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The predictive validity of the Depression Hopelessness Suicide screening form for self-harm among prisoners

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Abstract

The Depression Hopelessness Suicide Screening Form (DHS) includes twelve “critical items”, which have not been validated for the prospective prediction of self-harm. We conducted a retrospective cohort study ($N = 4196$) to validate the ability of the DHS critical items to predict inmates who performed at least one incident of self-harm during the first six months of imprisonment. While the critical items were highly sensitive (89.5%) at predicting incidents of self-harm, 51.3% of inmates endorsed at least one item. Five items reflecting more recent and specific risk factors reduced the referral rate to 17.7%, while maintaining high sensitivity (84.2%). While the DHS has high sensitivity to predict inmates at risk of self-harm, treating all items as equally critical results in excessive numbers of false positives that likely exceed the capacity of prison resources for professional assessment and intervention. Referral rules based on recency and specificity of risk factors are proposed.

Keywords: Deliberate self-harm; Suicide; Prisons; Mass Screening

The prevalence of suicide and self-injurious behaviour is higher in a correctional environment compared to the community. The rate of suicide in prisons and jails is 3 to 9 times higher than that of the general population (White, Schimmel, & Frickey, 2002). Between 7 and 48% of offenders report a history of self-inflicted injury compared to 4% of adults in the community (Dixon-Gordon, Harrison, & Roesch, 2012). Estimates of self-harm during incarceration range from 0.1% (Smith & Kaminski, 2009) to approximately 5% of sentenced prisoners (Hawton, Linsell, Adeniji, Sariaslan, & Fazel, 2013; Maden, Chamberlain, & Gunn, 2000). Higher rates of self-harm have been reported among women, and individuals in pre-trial jails (Hawton et al., 2013). While preventing self-harm is complex given that there are multiple factors that interact to cause self-harm (Dear, 2008), there is a general consensus that screening at intake for risk of self-harm is a central component of a self-harm prevention strategy (Daigle, 2007; Federal-Provincial-Territorial Heads of Corrections Working Group in Mental Health, 2012; Konrad et al., 2007). There are often insufficient clinical resources to offer assessments for all inmates. Therefore, simple checklists or screening tools that can be administered by non-clinical staff or through the use of computers are recommended to identify those at highest risk and in need of professional assessment (Konrad et al., 2007).

Dixon-Gordon and colleagues have noted “despite the substantial overlap between the populations of individuals who engage in [self-injury] and those who attempt suicide, it is important to conceptualize these behaviours as distinct” (Dixon-Gordon et al., 2012, p. 34). Nonetheless, given the potential for non-suicidal self-injury to result in accidental death and the impacts of the behaviours on staff and other inmates (DeHart, Smith, & Kaminski, 2009), prison systems devote substantial efforts to preventing both non-suicidal self-harm and suicidal behaviour. In the Canadian context where the current study was conducted, a single policy

addresses both behaviours (Correctional Service of Canada, 2011). Furthermore, at the screening phase, the operational response to elevated risk of self-injury or suicide is likely to be similar, with referral for further assessment required to determine the appropriate intervention strategy. It is at this follow-up assessment that appropriate clinical interventions can be determined on the basis of a comprehensive assessment to distinguish self-injurious and suicidal intent. Therefore, throughout this paper the term self-harm refers to both non-suicidal self-injurious and suicidal behaviour.

Despite the consensus about the value of screening inmates for self-harm risk, few studies have examined the ability of screening tools prospectively predict self-harm in prison. Perry and Gilbody (2009) compared the performance of the Beck Depression Inventory, the Beck Hopelessness Inventory and the self-harm concerns about offenders in prison environment (SCOPE) screening form to predict self-harm in prison by women inmates. The Beck Depression Inventory had a sensitivity of 80.0% with a specificity of 69.4%, and the SCOPE had a sensitivity of 70.2% and specificity of 63.1%. The Beck Hopelessness Inventory performed no better than chance. Dahle and colleagues (Dahle, Lohner, & Konrad, 2005) developed two versions of a short screening tool using file information. A version which required clinical information (e.g. any Axis I diagnosis) had a sensitivity of 83%, a specificity of 77%, and a positive predictive value (PPV) of 0.19%. A modified version excluding the Axis I diagnosis item allowing for security staff to conduct screening had a sensitivity of 70%, a specificity of 93% and a PPV of 0.53%.

Mills and Kroner (2003, 2004) developed the Depression Hopelessness Suicide Screening Form (DHS) to screen offenders for depression, hopelessness and indicators of risk for suicide. The DHS was designed specifically for use in correctional settings, and avoids the use of

terms that are often included in screening tools (e.g. guilty) which may have ambiguous meaning for inmate populations (Kroner, Kang, Mills, Harris, & Green, 2011). The DHS consists of 39 true-false items to measure signs of depression, hopelessness and risk of suicide. Of particular interest to the prediction of self-harm, the authors defined twelve items as “critical items” for suicide risk. Six items specifically refer to suicide (e.g. “I have attempted suicide in the past 2 years”), whereas other items are ambiguous about intent (e.g. “I have recently had thoughts of hurting myself”). The 12 critical items assess both historical and current self-injurious and suicidal thoughts and behaviours, a self-reported diagnosis of depression, and whether the inmate has “close friends or family members who have killed themselves”. These are among the risk factors with the most consistent support according to recent reviews (Dixon-Gordon et al., 2012; Fazel, Cartwright, Norman-Nott, & Hawton, 2008; Lohner & Konrad, 2007). The user manual provides for discretion of the test administrator to develop a protocol to determine the appropriate response to offenders endorsing one or more of the critical items based on available resources and needs (Mills & Kroner, 2003). While the DHS has been shown to have good test-retest and inter-item reliability and divergent and construct validity for both men and women (Kroner et al., 2011; Mills & Kroner, 2005) we are unaware of any research evaluating potential referral rules for these critical items. .

The labelling of these 12 indicators as critical items creates an apparent expectation to intervene for any inmate reporting at least one of these items. Therefore, there is a need to evaluate whether all items are equally critical, or whether some items are more critical than others. To address this gap in the literature, we tested the ability of each critical item on the DHS to predict self-harm, and then compared various combinations of these items in order to evaluate their effectiveness in predicting self-harm in the early period of incarceration.

Methods

Context

The current study included only inmates admitted to prison, who have received a sentence of 2 years or longer (versus jail inmates awaiting trial or sentenced to less than two years). Inmates typically complete a computerized mental health screening within 14 days of admission to prison. The computerized screening included two psychological screening measures at the time this study was conducted: the Brief Symptom Inventory (Derogatis, 1993) and the DHS, although it has since been updated to include measures to screen for attention deficit hyperactivity disorder and intellectual ability (Martin, Wamboldt, O'Connor, Fortier, & Simpson, 2013). Screening is typically completed in a group testing area with separate work stations for each inmate, although in some cases it may be administered individually depending on the institution. A psychology testing assistant is present during the screening to clarify any questions that inmates may have. Inmates with elevated screening results are referred to a mental health professional – usually a psychologist or psychiatrist.

Additionally, staff may flag an inmate to participate in the Inmate Suicide Awareness Prevention Workshop if they are assessed as high risk for self-injury or suicide, or if the inmate requests to participate. The workshop "assists inmates in recognizing the signs and symptoms of suicide and promotes the services and supports available to them" (Wheatley, 2012, sec. 1010).

Data Collection

The current study used secondary data from prison records. We collected individual item responses to the DHS critical items from the computerized mental health screening system. We also collected information from the prison's electronic case management system. Prison staff enter incidents using forced choice fields to record the inmate's role (i.e. instigator, associate, or

victim) and involvement (e.g. commit, attempt to commit, threaten to commit, etc.) in the incident, as well as the type of incident. Our outcome variable was any incident where the inmate was the 'instigator' or 'victim' of a 'self-inflicted', 'suicide' or 'attempt suicide' incident. For the purposes of the current study, only actions (e.g. commit or attempt to commit self-harm) were included; threats were not counted as incidents.

The determination of whether an incident is 'self-inflicted' (i.e. non-suicidal self-injury) or an attempted suicide is determined by the mental health professional based on clinical assessment and treatment offered following the intervention. A mortality review is conducted by a health care professional following any death in custody to determine whether a suicide occurred. If during the course of this review it is determined "that there is reason to believe that the inmate did not die from natural causes" a national board of investigation is convened (Correctional Service of Canada, 2010). The coroner/medical examiner with jurisdiction over the area where the institution is located must be notified to determine cause of death (Correctional Service of Canada, 2013).

A previous CSC study found that some incidents of self-injury were not coded as self-harm in prison records due to the fact that multiple incident codes often applied to a single event (e.g. disciplinary problem, cell extraction, etc.), whereas staff were able to choose only one of these codes (Gordon, 2010). Subsequent changes in reporting practices now allow staff to enter multiple incident categories for the same incident. The first author reviewed two hundred randomly selected files to validate the coding of incidents. Two (1%) files had at least one incident of self-harm. There was 100% agreement between information coded based on file review and the extracted data. This does not address undetected incidents and is based on a very

small number of incidents, but tentatively suggests that CSC reporting of self-harm has improved.

Sample

The sample for the current study was drawn from a retrospective cohort of all 5154 admitted to a Canadian prison during 2011, and who remained incarcerated for at least 180 days¹. The 958 offenders (18.6%) who did not complete the DHS for various reasons (e.g. refused to consent, transferred prior to completing screening, language issues, etc.) are excluded from this study. Excluded offenders were similar to the sample on demographic variables, childhood family experiences, criminal history, and substance abuse needs (see Table 1). However, excluded inmates had worse outcomes prior to incarceration and during the first 180 days of their current sentence, including higher rates of self-harm. It is likely that in at least some cases, those who did not complete the DHS may have already been referred to services (e.g. due to poor behavioural adjustment or other signs) prior to screening. Fewer inmates who did not complete screening had at least one contact with a mental health professional. This may reflect the impact of false positives. Previous research found that approximately 22% of all offenders completing the screening received a false positive result (Stewart, Wilton, & Malek, 2011), which is consistent with the observed difference.

Data Analysis

We calculated the sensitivity, specificity, the PPV and the negative predictive value (NPV) for each critical item, and of various combinations of the items. We grouped items that would lead to a similar expectation of a clinical response if an inmate endorsed any of the items. Models were developed under the expectation that more recent and more specific risk factors for self-harm require a more immediate and comprehensive response. We considered items to be

¹ 26 inmates were released prior to 180 days, most of whom were released in the first 30 days.

more specific if they directly referred to self-injury or suicide and to the inmate's actual circumstances (versus referring to others or to hypothetical situations). Therefore, in the first model we included recent thoughts of self-harm or a plan to self-harm, a history of self-injury, multiple past suicide attempts, or a suicide attempt in the last 2 years. In the 2nd model, we added the "life is not worth living" item as a less specific report of current suicide ideation. In the 3rd model, we included inmates with a single suicide attempt that was more than 2 years prior to the screening. In the 4th model we added a history of thoughts of suicide. The 5th model added the two items regarding whether or not suicide was perceived as an option, as we considered these hypothetical items to be less specific risk factors. The 6th model added a past diagnosis of depression, and the 7th model added having close friends or family members who completed suicide.

Ethics Review Board

As the study used secondary data from prison records, participant consent was not obtained. Ethics approval was obtained from the Centre for Addiction and Mental Health Ethics Review Board prior to commencing the study. Correctional Service of Canada's Research Committee also reviewed and approved the research prior to commencing the project to ensure compliance with its research policies, and federal privacy legislation.

Results

Nineteen (0.45%) of the 4196 inmates who completed the DHS had at least one incident of self-harm during the first 180 days in prison. Among these, only two were recorded as suicide attempts, whereas the remainder were coded as non-suicidal self-injury. Table 2 presents the number of inmates reporting each item, the percentage of inmates with an incident who reported the item (i.e. the sensitivity), the percentage of inmates without an incident who did not report

the item (i.e. the specificity), the percentage of inmates who reported the item who had an incident (i.e. the PPV), and the percentage of inmates who did not report the item who did not have an incident (i.e. the NPV). Relatively few inmates reported current risk factors, ranging from 0.6% inmates who reported a plan to self-harm to 6.6% who responded false to the question “suicide is not an option for me.” More inmates reported historical risk factors, ranging from 5.9% of inmates reporting a suicide attempt in the last 2 years to 26.0% reporting a history of depression. In terms of the predictive ability of the critical items, less than half of the inmates who self-harmed reported 9 of the 12 critical items (i.e. a sensitivity of below 50%). However, 15 (78.9%) inmates with an incident reported prior intentional self-injury, 14 (73.7%) reported a previous diagnosis of depression, and 10 (52.6%) reported multiple prior suicide attempts. The PPV for the individual items ranged from 0.7% (close friends or family members who killed themselves) to 4.2% (“I have a plan to hurt myself”). Expressed differently, a PPV of 0.7% indicates that 143 (1/0.007) inmates reported that a friend or family member had killed themselves for every inmate who had an incident. Similarly, a PPV of 4.2% represents 24 inmates who reported a plan to hurt themselves, for every incident of self-harm. Very few inmates who did not report the items had an incident of self-harm. There were between 0.2 and 0.4% of inmates who did not report each item, who had an incident of self-harm (i.e. 1 minus the negative predictive value).

As seen in Table 3, there was little or no increase in the sensitivity of the critical items when adding the less recent and specific critical items to the scoring models. Using the first model, 16 of the 19 inmates with an incident of self-harm endorsed at least one of the items (i.e. sensitivity = 84.2%). It was not until model 6 (adding a past diagnosis of depression) that one additional inmate with an incident of self-injury would be referred. However, an additional 495

inmates (11.8%) would be referred relative to the previous model and 941 (22.4%) additional inmates would be referred relative to the first model. As seen in model 7, two (10.5%) inmates with an incident did not report any of the critical items.

Given that the most efficient model was our first model, as post-hoc exploratory analyses, we divided the five items into subsets reflecting past self-harm behaviour (model 1H) and current thoughts or plan (model 1C). As seen in the table all 16 of the 19 inmates (84.2%) with an incident who would be referred reported a history of self-harm or suicide attempts, whereas only 4 (21.1%) reported recent thoughts or a plan to self-harm. However, excluding the current ideation items would have a minimal impact on the overall referral rate, decreasing it to 16.8% in model 1H versus 17.7% in model 1, indicating that few inmates without a history of self-injury or suicide reported recent thoughts or a plan.

Discussion

This is the first study to consider the predictive validity of the DHS to identify inmates who engage in self-injury or attempt suicide. While the DHS critical items do not cover all recommended items for a self-harm screening checklist (Dixon-Gordon et al., 2012; Konrad et al., 2007), they nonetheless had a high sensitivity to predict incidents of self-harm, and their performance was comparable to, if not slightly better than results of previous prospective validations of screening tools in prisons (Dahle et al., 2005; Perry & Olason, 2009). However, 51.3% of inmates reported at least one of the critical items. If all such persons were referred for comprehensive clinical assessments clinical resources would be overwhelmed by false positive referrals. As the incidence of self-harm is low, prediction of risk for self-harm will inevitably lead to over-referral.. Developing an appropriate referral rules presents a tension between

statistical performance and practical considerations such as available resources and legal and ethical obligations.

The five items regarding current thoughts or a plan of self-harm or having recent and/or multiple incidents of self-harm were the most efficient predictors of self-harm during the first six months of incarceration, and are likely to require clinical intervention on legal and/or professional grounds. This is consistent with other suicide risk assessment tools, such as the Columbia Suicide Severity Rating Scale, which recommends referrals for inmates with ideation and at least some intent (Posner et al., 2011). While clinical interventions would be desirable to develop risk management plans for inmates reporting the items in models 2 through 7, this may not always be feasible. Interventions by adequately trained correctional officers and other non-mental health staff may be appropriate in this case (Daigle, 2007; Konrad et al., 2007). Correctional officers play a key role in monitoring inmates for changes in their personal and/or situational factors that may increase the risk of self-harm and require clinical intervention. They may also offer supports for inmates who are adapting to the circumstances of the prison environment, and assist in diffusing crisis situations as the first-line responders (Appelbaum, Hickey, & Packer, 2001; Dvoskin & Spiers, 2004).

Analyses comparing the critical items assessing history of self-harm thoughts and behaviours with current thoughts or plans should serve as caution about overreliance on self-reported thoughts or plans to self-harm. While suicide ideation had the largest odds ratio in a previous meta-analysis of predictors of prisoner suicide, consistent with our results, the majority (63%) of suicide cases did not report suicide ideation (Fazel, Cartwright, Norman-Nott, & Hawton, 2008, Table 1). It is possible that current ideation has low sensitivity to predict self-injurious behaviour due to under-reporting. On the other hand, inmates who do not report current

thoughts at the time of screening may receive less follow-up, and the onset of such thoughts may be missed. As ideation may fluctuate, repeated screening to measure changes in risk of self-harm may be needed (Konrad et al., 2007). However, the interval at which repeating screening could improve detection is unknown.

Limitations and future directions

A major limitation of most prison research is high non-participation rates. While 83% of inmates completed the DHS, only 50% of those who self-harmed did so. Our findings reflect the real-world application of offering screening to the entire prison population, and therefore reflect the performance of the DHS inclusive of refusal and non-completion rates. However, they may be biased by the exclusion of an apparently higher risk and more challenging subgroup of the inmate population who did not complete screening. If for example, these inmates are less likely to report risk factors, the sensitivity of the tool may be over-estimated.

It is unknown how many incidents of self-harm may have been undetected or unreported. Sensitivity and specificity are generally recommended since they are independent of base-rates whereas PPV and NPV are not (e.g. Glaros & Kline, 1988). However, as shown in sensitivity analyses (see online Tables S1 through S4), all four measures may be biased when the prevalence differs due to misclassification. We varied two factors to illustrate the impacts of misclassification: 1) the number of missed incidents of self-harm; and 2) the proportions of missed incidents by screening result. As seen in online Table S1, if the proportion of undetected incidents is the same for all inmates regardless of whether they endorse DHS critical items or not (i.e. non-differential misclassification bias), the sensitivity and specificity estimates remain materially unchanged regardless of the number of missed incidents, although the PPV is underestimated. If self-harm by inmates without risk factors is more likely to be missed by prison staff

due to the fact that they may be less monitored, the sensitivity is over-estimated and the PPV is underestimated (the impact on the specificity and NPV is relatively small given the low base-rates of self-injury). The estimates would be increasingly biased as the proportion of undetected incidents by inmates without risk factors increases (see online supplement Tables S2, S3 and S4). We have not presented tables with the scenario where under-reporting of incidents is higher for inmates with risk factors, given that the scenario is highly unlikely. In this case the impacts would be reversed (i.e. the sensitivity would have been underestimated in this study, whereas the PPV would be over-estimated).

Given that it is unethical to withhold information related to increased risk of self-harm (Mishara & Weisstub, 2005), a blinded validation study is unlikely, rendering it difficult to know what percentage of undetected self-harm involves inmates without risk factors and what the true performance of the DHS critical items is. Further, results of the DHS in this study were used by front line clinicians and correctional staff to prioritise persons for further assessment and intervention in the prison. Therefore the self-injurious behaviour that occurred is that that occurred despite these interventions, not what would have occurred in the absence of screening and service response. Given that incidents that are recorded on file are more likely to be the most severe incidents, prospective studies such as this one can estimate the extent to which screening might be able to identify those at risk of the most severe self-harm and offer an opportunity to prevent these incidents. It is possible that these screening tools are equally effective for undetected (and potentially less severe) self-harm, although novel study designs are needed to improve the detection of self-harm and explore this question. Under-detection of self-harm, and the possibility of misclassifying suicidal intent precluded us from comparing the performance of the DHS critical items in predicting suicidal versus non-suicidal behaviour. Given the small

number of suicide attempts recorded on file, future work is needed to ensure that the DHS is equally predictive of both types of self-harm.

Finally, while the current study is strengthened by the inclusion of the entire population of intakes to prison, our findings may not generalize to jail or forensic settings or for the prediction of self-harm at later points of incarceration. Given rapid turnover in jail settings, and the circumstances faced by individuals awaiting trial or under the jurisdiction of review boards, it is unknown whether the DHS critical items will perform comparably in these settings. Self-harm is more common in jails (and in particular un-sentenced inmates; Fazel, Cartwright, Norman-Nott, & Hawton, 2008), and the motivations for such behaviour may differ among jail and prison inmates (Konrad et al., 2007). Larger samples are needed to ensure that the DHS critical items perform equally well among men and women given that different norms have been suggested for the depression and hopelessness scales of the test (Kroner et al., 2011). We conducted exploratory analyses regarding sex differences in the performance of the items, and found similar sensitivity and specificity values for all models for men and women (analyses available upon request from the first author). Further work is also needed to explore whether the DHS critical items are predictive of incidents over a longer follow-up period in prisons. However, in Canadian prisons, policy requires screening for suicide risk following transfer between institutions, admission to segregation and at other potentially high risk periods (Correctional Service of Canada, 2011). This would suggest less reliance on intake screening results later in incarceration, and that a shorter follow-up is reflective of the use of screening tools in practice.

Conclusions

The DHS critical items reflect well supported risk factors for self-harm (Dixon-Gordon et al., 2012; Fazel et al., 2008; Lohner & Konrad, 2007), but many of these factors lacked

incremental predictive validity after accounting for those factors associated with the greatest risk (i.e. more extensive and/or recent histories of self-harm). Cost-effective screening and interventions are required to address self-harm risk among prisoners. However, screening can identify risk in a timely manner to ensure that information is shared with appropriate staff, and that the inmate is monitored for changing risk levels and offered interventions as required by correctional and mental health staff (Konrad et al., 2007). Given that the DHS critical items identified the majority of inmates who subsequently engaged in incidents of self-harm, they appear to be a useful screening tool upon intake to prisons. However, high endorsement rates of many items will pose challenges in prisons with limited clinical resources for follow-up. The use of the DHS, or any screening at intake to prison, does not replace the need for ongoing monitoring of dynamic risk factors for self-harm. This includes ongoing monitoring of inmates who do not report risk factors for self-harm upon intake, given that inmates circumstances may change during incarceration. While replication of these findings is needed, considering the extent to which the items reflect specific indicators of risk of self-harm and how recently the factor is or was experienced may offer one framework to determine the nature of follow-up required for those endorsing the critical items on the DHS or similar screening checklists.

References

- Appelbaum, K. L., Hickey, J. M., & Packer, I. (2001). The role of correctional officers in multidisciplinary mental health care in prisons. *Psychiatric Services, 52*(10), 1343–1347. doi:10.1176/appi.ps.52.10.1343
- Correctional Service of Canada. (2010). *Incident investigations*. Commissioner's Directive 041. Ottawa: Correctional Service of Canada.
- Correctional Service of Canada. (2011). *Commissioner's Directive 843: Management of self-injurious and suicidal behaviour*. Ottawa: Author.
- Correctional Service of Canada. (2013). *Death of an inmate: Notifications and funeral arrangements*. Commissioner's Directive 530. Ottawa: Correctional Service of Canada.
- Dahle, K.-P., Lohner, J. C., & Konrad, N. (2005). Suicide prevention in penal institutions: Validation and optimization of a screening tool for early identification of high-risk inmates in pretrial detention. *International Journal of Forensic Mental Health, 4*(1), 53–62. doi:10.1080/14999013.2005.10471212
- Daigle, M. S. (2007). Mental health and suicide prevention services for Canadian prisoners. *International Journal of Prisoner Health, 3*(2), 163–171. doi:10.1080/17449200701321779
- Dear, G. E. (2008). Ten years of research into self-harm in the western Australian prison system: Where to next? *Psychiatry, Psychology and Law, 15*(3), 469–481. doi:10.1080/13218710802101613
- DeHart, D. D., Smith, H. P., & Kaminski, R. J. (2009). Institutional responses to self-injurious behavior among inmates. *Journal of Correctional Health Care, 15*(2), 129–41. doi:10.1177/1078345809331444
- Derogatis, L. (1993). *Brief Symptom Inventory: Administration, scoring, and procedures manual* (4th ed.). Minneapolis: National Computer Systems.
- Dixon-Gordon, K., Harrison, N., & Roesch, R. (2012). Non-suicidal self-injury within offender populations: A systematic review. *International Journal of Forensic Mental Health, 11*(1), 33–50. doi:10.1080/14999013.2012.667513
- Dvoskin, J. A., & Spiers, E. M. (2004). On the role of correctional officers in prison mental health. *The Psychiatric Quarterly, 75*(1), 41–59. doi:10.1023/B:PSAQ.0000007560.09475.a0
- Fazel, S., Cartwright, J., Norman-Nott, A., & Hawton, K. (2008). Suicide in prisoners: A systematic review of risk factors. *The Journal of Clinical Psychiatry, 69*(11), 1721–31.

- Federal-Provincial-Territorial Heads of Corrections Working Group in Mental Health. (2012). Mental health strategy for corrections in Canada. Retrieved January 16, 2013, from <http://www.csc-scc.gc.ca/text/hlth/pdfs/MH-strategy-eng.pdf>
- Glaros, A. G., & Kline, R. B. (1988). Understanding the accuracy of tests with cutting scores: The sensitivity, specificity, and predictive value model. *Journal of Clinical Psychology, 44*(6), 1013–23.
- Gordon, A. (2010). *Self-injury incidents in CSC institutions over a thirty-month period*. Ottawa: Correctional Service of Canada.
- Hawton, K., Linsell, L., Adeniji, T., Sariaslan, A., & Fazel, S. (2013). Self-harm in prisons in England and Wales: An epidemiological study of prevalence, risk factors, clustering, and subsequent suicide. *Lancet, 6736*(13), 1–9. doi:10.1016/S0140-6736(13)62118-2
- Konrad, N., Daigle, M. S., Daniel, A. E., Dear, G. E., Frottier, P., Hayes, L. M., ... Sarchiapone, M. (2007). Preventing Suicide in Prisons, Part I: Recommendations from the International Association for Suicide Prevention Task Force on Suicide in Prisons. *Crisis, 28*(3), 113–121. doi:10.1027/0227-5910.28.3.113
- Kroner, D. G., Kang, T., Mills, J. F., Harris, A. J. R., & Green, M. M. (2011). Reliabilities, Validities, and Cutoff Scores of the Depression Hopelessness Suicide Screening Form Among Women Offenders. *Criminal Justice and Behavior, 38*(8), 779–795. doi:10.1177/0093854811409004
- Lohner, J., & Konrad, N. (2007). Risk factors for self-injurious behaviour in custody: Problems of definition and prediction. *International Journal of Prisoner Health, 3*(2), 135–161. doi:10.1080/17449200701321654
- Maden, A., Chamberlain, S., & Gunn, J. (2000). Deliberate self-harm in sentenced male prisoners in England and Wales: Some ethnic factors. *Crim Behav Ment Health, 10*(3), 199–204. doi:10.1002/cbm.357
- Martin, M. S., Wamboldt, A. D., O'Connor, S. L., Fortier, J., & Simpson, A. I. F. (2013). A comparison of scoring models for computerised mental health screening for federal prison inmates. *Criminal Behaviour and Mental Health, 23*(1), 6–17. doi:10.1002/cbm.1853
- Mills, J. F., & Kroner, D. G. (2003). *Depression, Hopelessness and Suicide Screening Form: User Guide*. Kingston, ON: Author.
- Mills, J. F., & Kroner, D. G. (2004). A new instrument to screen for depression, hopelessness, and suicide in incarcerated offenders. *Psychological Services, 1*(1), 83–91. doi:10.1037/1541-1559.1.1.83

- Mills, J. F., & Kroner, D. G. (2005). Screening for suicide risk factors in prison inmates: Evaluating the efficiency of the Depression, Hopelessness and Suicide Screening Form (DHS). *Legal and Criminological Psychology, 10*(1), 1–12. doi:10.1348/135532504X15295
- Mishara, B. L., & Weisstub, D. N. (2005). Ethical and legal issues in suicide research. *International Journal of Law and Psychiatry, 28*(1), 23–41. doi:10.1016/j.ijlp.2004.12.006
- Perry, A. E., & Gilbody, S. (2009). Detecting and predicting self-harm behaviour in prisoners: A prospective psychometric analysis of three instruments. *Social Psychiatry and Psychiatric Epidemiology, 44*, 853–861. doi:10.1007/s00127-009-0007-7
- Perry, A. E., & Olason, D. T. (2009). A new psychometric instrument assessing vulnerability to risk of suicide and self-harm behaviour in offenders: Suicide Concerns for Offenders in Prison Environment (SCOPE). *International Journal of Offender Therapy and Comparative Criminology, 53*(4), 385–400. doi:10.1177/0306624X08319418
- Posner, K., Brown, G. K., Stanley, B., Brent, D. A., Yershova, K. V, Oquendo, M. A., ... Mann, J. J. (2011). The Columbia-Suicide Severity Rating Scale: Initial validity and internal consistency findings from three multisite studies with adolescents and adults. *American Journal of Psychiatry, 168*(12), 1266–1277. doi:10.1176/appi.ajp.2011.10111704
- Smith, H. P., & Kaminski, R. J. (2009). Inmate self-injurious behaviors: Distinguishing characteristics within a retrospective study. *Criminal Justice and Behavior, 37*(1), 81–96. doi:10.1177/0093854809348474
- Stewart, L. A., Wilton, G., & Malek, A. (2011). *Validation of the Computerised Mental Health Screening System (CoMHSS) in a federal male offender population*. Ottawa: Correctional Service of Canada.
- Wheatley, J. (2012). *Minutes - Standing Committee on Health (March 6 - number 032, session 1)*. Ottawa: Government of Canada.
- White, T. W., Schimmel, D. J., & Frickey, R. (2002). A Comprehensive Analysis of Suicide in Federal Prisons: A Fifteen-Year Review. *Journal of Correctional Health Care, 9*(3), 321–343. doi:10.1177/107834580200900308

Table 1. Comparison of characteristics of excluded inmates

	Included in study	Excluded
Male	3929 (93.6%)	886 (92.5%)
Aboriginal	859 (20.5%)	218 (22.8%)
Prior charges – youth court	1680 (45.2%)	401 (49.1%)
Prior charges – adult court	2982 (79.7%)	671 (81.6%)
Current offence type		
Drug	759 (20.2%)	135 (16.4%)
Violent	1566 (41.8%)	384 (46.6%)
Sexual	573 (15.3%)	107 (13.0%)
Murder/Manslaughter	268 (7.1%)	88 (10.7%)
Moderate/Severe Substance Abuse	2491 (59.6%)	529 (58.1%)
Childhood family experiences		
Limited attachment to family	1095 (29.8%)	263 (32.9%)
Negative relations with parent figure	1639 (44.9%)	376 (47.8%)
Abused	1332 (37.1%)	283 (36.6%)
Witnessed family violence	1253 (35.1%)	264 (34.6%)
Social functioning pre-incarceration		
Less than grade 10 education	1939 (53.5%)	489 (62.5%)
Unemployed at time of arrest	2304 (63.7%)	549 (69.1%)
Unstable accommodation	1270 (34.7%)	326 (41.3%)
Limited community attachment	1658 (45.5%)	434 (55.4%)
Outcomes in first 180 days in prison		
Treatment Centre Admission	112 (2.7%)	59 (6.2%)
Completed suicide awareness program	1354 (32.3%)	172 (18.0%)
At least one mental health contact	3040 (72.4%)	462 (48.2%)
Missed at least one MH contact	224 (5.3%)	84 (8.8%)
Segregation admission	637 (15.2%)	239 (24.9%)
Violent incident	200 (4.8%)	81 (8.5%)
Disciplinary incident	361 (8.6%)	126 (13.2%)
Self-injury or suicide attempt	19 (0.45%)	19 (1.9%)

Table 2. Endorsement rates and performance of the twelve critical items.

Item ^a	<i>n</i> (%)	Sensitivity	Specificity	PPV	NPV
Historical risk factors					
I have close friends or family members who have killed themselves. (7)	1121 (26.7)	42.1	73.4	0.7	99.6
I have been diagnosed as being depressed by a psychiatrist or psychologist in the past (6)	1089 (26.0)	73.7	74.3	1.3	99.8
I have had serious thoughts of suicide in the past (4)	720 (17.2)	36.8	82.9	1.0	99.7
In the past my suicidal thoughts have led to an attempt (3)	613 (14.6)	47.4	85.5	1.5	99.7
I have intentionally hurt myself (1/1H)	533 (12.7)	78.9	87.6	2.8	99.9
I have attempted suicide more than once in the past (1/1H)	397 (9.5)	52.6	90.7	2.5	99.8
I have attempted suicide in the past 2 years (1/1H)	247 (5.9)	31.6	94.2	2.4	99.7
Current risk factors					
Suicide is not an option for me (reverse scored) (5)	278 (6.6)	15.8	93.4	1.1	99.6
If circumstances get too bad, suicide is always an option (5)	159 (3.8)	21.1	96.3	2.5	99.6
Life is not worth living (2)	101 (2.4)	10.5	97.6	2.0	99.6
I have recently had thoughts of hurting myself (1/1C)	156 (3.7)	21.1	96.4	2.6	99.6
I have a plan to hurt myself (1/1C)	24 (0.6)	5.3	99.4	4.2	99.6

^a Numbers in parentheses next to each item correspond to the model number in which the item was added (see Table 3).

Table 3. Comparison of scoring models for the prediction of self-harm in the first 180 days of incarceration.

Model	Referred <i>n</i> (%)	Sensitivity [95% CI]	Specificity [95% CI]	PPV [95% CI]	NPV [95% CI]
1	742 (17.7)	84.2 [62.4-94.5]	82.6 [81.4-83.7]	2.2 [1.3-3.5]	99.9 [99.7-99.97]
2	772 (18.4)	84.2 [62.4-94.5]	81.9 [80.7-83.0]	2.1 [1.3-3.3]	99.9 [99.7-99.97]
3	897 (21.4)	84.2 [62.4-94.5]	78.9 [77.6-80.1]	1.8 [1.1-2.9]	99.9 [99.7-99.97]
4	1034 (24.6)	84.2 [62.4-94.5]	75.6 [74.3-76.9]	1.6 [1.0-2.5]	99.9 [99.7-99.97]
5	1188 (28.3)	84.2 [62.4-94.5]	71.9 [70.6-73.2]	1.4 [0.8-2.2]	99.9 [99.7-99.97]
6	1683 (40.1)	89.5 [68.6-97.1]	60.1 [58.6-61.6]	1.0 [0.6-1.6]	99.9 [99.7-99.98]
7	2153 (51.3)	89.5 [68.6-97.1]	48.9 [47.4-50.4]	0.8 [0.5-1.3]	99.9 [99.6-99.97]
1H	705 (16.8)	84.2 [62.4-94.5]	83.5 [82.4, 84.6]	2.3 [1.4-3.7]	99.9 [99.8-99.97]
1C	163 (3.9)	21.1 [8.5-43.3]	96.2 [95.6, 96.7]	2.5 [1.0-6.1]	99.6 [99.4-99.8]

PPV = positive predictive value; NPV = negative predictive value

Table S1. Sensitivity analyses with increasing rates of under-reporting of self-harm. Rate of under-reporting is the same regardless of whether the inmate reported DHS critical items or not. 85% of inmates with an undetected incident of self-harm reported a critical item and 15% did not (consistent with the sensitivity and specificity presented in Table 3).

True incidence	# of inmates with missed incidents			Sensitivity	Specificity	PPV	NPV
	Total	1+ DHS critical item	No DHS critical items				
1.0%	23	20	3	85.7%	83.0%	4.9%	99.8%
2.0%	65	55	10	84.5%	83.7%	9.6%	99.6%
3.0%	107	91	16	84.9%	84.4%	14.4%	99.4%
4.0%	149	127	22	85.1%	85.1%	19.3%	99.3%
5.0%	191	162	29	84.8%	85.9%	24.0%	99.1%

Table S2. Sensitivity analyses with increasing rates of under-reporting of self-harm with slightly higher rate of under-reporting for inmates not reporting the DHS critical items. 75% of inmates with an undetected incident of self-harm reported a critical item and 25% did not.

True incidence	# of inmates with missed incidents			Sensitivity	Specificity	PPV	NPV
	Total	1+ DHS critical item	No DHS critical items				
1.0%	23	17	6	78.6%	82.9%	4.4%	99.7%
2.0%	65	49	16	77.4%	83.5%	8.8%	99.4%
3.0%	107	80	27	76.2%	84.1%	12.9%	99.1%
4.0%	149	112	37	76.2%	84.8%	17.3%	98.8%
5.0%	191	143	48	75.7%	85.4%	21.4%	98.5%

Table S3. Sensitivity analyses with increasing rates of under-reporting of self-harm with higher rate of under-reporting for inmates not reporting the DHS critical items. 50% of inmates with an undetected incident of self-harm reported a critical item and 50% did not.

True incidence	# of inmates with missed incidents			Sensitivity	Specificity	PPV	NPV
	Total	1+ DHS critical item	No DHS critical items				
1.0%	23	12	11	66.7%	82.8%	3.8%	99.6%
2.0%	65	33	32	58.3%	83.1%	6.6%	99.0%
3.0%	107	54	53	55.6%	83.5%	9.4%	98.4%
4.0%	149	75	74	54.2%	83.8%	12.3%	97.8%
5.0%	191	96	95	53.3%	84.2%	15.1%	97.2%

Table S4. Sensitivity analyses with increasing rates of under-reporting of self-harm and considerably higher rate of under-reporting for inmates not reporting the DHS critical items. 25% of inmates with an undetected incident of self-harm reported a critical item and 75% did not.

True incidence	# of inmates with missed incidents			Sensitivity	Specificity	PPV	NPV
	Total	1+ DHS critical item	No DHS critical items				
1.0%	23	6	17	52.4%	82.7%	3.0%	99.4%
2.0%	65	16	49	38.1%	82.7%	4.3%	98.5%
3.0%	107	27	80	34.1%	82.8%	5.8%	97.6%
4.0%	149	37	112	31.5%	82.9%	7.1%	96.7%
5.0%	191	48	143	30.5%	83.0%	8.6%	95.8%