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Assessing Risk Factors for Victims of Violence in a Hospital-Based Violence Intervention Program

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Abstract: Introduction: Personal, behavioral, and environmental risk factors are correlated to varying degrees with each other and with the overall likelihood of violent reinjury. When used with fidelity, risk assessment instruments, including the violence reinjury risk assessment instrument (VRRAI), identify domains in which individuals present elevated risk levels to aid in matching services with needs. Less is known about the collinearity among risk factors for violently injured individuals admitted to hospitals. Collinearity between risk factors has ramifications for predictive modeling of violent reinjury risk. The objective of this study was to identify significantly correlated risk factors when the VRRAI was used by hospital-based violence intervention programs (HVIP) for clients. Materials and Methods: Victims of violent injury by modality of firearm, stabbing, and physical assault who were admitted to a level 1 trauma center at a single institution were voluntarily enrolled in a hospital-based violence intervention program (HVIP) between September 2020 and June 2022. Violence intervention specialists (VIS) completed the VRRAI within the first month of participant enrollment. The VRRAI is comprised of 29 binary indicators that may signal elevated risk of violent reinjury. Data from completed assessments were used to apply risk-need-responsivity (RNR) principles along with phi coefficients of key indicators to examine overlap and prevalence in the population. Results: A total of 98 participants were enrolled in the HVIP. The median age was 27 years old and 79 (80.6%) were male, while 66 (67.3%) were non-Hispanic Black or African American, 9 (9.2%) were non-Hispanic White, and 17 (17.3%) identified as Hispanic or Latino. Several statistically significant relationships existed between key risk indicators in the VRRAI. Importantly, a robust relationship was found between the two dynamic risk factors of having heavy connection with gangs and a perception of imminent threat of violence ($\varphi c = 0.57$, $p < 0.01$). Conclusion: Data suggest that some variables could be consolidated or removed from the VRRAI to create an even shorter instrument that can be performed more rapidly in the clinical setting. The application of the RNR model illustrates a limited number of dynamic risk factors that could be immediately addressed as part of case management should be prioritized among the questions selected from the VRRAI for inquiry at the intake assessment.

Keywords: violence intervention; risk assessment; violent injury; interpersonal violence; reinjury; trauma; hospital based violent intervention program

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1. Introduction

1.1. Gun Violence and Violent Injuries at Distressing Level in the U.S.

The United States continues to experience dramatic increases in gun-related deaths and violent injuries, reaching what has been recently described as a distressing peak in 2021 [1]. During the pandemic, gun deaths became the leading cause of mortality among children under 19 years of age. According to the Center for Disease Control (2022) [1], youth homicide rates are now elevated to levels not seen since the late 1990s. Across all ages, in 2019 these incidents claimed 39,773 lives, more deaths than falls and motor vehicle collisions combined [2]. To put these data in further context, the most recent National Violent Death Reporting System data [3] demonstrate that every hour, seven people die a violent death.

In addition to gun violence being a prevalent cause of mortality in the United States, a related disturbing trend is the 1.5 million violent injuries treated in 2019 that did not directly result in death. Research on patterns of violent injuries requiring hospital admission shows that such injuries are geographically concentrated in urban areas, tend to be intergenerational, and are highly racialized in that they disproportionately affect young people of color [4] in marginalized communities. Of patients admitted to the hospital for violent injury, up to 44% incurred subsequent violent reinjury upon release, or injury recidivism. Without successful intervention in ongoing community violence trends, experts believe that, when coupled with the current economic downturn and other societal factors, mortality and injury trends will remain high.

Violent victimization injuries and injury recidivism are not only individually devastating, but costly to individuals and to communities. The Centers for Disease Control and Prevention (CDC) estimates the average medical cost of a hospitalized patient with a violent injury range from $37,260 to $54,836 [5]. Based on directly measurable expenses within Nebraska, the initial financial burden of gun violence victimization is over $342 million per year, including healthcare ($17 million), law enforcement and criminal justice expenses ($22 million), costs to employers ($2 million), and lost income ($301 million). Much of these costs are absorbed by public dollars given that up to 85% of gunshot victims are uninsured or on a form of publicly funded insurance. Broad-based efforts to prevent injury recidivism through violence intervention among community and social institutions using a transdisciplinary perspective are critical to address this distressing public health crisis and mortality. In this paper, we discuss the systematic improvement of risk assessment among participants in a hospital-based violence intervention program to improve service delivery, expedite the collection of priority information from this client base, and create valid information for use in predictive models.

1.2. Complexities of Gun Violence Informing Intervention

Violence intervention programming efforts must consider determinants of gun carrying behavior and retaliatory violence in the community to meet the safety needs of program participants. Among youth, gun carrying is often related to the youth's perceived need for protection [6], which may dramatically increase if a family member has been injured by gun violence, or if the youths perceive another person has disrespected them or their family member, even when the interaction occurs in an online environment (i.e., social media) [7]. Furthermore, studies of individuals exposed to violent incidents or direct victimization show that they have an elevated risk of future violence, intentions to use violence, gun carrying, and attitudes accepting of violence and aggressive behavior in conflict resolution. Individuals exposed to violence as a victim or witnessing violence have significantly increased odds of gun carrying ranging from 1.43 to 1.87 with each additional report of exposure to violence [8].

We also know that victims of gun injury across all ages report feeling isolated and oftentimes modify their routines to avoid circumstances, situations, and individuals they perceive as unsafe. Not only are these individuals more likely to report gun carrying behavior following violent injury, but they also report a willingness to use the gun if

deemed necessary [8]. It is reasonable that this logic applies to the family members of violently injured individuals. Family members may also feel significantly less safe after a violent event occurs, thus exponentiating the risk of violence in a localized community. A single firearm victimization impacts a community beyond the patient and, if the client engages in retaliatory violence, several more individuals would be negatively affected.

Significant published research supports the critical importance of attenuating gun carrying behaviors as part of violence intervention services to offset injury recidivism. Researchers find an important victim–offender overlap in gun carrying behavior [9], such that prior gun victimization substantially increases the likelihood of subsequent gun carrying behavior [10] and elevates the risk of retaliatory violence. Community violence is complex. Oftentimes, the subset of individuals engaging in violent behavior are exposed to violence through direct or indirect victimization [11]. Among youth, reciprocal high-risk behavior contributes to violent injuries [12]. Moreover, patterns of gun carrying behavior tend to emerge in adolescence and inform gun carrying behaviors in adulthood [13], which underscores the importance of focusing on youth prevention programming and intervention with family members associated with violent incidents as well as adult populations.

Violent reinjury prevention and intervention is a high priority among ongoing clinical and public health efforts nationally. One growing approach to intervention is the implementation of hospital-based violence intervention programs (HVIPs) throughout the United States. These programs aim to identify and engage with patients who are admitted to the hospital because of violent victimization and are determined to have an elevated risk for violent reinjury from community gun violence [14,15]. Where possible, case management and related services also incorporate the victim's immediate family. The primary stated purpose of many HVIPs is to promote healthy relationships and interrupt the cycle of violence among victims of violence through hospital-based, community-linked, culturally competent intervention and case management. HVIPs intend to break the cycle of violence by addressing the victim's unmet social (housing, education, and employment), legal (immigration, court advocacy), behavioral health (mental health, substance abuse), and healthcare needs using a victim services approach [16]. By closing the service gaps that exist in the care of victims of violence, HVIPs aim to reduce the risk of reinjury recidivism and promote healthy relationships and recovery among these victims. If successful in modifying the individual's trajectory by addressing previously unmet needs, the likelihood of retaliatory violence and reinjury is reduced, thereby decreasing community violence as well.

1.3. Intervention Efforts through Hospital-Based Violence Intervention Programs (HVIP)

As noted earlier, violent victimization resulting in hospital admission tends to be geographically concentrated in urban areas, intergenerational, and to disproportionately affect young people of color. Hospitalization for violent injury presents a unique opportunity for early intervention with individuals who have elevated risk of revictimization and reinjury. The trend toward HVIP implementation is a promising approach to offsetting a trajectory of injury recidivism because individual risk factors are identified, and trauma-informed case management follows by matching services to the individual needs. Evaluation of HVIP effectiveness that accounts for medical and public health considerations along with a criminological research lens is undeniably needed to support program development and amass critical data and knowledge regarding this modality of victim services. In the interim, service provision that addresses underlying risk factors for gun carrying and retaliatory violence, such as enhancing a perceived sense of mental well-being and safety, as well as meeting basic social and physical needs, is a promising direction for community violence intervention.

HVIPs initiate the early intervention of victim services to the most seriously victimized individuals. Victim services are provided at a critical juncture to meet individual needs, with the theory that when addressed along with case management via violence intervention specialists (i.e., credible messengers), retaliatory violence that results in further victimiza-

tion will be mitigated. While promising, the knowledge and data gap regarding HVIP outcomes is vast, beginning with whether HVIPs are adequately assessing risk factors.

Like infectious diseases, violence follows the same pattern, leaving a person in a vicious cycle if not interrupted. HVIPs take advantage of the time window following a traumatic experience (i.e., a "teachable" moment), as individuals are most receptive to behavioral life changes after an injury [14,17–20]. Working at bedside, violence intervention specialists, in conjunction with social workers and medical staff, screen patients and offer program enrollment to those patients found to be high risk for injury recidivism [21]. Initial contact is meant to develop patient-case worker trust and assess immediate risk for reinjury [16]. An initial risk assessment is necessary to document risks- and needs-based reassessment during case management periods, as risk level is subject to change over time, needs addressed with additional risks or needs presented.

1.4. The Need for Improving Risk Assessment in HVIPs

The risk of injury and reinjury is influenced by a complex array of individual, behavioral, and environmental factors, some of which are known to have overlapping etiology. Recognition of the multifaceted issue of injury recidivism can be conceptualized through the lens of a social ecological model. From a social ecological perspective, the individual is a central node or micro level component in a network of relationships that includes interpersonal and macro level components of community and societal relationships. Using a transdisciplinary lens, violence intervention efforts can target one or more factors at the micro or macro level aiming to decrease the likelihood of injury recidivism. Adequate individual assessment at the outset of a violence intervention program, targeting micro-level factors, is critically important to effectively modify individual or interpersonal trajectories of violent injury recidivism.

Conducting risk assessment and developing individualized case plans of services are recommended practices for any type of intervention program and is especially important when addressing violent reinjury. Within HVIPs, in addition to identifying the patient's risk of injury recidivism, assessment is also necessary to reliably evaluate the tier of service designation (i.e., low, medium, and high intensity of services provided). The knowledge gained during risk assessment is informative in developing a case plan and connecting clients to services in the community. Currently, assessment tools for use in HVIPs are underdeveloped and little research on risk assessment strategies employed by HVIPs has been documented (see [22]).

Practices most commonly include program staff using intuition based on their own personal experience to guide their assessment of risk and prioritization of needs. Anecdotally, Kramer and colleagues (2017) [22] indicate experience can be used to discern which program participants are at the highest level of need; however, a lack of standardization in practice is problematic. Without the use of a structured assessment tool, validation and consistency within/across programs clients is detrimental. Without the ability to include risk scores collected using validated tools as control measures, any statistical comparisons across sites in effective programming and outcomes are limited in predicting injury recidivism [23]. The lack of a data driven assessment and documentation of risks and needs poses a challenge for service providers who are responsible for implementing case plans across a multidisciplinary treatment team. Finally, a reliance on the professional judgement of a single individual during program intake opens the door for personal bias to negatively affect client progress and outcomes.

Risk assessment tools that are commonplace in the field of criminology and criminal justice "offer a science-based approach to regulate decision-making to avoid or minimize biases, decrease unnecessary discretion, improve proper use of resources, and/or increase fairness" [24] and serve multiple purposes. First, the individual assessment phase creates a definitive period during which the program staff member (i.e., violence intervention specialist or case manager) can focus on building rapport with the client-victim, establish trust, and determine a prioritization of client needs. Next, as the program staff assess

the client's level of risk for injury recidivism, he or she develops an individual case plan tailored to the goals and objectives of the program and the client [23]. Finally, data driven case management spans the lifespan of client's involvement with the program creating the opportunity to reassess risk throughout this duration to determine change.

1.5. Fundamentals of Risk, Needs and Responsivity in Risk Assessment

When focusing on intervention at the individual level, the criminological literature demonstrates the importance of matching services with the specific risks and needs of the client identified using validated risk assessment tools. Risk assessment is most effective when guided by principles of the risk, need, and responsivity (RNR) model [25–28]. Risk refers to the combination of static and dynamic factors that places a person at elevated risk of victimization or injury recidivism in comparison to the balance of the population.

In the normative risk-needs-responsivity framework of rehabilitation services in the criminal justice discipline, an individual is less likely to engage in criminal behavior, including violence, if their specific needs are considered and "treated" with an individualized case plan, not a one-size-fits-all approach to service provision. Given the victim–offender overlap, it follows that decreased likelihood of criminal behavior including gun violence (initial or retaliatory) would extend to decreasing the likelihood of victimization and/or injury recidivism. An individualized approach to case management requires the use of a validated risk-needs assessment tool that identifies domains with the predominant dynamic risk factors presented and most critical needs [26]. If the program staff member is successful in building rapport with the client and identifies the most critical needs, the likelihood that the client will subsequently engage in meaningful program participation is greater.

When examining an individual's level of risk, whether to determine likelihood of engaging in criminal behavior or the likelihood of victimization and reinjury, criminological literature on risk assessment emphasizes that two categories of risk factors exist—static and dynamic risk factors. Static factors are typically comprised of non-malleable characteristics such as personal demographics or prior criminal involvement [29]. Essentially, these factors are either historical or cannot be changed by any type of intervention. Comparatively, dynamic risk factors have the potential for malleability and should serve as targets for intervention efforts. Changeable aspects of an individual typically stem from general life challenges or barriers [25,30]. Examples include employment instability, addiction issues, antisocial values, low or limited self-control, and associations with criminal or antisocial peers [29,31]. Similarly, the risk of victimization follows the trend of being affected by those same sociologically dynamic factors [32,33]. The risk principle further holds that the level of service should match the level of risk one possesses and not overserve or unnecessarily complicate aspects of an individual's life that are stable or hold promise.

The need principle expresses that as individuals are assessed and risks determined, dynamic risks should comprise or inform the targeted needs for service intervention that are expected to offset or reduce those malleable risk factors. Lastly, the responsivity principle asserts that interventions should be tailored to the individual's abilities, strengths, and learning behaviors. Responsivity is how a program goes about maximizing the individual's likelihood of benefiting from an intervention. An emphasis is placed on consideration of the individual's age, gender, motivation level, and psychological health when choosing intervention techniques [34] so the intervention is responsive to cultural, gender or other aspects of that individual. Responsivity is also considered in terms of general and specific [35]. General responsivity occurs when an intervention that is generally found to be effective is utilized, thereby engaging a general framework of impact on the desired change. Specific responsivity considers the individual's odds of receiving benefit from an intervention by matching the individual's learning style, thinking patterns, or personal strengths and weaknesses. Related fields might consider this concept as akin to a strengths-based approach to treatment matching. Working as a collective framework, the RNR model stresses the importance of understanding an individual to appropriately serve and support them [36]. The principles of the RNR model bolster traditional risk screening in medical

settings, which tends to focus on the presence or absence of risk factors, by considering responsivity. Systemic responsivity, meaning the ability of systems to adequately respond, is especially critical to HVIPs that rely on medical and community systems to address the needs of participants and should consider the capacity and ability of these systems to adequately meet the needs of program participants [24,37].

1.6. The Violence Reinjury Risk Assessment Instrument

An emerging shift in risk assessment by HVIPs is the increasing utilization of a structured assessment tool. To date, the only known instrument used in some HVIPs is the violence reinjury risk assessment instrument (VRRAI) developed by Kramer and colleagues (2017) [22]. HVIPs use such tools to identify clients at elevated risks of violent reinjury. Kramer et al. developed the VRRAI in response to their identification of the lack of validated guidelines for risk factors in the HVIP setting. They created the VRRAI based primarily on professional judgement and a reliance on models used to predict intimate partner violence (IPV) and suicide risk. Specifically, the team conducted 11 semi-structured interviews and 2 focus groups with key informants using snowball sampling. Informants included a range of subject matter experts such as case managers, nurse practitioners, psychotherapists, violence intervention specialists, and community leaders. Qualitative data gathered were analyzed to identify risk factors. There were 18 key themes and 141 potential risk factors that were initially identified. Eight models were subsequently developed and presented to case managers and leadership focus groups. Structured professional judgement was used to choose a 29-item model that includes four tiers of risk factors for violent reinjury, thus comprising the VRRAI. The 29-item VRRAI is described as assessing the presence of risk indicators, behavioral factors, and conditional or environmental factors that may signal an elevated risk of reinjury for patients. The presence of an indicator is documented in a binary manner. The indicators were identified within the seven domains of environment, identity, mental health, behavior, conflict, indicators of lower risk, and case management. When the suggested algorithmic structured professional judgement is applied, as suggested by the case managers in the study, several factors in the "elevated risk" grouping are considered in a binary manner before assessment in the next three groupings of risk factors. Depending upon the combination of risk factors present, clients are deemed elevated risk or moderate risk.

The advantage of risk assessment tools, such as the VRRAI, includes its ability to be readily deployed in the clinical setting or HVIPs. However, wide adoption in the hospital setting is subject to the challenges of other screening instruments—namely, whether the instrument is simple to use, rapid to use, and provides actionable data. The VRRAI does provide actionable data but concerns with the VRRAI as an optimal tool in its current form exist. The ease of use in clinical settings is hampered by the length of the instrument. Anecdotal evidence at one HVIP suggests that deploying the instrument as currently structured is time consuming.

Conceptual overlap, and possible statistical overlap (i.e., collinearity), between the 29 indicators of risk suggest that a reduced set of indicators that specifically map onto dynamic dimensions of risk as identified in the criminological literature may be both informative and be a more efficient approach. Specifically, identifying the most robust factors that contribute to community violence and that may be addressed in the short-term through case management in HVIPs to attenuate injury recidivism and retaliatory violence may an improved approach in risk and need identification. Anecdotal evidence of conceptual overlap also warrants an exploration of instrument data in the future to begin assessing collinearity and inform structured, multivariate statistical models employed to predict likelihood of reinjury.

Finally, in its current format, the VRRAI may not account for wide swaths of long-standing theoretical underpinnings related to risk needs identification developed in the criminological literature in the risk needs responsivity model. The approach of the VRRAI was limited to forensics and psychology [22], specifically IPV and suicide risk assessment

tools. While these fields have much to contribute and assessment tools are also critical to these issues, they are less informative for victims of intentional community-based gun violence who are the target population of HVIPs. Given the victim–offender overlap evident particularly among individuals involved in gun violence, it is critical to apply a broader transdisciplinary lens to risk assessment in HVIPs that incorporates global criminogenic risk factors. Moreover, while risk levels are informative, all prospective clients are hospitalized due to violent victimization presenting at least moderate risk or injury recidivism by the very nature and context of their injury. HVIPs target meeting the needs of clients as a priority. Therefore, distinguishing between static risk factors and dynamic needs to which HVIPs can be specifically responsive (i.e., engage in specific responsivity) should be prioritized.

To our knowledge, no statistical validation of the VRRAI instrument has occurred, nor has the VRRAI been mapped onto criminogenic risk factors using the RNR model as a framework. The objective of the balance of this study is to examine VRRAI indicators as they overlap with the theoretical underpinnings of the RNR model and discuss efficiencies that would reduce collinearity in statistical applications that would inform specific responsivity of HVIPs and predictive models of injury recidivism in the future.

2. Materials and Methods

2.1. Study Design and Participants: Retrospective Cohort Study

Setting: Single-institution ACS-verified level I trauma center (University of Nebraska Medical Center in Omaha, Nebraska) with a hospital-based violence intervention program (ENCOMPASS Omaha) between September 2020 and June 2022.

Participants: Patients who were victims of interpersonal violence (firearm injuries, stabbing, physical assault) admitted to the trauma center and voluntarily enrolled in a hospital-based violence intervention program after meeting with a violence intervention specialist.

2.2. Data Sources

Violence intervention specialists (VIS), the HVIP credible messenger, engaged with HVIP patients to ascertain information that would allow for the VIS to complete the VRRAI based on information self-reported by the patients. Results were entered, deidentified, into a secure database for analysis.

Variables: The VRRAI is comprised of 29 binary indicators coding denoting the absence or presence of a risk factor. These indicators are grouped into four dimensions as per Kramer et al. (2017) [22] including elevated risk indicators; behavioral factors; severe conditional factors; and moderate conditional factors. Elevated Risk Indicators include (1) perceived imminent threat of violence, (2) heavily connected with gangs, gang/criminal lifestyle, (3) history of 2 or more gunshot wounds, stab wounds, or other assaults, (4) incarceration/probation/parole history, (5) heavy family/social network history of violence, and (6) disengaged/unreceptive to services. Behavioral Factors include (1) severe mental health diagnosis, (2) substance use disorder, (3) dissociative behavior, (4) high aggression/impulsivity, (5) low recognition of dangerous situations, and (6) denial of involvement in present injury. Severe Conditional Factors include (1) disrespect as a factor leading to injury, (2) recent illegal activity, (3) weapons use in past year, (4) unstable housing in past year, (5) living in a high-risk neighborhood, (6) undocumented minor with poor local support network, (7) substance use at injury, and (8) not involved in recommended programs, school, and/or work. Moderate Conditional Factors include (1) pursuing/glorifying/wanting to be in a gang, (2) no motivation to commit to major life changes following injury, (3) been in a fight in the past year, (4) fears of future violence, (5) access to guns, (6) unemployed, (7) low educational attainment, (8) undocumented immigration status, and (9) unstable family life.

3. Results

3.1. Participant Demographics

A total of 98 participants were enrolled in the HVIP and 100 percent had an assessment completed. The median age was 27 years old and 79 (80.6%) were male, while 66 (67.3%) were non-Hispanic Black or African American, 9 (9.2%) were non-Hispanic White, and 17 (17.3%) identified as Hispanic or Latino.

3.2. Participant Risk Factors

Details for the VRRAI used in one HVIP is presented in Table 1 consistent with the original groupings suggested by Kramer and colleagues. In the table, the first column indicates the original grouping and question number followed by the explanatory text in column 2. Column 3 indicates "D" for dynamic risk or malleable factor, and "S" for static risk or need which is non-malleable or often historic client information (not part of the Kramer et al. tool). The final column indicates the valid percentage of respondents who indicated affirmatively to each binary question posed in the 29 indicator VRRAI tool, which ranged from 3.1% for undocumented minor to 76.1% for substance use.

Table 1. Violent Re-injury Risk Assessment.

Category A: elevated-risk indicators			
A.1	Imminent threat of violence (real or perceived, unresolved conflict)	D	62.3
A.2	Heavily connected with gangs, gang/criminal lifestyle (carrying weapons, involved in aggravated robbery(s), associates with elevated- risk individuals, views injury as "badge of honor")	D	39.0
A.3	History of 2+ GSW, SW, other assaults	S	31.6
A.4	Incarceration/probation/parole history	S	47.4
A.5	Heavy family/social network history of violence	S	64.5
A.6	Disengaged/unreceptive (does not want services)	D	14.3
Category B: behavioral factors			
B.1	Severe mental health diagnosis (PTSD, psychosis/schizophrenia, etc.)	D	29.3
B.2	Substance abuse (alcohol, marijuana, prescription drugs, hard drugs, etc.)	D	76.1
B.3	Dissociative behavior (unconcerned/unaware of personal safety)	D	21.4
B.4	High aggression/impulsivity	D	34.1
B.5	Low recognition of dangerous situations	D	27.2
B.6	Denial of involvement in present injury	D	25.8
Category C: severe conditional factors			
C.1	Disrespect as factor leading to injury ("code of the street")	D	19.5
C.2	Recent illegal activity (selling drugs/theft/robbery/prostitution)	D	22.2
C.3	Weapons use in past year	S	36.2
C.4	Unstable housing history (past year)	S	54.5
C.5	Lives in high-risk neighborhood	D	75.7
C.6	Undocumented minor with poor local support network	D	3.1
C.7	Substance use at injury	S	61.7
C.8	Not involved in recommended programs and/or school or work	D	37.5

Table 1. *Cont.*

Category D: moderate conditional factors			
D.1	Pursuing/glorifying/wanting to be in "street"/gang lifestyle	D	20.7
D.2	Unmotivated to change life trajectory after injury	D	32.4
D.3	Has been in a fight in past year	S	28.8
D.4	Victim fears future violence	D	45.1
D.5	Has access to guns	D	55.2
D.6	Unemployed	D	55.7
D.7	Low educational attainment	D	32.8
D.8	Undocumented immigration status	S	4.5
D.9	Unstable family/lacks positive role model	D	68.1

In a closer assessment of the data across participants, nearly seventy percent were deemed high risk based on the presence of a Category A indicator. This category of indicators contains both static and dynamic risk factors some of which have statistically significant relationships. For example, calculation of Cramer's phi between imminent threat of violence (real or perceived, unresolved conflict) and heavy family/social network history of violence was 0.91 ($p < 0.001$) demonstrated that most participants who perceived an imminent threat of violence also had a social network with a history of violence. Or conversely, those participants who did not perceive an imminent threat tended not to have a social network with historical violence. Important for consideration is that a historical consideration is not dynamic risk factor but through case management that could include development of a safety plan, a participant's perception of safety is a malleable risk factor. Additionally, the imminent threat indicator was closely related to the indicator heavily connected with gangs, gang/criminal lifestyle (carrying weapons, involved in aggravated robbery(s), associates with elevated risk individuals, views injury as 'badge of honor') ($\varphi_c = 0.57$, $p < 0.01$). Notably, both indicators in the latter example are dynamic risk factors. It follows that for efficiency purposes and specific responsivity to dynamic risk factors, a program might consider limited initial assessment tool to include only VRRAI indicators A.1 and A.2.

While the VRRAI prioritizes indicators in category A for high-risk classification, a mapping of the balance of the indicators conceptually employing the RNR model sheds light considers other factors that might led to a prioritization of case management through HVIPs. Table 2 categorizes the remaining 29 indicators along with parenthetical display of prevalence in our participants. Indicators are grouped by dynamic risk factors that are more immediately malleable within the individual with resources available through an HVIP, as well as external to the individual or situational factors, followed by dynamic risk factors have intermediate or longer-term time frame (i.e., characteristics that may take months of cognitive behavioral intervention to affect change) and HVIP may not have resources to address, and finally statics risk factors both individual and situational.

Categorized by quadrant of malleable risk factors (according to the RNR framework), the data show high levels of indicators that both stem from violent victimization but also contribute to increase likelihood of retaliatory violence based on existing literature. Specifically, within individuals, we find high levels of access to guns, fear of violence which will likely lead to gun carrying. Situationally, risk factors include high risk environments, unemployment and lack of social support.

Table 2. Priority quadrant for HVIP risk assessment based on RNR principles.

	Immediate Goal/Dynamic Risk Factor	**Longer Term Goal and/or Dynamic Risk Factor**	**Static Risk Factor**
Individual (Internal) Factors	• Has access to guns (55.2) • Victim fears future violence (45.1) • Unmotivated to change life trajectory after injury (32.4) • Pursuing/glorifying/wanting to be in "street"/gang lifestyle (20.7)	• Severe mental health diagnosis (29.3) • Substance abuse (76.1) • High aggression/impulsivity (34.1) • Dissociative behavior (21.4) ○ Low recognition of dangerous situations (27.2) ○ Denial of involvement in present injury (25.8) • Disrespect as factor leading to injury (19.5)	• Substance use at injury (61.7) • Weapons use in past year (36.2) • Has been in a fight in past year (28.8) • Recent illegal activity (22.2)
Situational (External) Factors	• Lives in high-risk neighborhood (75.7) • Unstable family/lacks positive role model (68.1) ○ Undocumented minor with poor local support network (3.1) • Unemployed (55.7) ○ Not involved in recommended programs and/or school or work (37.5) ○ Low educational attainment (32.8)		• Unstable housing history (54.5) • Undocumented immigration status (4.5)

4. Discussion

By design and through expert consensus, category A variables in the VRRAI represent the most sensitive risk factors for reinjury and the presence of any one of these risk factors flags a patient for elevated risk. Category B variables are risk factors conceptually thought to potentiate category C and D risk factors. Category C and D variables are thought to be increasingly less sensitive than category A variables, and thus a greater number of these risk factors must be present to flag a patient for elevated risk of reinjury.

These data may suggest that some variables may be able to be consolidated or removed to create an even shorter instrument that can be performed more rapidly in the clinical setting.

Multiple category A variables were correlated with one another, and, when considering the malleable nature of these indicators, two risk factors appeared more critical—one factor related to imminent threat or perceived safety, the other indicative of the individual's peer network and associates. Both are addressable through engagement with a credible messenger, and multidisciplinary team particularly with the development of a safety plan and recognition for disassociating with negative peer influences. During initial intake assessment, category A could be pared to these two indicators with the other indicators collected during future periods of formal or informal reassessment given the static nature of those indicators.

A further opportunity to expedite the VRRAI may be found in consolidating indicators in categories B through D variables according to those indicators for which the case work may work temporally to address such as access to weapons, reaffirming the connection with a credible mentor whether it be the case worker, a credible messenger, or other individual, and key situational factors, such as housing and unemployment. Consideration should be given from a strengths-based perspective of the HVIP in prioritizing the balance of the situational factors queried. For example, if the HVIP has strong resources and is able to connect the client with housing or employment opportunities, those risk factors should be discussed in more detail. If this area is less pertinent, or resources are lacking, the

assessment might increase the focus on intermediate or longer term within individual change through an emphasis on de-escalation and other skills internal to the client.

Notable in the data is evidence that at least some indicators should be contextualized by the population a HVIP serves. For example, for the current HVIP, less than five percent of participants indicated the risk factors of undocumented minor with poor local support network and less than three percent reported as undocumented immigration status. It is reasonable to expect these could be risk factors, although it would be important to disentangle immigration status with existing local support, and from resulting employment issues which the criminological literature would suggest being the underlying dynamic risk factors.

Firearm violence is not solely an American health issue. Many countries face the same static risk factors identified in the American population; globally, men are more likely to face firearm related mortality than women, with rates often highest among 20–24 years old [38]. The RNR principles can be further used to develop risk assessment tools that consider the dynamic risk factors specific to different cultural contexts.

A limitation of this study is the lack of inclusion of a participant needs assessment or analysis of individualized case plans. Including these components are necessary to assess the intervention's effectiveness of addressing or reducing malleable risk factors. Further modifications to the VRRAI would require additional data collection and revalidation.

Ultimately, professional judgement remains one of the most important factors in identifying victims of violence at high risk of reinjury. Also, by design, the authors note deliberatively that a more complex instrument was a tradeoff for creating a structured professional judgement model that case managers and program staff can use as an adjunct to their own expertise. With the weight placed on professional judgement, it may be possible to create a shorter instrument to efficiently incorporate in daily workflows.

5. Conclusions

This study found that many risk factors contained in contemporary reinjury assessment instruments show collinearity and are especially prevalent among victims of violent injury. These data may be used to modify or create a shorter risk assessment tool for use by violence intervention specialists. Though importance is still placed on professional judgement, a design of risk stratification tools considering RNR principles, as well as validation in clinical settings, can help create an effective and easy-to-use risk stratification tool for use in HVIPs. We strongly encourage professionals to consider the RNR principles of dynamic versus static factors, and short term versus longer term priorities. Progressive risk assessment as trust is gained and relationships built may result in more forthcoming responses and clear goal setting to the benefit of the client and program goals.

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