for risk management. A limited amount of risk assessment research has investigated the role that situational factors may play in the occurrence of violence. Estroff and Zimmer (1994) found that contact with few mental health professionals predicted violence in released psychiatric patients. Bartels et al. (1991) determined that patients who had difficulty in terms of housing, finances, and meals were at elevated risk for violence. Lack of support from family may also give rise to violence (Estroff & Zimmer, 1994; Klassen & O'Connor, 1988a, 1988b, 1988c, 1989). The fact that the R scale produced both large AUCs and contributed to regression models furthers this research to suggest that, in general, situational variables and poor risk management planning may play a significant role in violence by psychiatric patients. It also lends some credence to Mulvey and Lidz's (1995) concept of "conditional prediction", or specifying the situational conditions which may mitigate against or aggravate violence risk.

The relationship of the R scale to violence is encouraging and important because of its practical management and prevention implications. While it is vitally important to assess historical factors and to rely upon them in offering risk assessments, they may be of little use in devising release plans. However, if there are future situational factors which are known to relate to violence, then efforts to ensure that these are avoided during the release plan phase may diminish post-release violence rates. Of course, the best way to determine this is through empirical study. Studies could be conducted which parallel, in a conceptual sense, psychotherapy outcome studies. That is, groups of persons could be randomly assigned to conditions in which factors relevant to the R scale (access to weapons, victims, substances, feasibility of plans, support and supervision by professionals, relatives, and friends) are systematically manipulated, and violence at outcome could be compared between groups.

In summary, the HCR-20 appears to be able to predict violence with moderate to high levels of strength, although at any given cut-off level various indexes of violence may be less than preferable. The H and R scales independently predicted violence, while the C scale did not. While these results are promising, a more stringent test of the utility of the HCR-20 is to compare it to other measures which have shown some promise in the assessment of risk for violence.

Research Question Two

Full scale scores. The full scale PCL:SV score produced an AUC with violent crime of 0.77, which is nearly identical to that produced by the HCR-20 (0.78). Binder and McNiel's (1994a) screening instrument was, at best, no better than chance prediction (0.50), and, at worst, actually negatively related to violence (0.42), although moderately. Before discussing the PCL:SV and its comparison to the HCR-20, a few comments about McNiel and Binder's measure are in order.

First, the instrument contains at least two factors and possibly three which, though predicting violence in the inpatient samples of McNiel, Binder, and colleagues (Binder & McNiel, 1988; Lowenstein et al., 1990; McNiel & Binder, 1989, 1991; McNiel et al., 1988), have received support for their relationship to violence in the opposite direction in other research. First, being married rather than single is a risk factor in their scheme. Second, *not* being suicidal is a risk factor. Third, being male is a predictor. The first two of these items would receive scoring in the opposite direction on the HCR-20. Research has found that being *un*married acts as a risk factor for violence (Harris et al., 1991, 1993; Klassen & O'Connor, 1988b; Shaffer et al., 1994). Similarly, suicidiality and self-injurious behaviour has been shown to predict violent behaviour to others (Asnis et al., 1994; Brent et al., 1994; Convit et al., 1988; Hillbrand, 1995). Finally, though a good deal of research does support male gender as a risk factor, at least one high-quality study has found that women psychiatric patients have a base rate of community violence which not less than male psychiatric patients (Lidz et al., 1993). The tool of McNiel and Binder also was designed for the identification of *inpatient* violence, and not community violence, although McNiel and colleagues themselves have found that inpatient and community violence is strongly related (McNiel et al., 1988). Whether the poor performance of the tool for community post-release violence stems from sample differences, context, or both, its use in samples similar to the present one most definitely is not recommended.

Concerning the relative utilities of the PCL:SV and HCR-20, although the AUC for violent crime was comparable between the HCR-20 and the PCL:SV, the mean AUCs for physical violence and any violence were a fair amount larger for the HCR-20 (see Table 4). Regression analyses indicated that, concerning the number of violent acts, the PCL:SV was the only significant predictor of violent crime and physical violence, whereas the HCR-20 was the only measure to predict any violence. However, when time at risk was controlled for by using the rate of violence as the dependent measure, the only significant predictor of

each type of violence was the HCR-20. At a finer gradient of analysis, using the three HCR-20 subscales, the two PCL:SV parts, and McNiel and Binder's instrument, The H scale was the most consistent predictor, appearing in all six regression models concerning the number and rates of any, physical, and criminal violence. The R scale entered three of these analyses. No other predictors emerged.

In terms of comparing the HCR-20 and PCL:SV, it appears that the HCR-20 is more consistently and strongly related to violence than is the PCL:SV. In particular, the H and R scales account for this relationship. While these findings offer strong support for the predictive validity of the HCR-20, it does not necessarily follow that the PCL:SV has no predictive validity in civil psychiatric settings. Indeed, the AUCs would suggest otherwise. However, when used together, the HCR-20 accounts for all of the variance in violence. A future research project should examine carefully the relationships of the individual items of the HCR-20 and PCL:SV with violence, in order to understand which aspects of the scales seem to predict best. Such research would have to be replicated prior to permitting conclusions about the relationship between individual items and violence to be made.

There are several explanations for why the PCL:SV did not predict. First, and perhaps most obvious, is the fact that this study is but one comparison of the schemes. In fact, there are no other studies which have compared these instruments (or the PCL-R) in civil psychiatric patients in terms of community post-release violence. Klassen (1996) compared the H scale of the HCR-20 to the PCL:SV in terms of inpatient violence by civil psychiatric patients. The H scale was somewhat more strongly related to violence (average $\underline{r} = 0.30$) than the PCL:SV (average $\underline{r} = 0.26$), although the difference between these coefficients quite probably is due to chance. Apart from the present study, and the study by Klassen (1996), there is no other research which compares the HCR-20 and PCL:SV (or PCL-R) in civil psychiatric patients. However, these instruments have been compared in other samples. In a group of incarcerated Canadian federal inmates, the H scale correlated

at 0.52 with the number of past violent charges, the C scale at 0.31, and the PCL-R at 0.34 (Douglas et al., 1996). In a sample of forensic psychiatric patients, both the HCR-20 and PCL-R correlated at approximately 0.30 with several post-release violence indexes (Wintrup, 1996).

Second, the distribution of the PCL:SV was skewed positively. A truncated range of scores also could have reduced the size of co-efficients. Further, although traits of psychopathy should in theory predict violence regardless of the sample, psychopathy likely is a less salient factor in a civil psychiatric sample in comparison to correctional and forensic samples. Psychopathy occurs less frequently in civil psychiatric samples, and the underlying causes of violence by persons with mental disorders and persons with psychopathy, though unknown and certainly not addressed in the present research, are likely to differ (i.e., loss of touch with reality versus callousness). To the extent that the PCL:SV is related to certain causes of violence and not others, it may not predict violence which stems from these other causes.

A final explanation for the superior performance of the HCR-20 is, simply, that it is a superior predictor of violence compared to the PCL:SV. In principle, the HCR-20 should be better able to predict violence, as this was the sole purpose of its creation. The PCL:SV was designed to measure (or screen for) psychopathy, and not to predict violence. It just happens that psychopathy turns out to be a good predictor of violence. However, a person who is low in psychopathic traits is not necessarily without violence risk. It is for these people that the HCR-20 should, in theory, gain ground on the PCL:SV (or PCL-R). Persons who score, say, 11/24 on the PCL:SV, or 17/40 on the PCL-R would, depending on the sample and the cut-off for violence, typically be considered at low risk for violence. However, these persons may gather points on the HCR-20 and be classified as high risk. To the extent that this group of people is actually violent, the HCR-20 should emerge as the better predictor.

Another way to frame this discussion is to state that, while there is a good deal of overlap between the PCL:SV (or PCL-R) and the HCR-20, if the non-overlapping aspects of the HCR-20 are likely to predict violence, then it is apt to perform at higher levels of predictive accuracy. The most obvious overlap between these instruments is that the PCL directly can contribute up to five percent to the total HCR-20 score. In less direct ways, both scales likely would allot points for previous crime and violence, adolescent crime and other maladjustment, employment and relationship troubles, breaches of conditional releases, substance abuse, behavioural instability, lack of empathy, callousness, and other variables. If there are items on the HCR-20 which would not be awarded scores on the PCL, and which have some relevance to violence, then the HCR-20 may predict violence at higher rates of accuracy.

As is evident, there are many research questions which could be posed and subjected to empirical investigation. Large-scale studies which attempt to test the speculations offered above are necessary before the relationship between the HCR-20 and the PCL tests is well understood, and before it can be concluded with a high degree of confidence that the HCR-20 is the superior instrument for assessing violence risk. Based on the present findings, it is appropriate to conclude that there is support for the position that the HCR-20 is the better predictor of violence in a civil psychiatric sample. It has the added benefit of being able to inform risk management.

Limitations and Future Research

In addition to the research suggestions offered throughout the discussion, there are several limitations of the present study which should be addressed through future research. First, larger samples and longer follow-up periods should be used. Moreover, although there was a "community follow-up" to this research, the design was a retrospective archival study. A preferable approach would be a prospective design in which interviews of study participants before discharge are possible. In this way, the particulars of the design and

data collection can be tailored to meet the needs of the study, rather than tailoring the data collection process to fit the constraints of the existing data. Being able to interview patients also would be useful for rating the risk assessment measures, particularly the C scale of the HCR-20 and Part 1 of the PCL:SV. Further, interviews of social workers and clinicians could assist in the rating of the R scale of the HCR-20.

A related issue is the absence of community contact with the patients themselves and with "collaterals," or persons designated by the patient who are either family members, friends, or professionals who work with the patients in the community. Inclusion of these sources of information is sure to increase the proportion of violence detected, and likely will reduce the FPR. For example, Mulvey, Shaw, and Lidz (1994), using the data set of Lidz et al. (1993) of a follow-up of 629 patients, reported the proportion of violence which was detected from each outcome source used in their research. Through the use of official records, 12% (n = 73) of the sample was defined as having acted violently. When patient self-reports and collateral information were added, the base rate rose dramatically to 47% (n = 293). An added benefit of being able to contact patients and collaterals in the community is that the C scale can be updated frequently, and the data base regularly updated with current mental status. This may help to resolve whether the C scale is, in fact, related to violence, but not demonstrated to be because of the limitations of the current design.

Another limitation of the present study relates to generalizability. That is, do the present findings support the practical use of the HCR-20 in either forensic psychiatric or correctional samples? Of course, no matter how well the HCR-20 performed in this sample, the justification for its use in other contexts would not be as strong as from data gathered in those other samples. However, it is fair to claim that there is some limited support for the use of the HCR-20 in forensic or correctional samples. This may be particularly so for forensic samples, given that most persons in this system are mentally disordered. In the correctional system, estimates of the lifetime prevalence of major mental

disorder have been placed as high as 22.7% (Hodgins & Cote, 1990). Another reason that it may be acceptable to use the HCR-20 in correctional and forensic sample stems from the fact that 41.0% of the current sample had a criminal history, and 28.0% had a violent criminal history, meaning, that at one point, nearly one-half of the present sample of psychiatric patients were part of the correctional population.

The point is that there is overlap between the psychiatric, forensic, and correctional systems, with many persons cycling through all of them. Nevertheless, the most sound and defensible approach would be to gather data in these other samples, using large-scale prospective studies, prior to integrating the HCR-20 into any decision-making tasks in other than an informal manner. On this latter point, even if the HCR-20 (or any other scheme, test, or measurement) were to be introduced into the everyday practical assessment procedures of any institution, no decisions ought to be made solely on the basis of an individual's score. As with any psychological instrument, the HCR-20 should only be used as part of an assessment. There are circumstances in which a person who scores low on the HCR-20 may be considered to be at extremely high risk for violence (i.e., the person has directed specific homicidal threats at a particular person). In such cases, the need for any risk assessment tool is obviated. The basic point is that any risk assessment scheme can at most inform the decisions of clinicians and other professionals, and not make the decisions for the professionals. Risk assessment measures, no matter how strongly related to violence, do not abrogate professional responsibility.

A further limitation of the present research which also has future research implications, is that is was not possible to code for types and severities of violence apart from the physical/nonphysical and criminal/noncriminal distinctions. It would be important to investigate the extent to which the HCR-20 predicts certain types and severities of violence. That is, can it predict sexual or spousal violence? Is it able to predict stranger violence as well as, better, or worse than violence against persons known to the

perpetrator? Are severe acts such as stabbings or shootings predicted as well as minor acts such as pushing? Answers to such questions could be sought through the type of prospective research described above.

The final suggestion for future research is to compare the predictive utility of the HCR-20 across persons possessing key characteristics. At the most basic level, men and women should be compared. Findings from high-quality research by Lidz et al. (1993) indicate that clinicians are much worse at predicting the violence of women than men. The scores, whether the same or different, of various ethnic groups would be an important and useful piece of information to possess. Diagnostic groups also could be contrasted, as could persons with or without criminal histories. In order to investigate properly each of these comparisons, and the other research suggestions discussed above, large-scale, programmatic research, conducted in multiple locations and across various settings (psychiatric, forensic, correctional), using prospective designs whenever possible, is needed.

Conclusion

The findings of the present study provide strong support for the predictive validity of the HCR-20 in a civil psychiatric sample. The HCR-20 tended to produce larger effect sizes with indexes of violence than did the PCL:SV, and was the most consistent predictor to enter regression analyses. Although research on the HCR-20 is still needed, clinicians may be well served by using, responsibly, the HCR-20 in making assessments of future violence risk.

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Appendix A

General Hospitals from which Requests for Outcome Data were Made

Hospitals Which Complied With Request	Hospitals Which Did Not Comply With Request
1) Burnaby General	1) Surrey Memorial
2) Chilliwack General	2) Penticton
3) Delta	3) Kelowna
4) Golden District General	
5) *Greater Victoria Health Society (Royal Jubilee; Victoria General; Mount St. Mary)	
6) Lions Gate (North Vancouver)	
7) Nanaimo Regional General	
8) Prince George Regional	
9) Prince Rupert Regional	
10) Richmond	
11) Royal Inland (Kamloops)	
12) St. Vincent's (Vancouver)	
13) *Vancouver Health Sciences (Vancouver and UBC)	
14) *St. Paul's	
15) Royal Columbian (includes Eagle Ridge and Ridge Meadows)	

Note. A "*" represents hospitals which complied with requests, but were unable to make access to records available in time for completion of this research.

Appendix B

Coding Protocol for Riverview Hospital Research Project

Patient Information

Patient Status:_____

Admission Date:_____

Discharge Date:_____

Date of Application for Panel:_____

Psychiatrist at Admission:_____

Psychiatrist at Discharge:_____

Ward at Admission:_____

Ward(s) transferred to:_____ _____

Sex: 1 (male) 2 (female)

DOB:_____

Age at Admission:_____

Age at Discharge:_____

Height:_____

Weight:_____

Distinguishing marks (i.e., scars)_____

Length of index hospitalization_____

Ethnicity:_____

If appropriate, check

1 White, not of Hispanic origin

2 Hispanic

3 Aboriginal/Native

4 Asian

5 Black, not of Hispanic origin

6 East Indian

7 Bi-racial

8 Other (specify)_____

Birthplace:_____

First language:_____

Length of time in BC:___

Hospital's rating of potential assaultiveness: 1 low 2 med 3 high

Hospital's rating of potential for suicide: 1 low 2 med 3 high

Hospital's rating of potential for elopement: 1 low 2 med 3 high

Education (last program and/or grade completed):_____

Age patient left school:_____

Training/Skills:_____

Children: 0 No 1 Yes

Number_____

Does patient have custody? 0 No 1 Yes

If no custody, does patient have contact? 0 No 1 Yes

If no custody, were children apprehended by MSS? 0 No 1 Yes

If children were apprehended, why? (i.e., physical abuse) _____

_____

_____

Life Situation

Living arrangement prior to index hospitalization

1 Living by self in own apartment/house/condo etc
2 Living in boarding home
3 Living in skid row hotel
4 Living with family (nonmarital)
5 Living with partner
6 Living with friends
7 Living on the street
8 Extended care home
9 Other (specify)_____

Patient has lived in community living settings in the past (i.e., group home): 0 No 1 Yes

If yes, when?_____

Problems in community living settings? 0 No 1 Yes

Specify:
1 Physical aggression
2 Verbal aggression and/or threatening behaviour
3 Substance abuse
4 Fail to comply with rules
5 Other (Specify)_____

Employment

Amount of money received per month:_____

Equity (i.e., home): 1 Yes (specify)_____

2 No

Mother's occupation:_____

Father's occupation:_____

Sources of financial support: 1 Social assistance
2 Employment
3 Dependent on family
4 Dependent of friends
5 No income
6 Other (specify)_____

Patient employed at time of index hospitalization: 0 No 1 Yes

If no, why did patient leave job? _____

Most recent type of job_____

Patient has not sustained employment in last 5 years (i.e., is unemployed for at least half of the year, most years):

0 No 1 Yes

Employment history (dates and types of jobs)

_____

_____

_____

_____

_____

Marital Status 1 Never married
2 Never married or common law
3 Presently married (duration)_____
4 Presently common law, 2 yrs, . (duration)_____
5 Divorced (duration of last marriage)_____
6 Divorced and remarried (duration of each marriage) 1st_____ 2nd_____
7 Widowed (duration) _____
8 Widowed and remarried (duration of each marriage) 1st_____ 2nd_____
9 Separated

If relationship, it was: 1 heterosexual 2 homosexual

Sexual orientation: 1 heterosexual 2 homosexual 3 bisexual

In current nonmarital/noncommonlaw relationship? 0 No 1 Yes (duration) _____

Addition Life Situation Information (Code 0=no/uk; 1=yes)

_____Unemployed for 9 of 12 past months in community
_____No fixed address or homeless (living on streets) immediately prior to hospitalization
_____Ever had no fixed address or been homeless (living on streets)
_____Has never been involved in long-term intimate relationship as an adult (2+ years)
_____Relationship(s) have been marked by conflict (abusiveness; frequent breakups)
_____Estranged from family as an adult
_____History of threatening or assaulting family
_____Regular arguments with family members as an adult
_____Statements/feelings of negativity, resentment, blame, anger, or disappointment in family
_____Local family support
_____Visitors in hospital
How may visits?_____
Who has visited (relationship to patient), and how many times each?_____
_____
_____

Childhood Factors

****Each variable is coded 0=no or unknown; 1=yes**

_____History of sexual abuse
if yes, describe_____
_____History of physical abuse
if yes, describe_____
_____History of emotional abuse
if yes, describe_____
_____Family substance abuse
_____Parental separation, not due to death (at what age of child?)_____
_____Parent(s) died under the age of 16
_____Parental criminal involvement
_____Parental spousal abuse
_____Witness parental spousal abuse
_____Did not complete elementary school
_____Did not complete high school
_____Elementary school maladjustment
If yes, check all that apply:1 fighting 4 failed one grade
2 suspensions 5 failed two or more grades
3 expulsions 6 other _____
_____Maladjustment at high school
If yes, check all that apply:1 fighting 4 failed one grade
2 suspensions 5 failed two or more grades
3 expulsions 6 other _____

Patient grew up with/which family above infor based on:

1 Biological parent(s) 2 Foster parent(s) 3 Adoptive parent(s)
4 Extended biological family 5 Other (specify)_____

Criminological History

****Each variable is coded 0=no or uk; 1=yes**

Note: Violent arrests and violence include anything with the potential to cause harm (including robbery and sexual offences); "weapon"=any object used against a person

_____Past arrests
Number of past arrests _____
Age at first known criminal activity_____
_____Past arrests for violent offences
Number of past violent arrests_____
Age at first known violence_____
_____Self report of past crimes
_____Self report of past violence
_____Documented past physical violence, non arrest (i.e., from previous hospitalizations, etc)
_____Documented past verbal aggression or threatening behaviour
_____Physical violence in community during two weeks prior to hospitalization
_____Verbal aggression or threatening behaviour during two weeks prior to hospitalization
_____Two to four past known violent incidents
_____Five or more known past violent incidents
_____Age at first known violence under 19
_____Age at first known violence under 16
_____Prior breach of community condition release from penal or psychiatric institution
_____Prior escapes or attempted escapes or unauthorized absences
_____Prior breach of court orders or failure to appear
_____Past weapon use
_____Targets of past violence A (1=male; 2=female; 3=both)
_____Targets of past violence B (1=family; 2=friend or acquaintance; 3= stranger; 4=professional; 5=two of the prior; 6=three of the prior; 7=all of the prior; 8=animals)
_____Targets of past violence C (1=child; 2=adult; 3=both)

Current Criminality

_____Current criminal charges

How many?_____

Type (specify all that apply)

1 against person
2 against property
3 violation of conditions of parole or probation

Specific offences (record actual CCC number)_____

_____ _____

Description (incident, victim, weapon used, alcohol/drugs involved, injury, property damage etc) _____

_____

_____

_____

_____

_____

_____

_____

History of criminal charges:

Date/Age	Charge (with CCC#)	Outcome/Disposition

Suicide and Self-Harm History

Code 0=no or uk; 1=yes

_____Suicide history

_____Suicide attempts

Describe and date_____

_____

Timing: 1 incident occured in current month
2 incident in current year
3 incident more than one year ago

Number: 1 only one incident in life
2 two to four incidents
3 five to ten incidents
4 more than ten incidents

_____Suicidal ideation

Describe and date_____

_____

Timing: 1 incident occured in current month
2 incident in current year
3 incident more than one year ago

Number: 1 only one incident in life
2 two to four incidents
3 five to ten incidents
4 more than ten incidents

_____Self-harm

Describe and date_____

_____

Timing: 1 incident occured in current month
2 incident in current year
3 incident more than one year ago

Number: 1 only one incident in life
2 two to four incidents
3 five to ten incidents
4 more than ten incidents

Substance Abuse History

****Each variable is coded 0=no or uk; 1=yes**

_____Substance abuse (past or present)

Note: "past" refers to more than one year ago

_____Past abuse (anything)
_____Current abuse (anything)
_____Current abuse of alcohol
_____Current abuse of marijuana or hashish
_____Current abuse of other drugs
_____Current abuse of both alcohol and drugs
_____Current polysubstance abuse (3+ drugs [not alcohol] used concurrently for least 6 months)
_____Current presence of delirium tremens
_____Ever experienced delirium tremens
_____Current presence of substance induced psychosis
_____Ever experienced substance induced psychosis
_____Past abuse of alcohol
_____Past abuse of marijuana or hashish
_____Past abuse of other drugs
_____Past abuse of both alcohol and drugs
_____Past polysubstance abuse (3+ drugs [not alcohol] used concurrently for least 6 months)
_____Substance abuse began prior to age 18
_____Substance abuse began prior to age 16
_____Substance abuse has persisted for a period of 12 months up to date of hospitalization
_____Substance abuse has persisted for a period of 12 months in past

Psychiatric History

****Each variable is coded 0=no or uk; 1=yes**

_____Prior hospitalizations? (does not include transfers from another hospital to RVH or ER visits unless admitted/committed)

Number 1 one
2 two to four
3 five to nine
4 ten or more
Specific number_____

_____First hospitalization under age 19 (specific age: _____)
_____Age of onset of mental illness under 19 (specific age: _____)
_____History of medication noncompliance
_____History of medication nonresponsiveness
_____Longest past hospitalization equal to or greater than three months
_____Longest past hospitalization equal to or greater than six months
Specific duration of longest past hospitalization_____
_____Family history of mental illness
Relationship to patient and diagnoses_____
_____
_____
_____
_____

Events Preceding Admission

How patient got to hospital

1 police
2 transfer from another hospital (specify_____)
3 relative or friend
4 voluntary patient, status changed to involuntary
5 other (specify_____)

Code 0=no or uk; 1=yes

_____Any aggression in the two weeks prior to admission (if transferred from another hospital, two weeks prior to that hospitalization)
_____Physical aggression in the two weeks prior to admission (if transferred from another hospital, two weeks prior to that hospitalization)
_____Verbal aggression and/or threatening behaviour in the two weeks prior to admission (if transferred from another hospital, two weeks prior to that hospitalization)
_____Suicidal behaviour, attempts, gestures, ideation, or self harm in the two weeks prior to admission (if transferred from another hospital, two weeks prior to that hospitalization) -- *circle all that apply*

Diagnostic and Medication Information -- Current Hospitalization

Admission Diagnoses

Axis I: _____

Axis II: _____

Axis III: _____

Axis IV: _____

Axis V: _____

Discharge Diagnoses

Axis I: _____

Axis II: _____

Axis III: _____

Axis IV: _____

Axis V: _____

Discharge Medication

Psychiatric Medication _____

Nonpsychiatric medication_____

Medication noncompliance 0=no 1=yes

Medication refractoriness (non-responsiveness for any reason) 0=no 1=yes

Psychiatric medication changes (list them with start and stop dates)

Admission Psychiatric Symtomatology/Mental Status

Code 0=no or uk; 1=yes
Code from mental status examination and from nursing notes/summaries/notes from transfer hospital

_____Any psychotic symptoms

_____Presence of delusions _____Due to specified organic causes
_____Presence of paranoid delusions
_____Presence of grandiose delusions
_____Presence of delusions of reference
_____Presence of delusions of poisoning
_____Presence of other delusions (specify)

_____Presence of hallucinations _____Due to specified organic causes
_____Presence of visual hallucinations
_____Presence of auditory hallucinations
_____Presence of auditory hallucinations in which the voices are recognized
_____Presence of command hallucinations
_____Presence of command hallucinations to harm or kill others

_____Presence of hallucinations and delusions concurrently
_____Hallucinations and delusions thematically congruent

_____Number of threat/control-overide psychotic symptoms; one point for each of:
- _____Belief that others control how one moves or thinks
- _____Belief that one is being plotted against or others are trying to harm one
- _____Thought insertion or withdrawal
- _____Belief that others are following one

_____Thought insertion
_____Thought withdrawal
_____Thought broadcasting

_____Disoriented or confused _____Derailment
_____Incoherence
_____Disorganized speech or thinking (thought disorder)
_____Irritable, agitated, tense, or excited
_____Bizarre behaviour or speech

_____Anger
_____Impulsivity/reactivity
_____Labile affect
_____Inappropriate affect (does not include blunted affect)
_____Hostile, suspicious, paranoid, or guarded
_____Uncooperativeness
_____Coercive, manipulative, or "tests the limits"
_____Absence of negative symptoms (motor retardation, withdrawal, blunted affect)
_____Absence of insight into mental illness
_____Absence of depression
_____Homicidal ideation OTHERS!! (L IST)_____

Discharge Psychiatric Symtomatology/Mental Status

Code 0=no or uk; 1=yes
Code from mental status examination, discharge summary, and from nursing notes/summaries -- last two weeks of hospitalization

_____Any psychotic symptoms

_____Presence of delusions _____Due to specified organic causes
_____Presence of paranoid delusions
_____Presence of grandiose delusions
_____Presence of delusions of reference
_____Presence of delusions of poisoning
_____Presence of other delusions (specify)

_____Presence of hallucinations _____Due to specified organic causes
_____Presence of visual hallucinations
_____Presence of auditory hallucinations
_____Presence of auditory hallucinations in which the voices are recognized
_____Presence of command hallucinations
_____Presence of command hallucinations to harm or kill others

_____Presence of hallucinations and delusions concurrently
_____Hallucinations and delusions thematically congruent

_____Number of threat/control-overide psychotic symptoms; one point for each of:
_____Belief that others control how one moves or thinks
_____Belief that one is being plotted against or others are trying to harm one
_____Thought insertion or withdrawal
_____Belief that others are following one

_____Thought insertion
_____Thought withdrawal
_____Thought broadcasting

_____Disoriented or confused _____Derailment
_____Incoherence
_____Disorganized speech or thinking (thought disorder)
_____Irritable, agitated, tense, or excited
_____Bizarre behaviour or speech
_____Anger
_____Impulsivity/reactivity
_____Labile affect
_____Inappropriate affect (does not include blunted affect)
_____Hostile, suspicious, paranoid, or guarded
_____Uncooperativeness
_____Coercive, manipulative, or "tests the limits"
_____Absence of negative symptoms (motor retardation, withdrawal, blunted affect)
_____Absence of/limited insight into mental illness
_____Absence of depression
_____Homicidal ideation OTHERS!! (LIST)_____

Behaviour during Index Hospitalization

Code 0=no or uk; 1=yes

Note: Specify exact #s of aggressive incidents if possible

_____Any aggression
_____Any aggression against copatients
_____Any aggression against staff

_____Number of any aggressive incidents two to four
_____Number of any aggressive incidents five to nine
_____Number of any aggressive incidents ten or greater

_____Any physical aggression
_____Any physical aggression against copatients
_____Any physical aggression against staff

_____Number of physically aggressive incidents two to four
_____Number of physically aggressive incidents five to nine
_____Number of physically aggressive incidents ten or greater

_____Any verbal aggression or threatening behaviour
_____Any verbal aggression or threatening behaviour against copatients
_____Any verbal aggression or threatening behaviour against staff

_____Number of verbally aggressive or threatening behaviour incidents two to four
_____Number of verbally aggressive or threatening behaviour incidents five to nine
_____Number of verbally aggressive or threatening behaviour incidents ten or greater

_____Any aggression against self, suicide attempts, or self-mutilation
_____Number of aggressive incidents against self two to four
_____Number of aggressive incidents against self five to nine
_____Number of aggressive incidents against self ten or more

_____Any seclusions, hospital-initiated prns, or special attentions for unpredictable behaviour
_____Number of seclusions, etc two to four
_____Number of seclusions, etc five to nine
_____Number of seclusions, etc ten or greater

Timing of Aggressive Incidents

Number of days after admission to first incident of...

Any aggression against copatients_____
Any aggression against staff_____
Any aggression toward self_____
Any physical aggression against copatients_____
Any physical aggression against staff_____
Any verbal aggression or threatening behaviour against copatients_____
Any verbal aggression or threatening behaviour against staff_____

Aggression in Prior Transfer Hospital (immediately prior to RVH admission)

_____Any
_____Physical
_____Verbal aggression or threatening behaviour
_____Aggression against self, suicide attempts, or self mutilation

Do not try to code the number of these incidents, just whether there were any

Absences (Authorized and Unauthorized)

Code 0=no or uk; 1=yes

_____Authorized absences (i.e., day or weekend passes)

Number of authorized absences_____

Number of days until first absence_____

Arrangement: 1 With family
2 With friends
3 Alone, in boarding home
4 Other _____

Problems: 1 Aggression (specify physical, verbal, etc)
2 Substance use
3 Decompensation
4 Other _____

Number (be exact if possible)_____ 1=1 2=2-4 3=5-9 4=10+

_____Unauthorized absences/escapes

Number of days until first unauthorized absence_____

Problems: 1 Aggression (specify physical, verbal, etc)
2 Substance use
3 Decompensation
4 Other _____

Number (be exact if possible)_____ 1=1 2=2-4 3=5-9 4=10+

_____Attempted unauthorized absences/escapes

Number of days until first attempted unauthorized absence/escape_____

Release Plan

Check where appropriate

_____No plan
_____On boarding or group home waiting list
_____To live with spouse or family members
_____To live with friends
_____To live alone
_____Back to general hospital (psychiatric unit)
_____Other_____

Code 0=no or uk; 1=yes

_____Is released without community agency involvement or supervision
_____Is released without family support or assistance
_____Is released with no fixed address
_____Is released to skid row hotel
_____Is released to environment similar to the one which lived in prior to hospitalization
_____Is released to environment in which drugs and alcohol are readily available

Appendix C

Coding Protocol For Outcome Data

OUTCOME MEASURES

CRIMINAL RECORD OUTCOME MEASURES

Patient was charged with criminal offence 0 No 1 Yes

List all offences which patient was charged with (i.e., Criminal Code sections), dates, whether convicted, and dispositions.

	DATE	CODE SECTION	DISPOSITION
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

RIVERVIEW HOSPITAL OUTCOME MEASURES (to be completed for each rehospitalization to Riverview hospital)

Date of rehospitalization: _____

Length of stay (in days): _____

Status of patient on admission

☐ involuntary (indicate section of B.C. Mental Health Act: _____)
☐ voluntary

How did patient get to hospital?

☐ police
☐ ambulance
☐ self
☐ transfer from other hospital (specify: _____)
☐ other

For each Riverview rehospitalization, check all that apply:

☐ physical aggression as part of presenting problem
☐ verbal aggression and/or threatening/fear-inducing behaviour as part of presenting problem
☐ suicide attempt(s) as part of presenting problem
☐ suicidal ideation as part of presenting problem
☐ self-injurious behaviour as part of presenting problem

Description of incident(s) (nature of aggression; degree of victim harm; whether weapon involved; whether patient provoked; relationship of victim to patient; location of incident; etc)

☐ recent substance abuse in the community
☐ unemployed at time of rehospitalization
☐ patient was in a relationship at time of rehospitalization
☐ patient was living on streets/no fixed address
☐ patient was living by self (not in skid row hotel)
☐ patient was living in skid row hotel
☐ patient was living with family
☐ patient was living with friends
☐ patient was living in group home/community agency accommodations

GENERAL HOSPITAL OUTCOME MEASURES (to be completed for each admission to each general hospital)

Name and location of hospital with which patient had contact: _____

Date of rehospitalization: _____

Length of stay (in days): _____

For each rehospitalization, check all that apply:

☐ physical aggression as part of presenting problem
☐ verbal aggression and/or threatening/fear-inducing behaviour as part of presenting problem
☐ suicide attempt(s) as part of presenting problem
☐ suicidal ideation as part of presenting problem
☐ self-injurious behaviour as part of presenting problem

Description of incident(s) (nature of aggression; degree of victim harm; whether weapon involved; whether patient provoked; relationship of victim to patient; location of incident; etc)

☐ recent substance abuse in the community
☐ unemployed at time of rehospitalization
☐ patient was in a relationship at time of rehospitalization
☐ patient was living on streets/no fixed address
☐ patient was living by self (not in skid row hotel)
☐ patient was living in skid row hotel
☐ patient was living with family
☐ patient was living with friends
☐ patient was living in group home/community agency accommodations