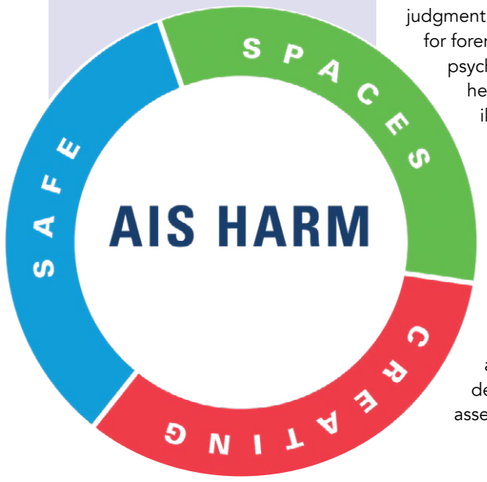
# Using Artificial Intelligence to improve prediction and prevention of violence

*Drs Gary Chaimowitz and Mini Mamak of McMaster University and St. Joseph's Healthcare, Hamilton, Canada have developed the Electronic Hamilton Anatomy of Risk Management (eHARM) platform. It is an innovative risk assessment and management tool for violence and aggression which can be used in a variety of mental health areas, including but not limited to forensic psychiatry. The validity of the tool has been established and verified through big data analyses, which demonstrate it can help predict the presence of violence, its escalation, desistance, and change in type of aggression. The eHARM allows for seamless risk management, research, program planning and quality improvement. Dr Heather Moulden joined as a key collaborator.*




Risk of violence and aggression has always been a concern within psychiatric services. It continues to be a focus of risk management within contemporary mental health services – particularly forensic units or wards. The consequences of poorly managed violence can be serious physical and psychological harm to patients, staff, and the public. Risk assessment tools are an important safety measure offering a structure to professional judgements; however, there is limited research on clinical implementation available.

## A GROUP-BASED RISK ASSESSMENT APPROACH

Over the last decade, Drs Gary Chaimowitz, Mini Mamak and Heather Moulden of McMaster University and St. Joseph's Healthcare in Hamilton, Canada have worked on a program of research which has focused on the evolution and innovation of violence risk prediction. They have undertaken this first through the development of a team-based structured professional judgment approach to risk assessment for forensic psychiatry, general psychiatry, and youth mental health. Their body of work illustrates the performance of this approach as comparable to other standard risk assessment tools and similar approaches. Importantly, their research describes the implementation of a group-based risk assessment approach within the clinical arena, reflecting real-world decision making for risk assessment and management.

This risk assessment approach has recently been subjected to machine learning modelling to further strengthen and improve prediction and ultimately prevent negative outcomes.

## MACHINE LEARNING AND BIG DATA

The team incorporated machine learning modelling to first test the efficacy of this approach in the risk assessment arena, with an eye to ultimately increase the predictive power of their risk assessment tool. While other risk assessment tools can predict violence within groups with some certainty, they are unable to make individual predictions for a given patient. Machine learning is a branch of artificial intelligence: a computer learns and adapts to new data without human intervention. This provided the research team with the capacity to statistically analyse the big data required. Given that machine learning is untethered by some of the conventions or assumptions of traditional statistical approaches this approach may also allow for the identification of novel risk factor candidates, which perhaps had not been previously unearthed. Furthermore, machine learning modelling can increase precision over time to offer individualized predictions.

Dr Chaimowitz, Dr Mamak and Dr Moulden used this machine learning method to process the large amount of information from a representative and diverse sample of patients in forensic mental health settings. Based on this, they developed and evaluated a risk assessment and management tool, the Electronic Hamilton Anatomy of Risk Management (eHARM) platform. Clinical, historical, and sociodemographic factors

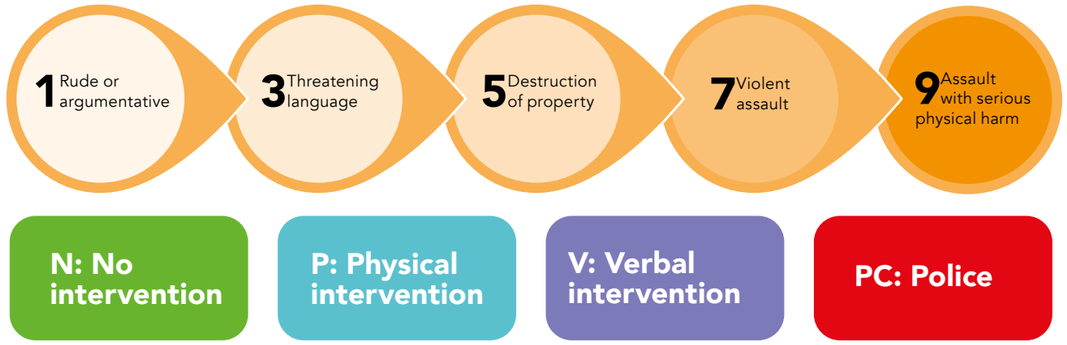



**Figure 1.** The AIS method consists of a two-part code: a number from 1-9 which describes the level of aggression experienced by the patient and a letter referring to the intervention needed.

were considered as potential predictors of violence and separate models were created for each type of criminal offense. Their results suggest that their machine learning models are comparable to previous gold-standard risk assessment tools. Unlike these existing tools, patient-focused eHARM (as opposed to the Aggregator eHARM) allows for the prediction and management of violence at an individual level, and specifically for clinicians dealing with immediate issues of risk management.

## THE RISK ASSESSMENT AND MANAGEMENT TOOL

The risk assessment and management tool developed by the team has three components: the Aggressive Incidents Scale (AIS), the Electronic Hamilton Anatomy of Risk Management (eHARM) and the eHARM aggregator. From their initial eHARM for forensic psychiatry, they developed four versions: the forensic version, the general version, the youth version, and the correctional version.

The forensic version was developed first, later improved using big data and machine learning. The big data developed from its implementation facilitated even bigger data sets. Further studies were undertaken to develop the general version with input from clinicians and with data collected through implementation. This will lead to big data validity for the general version. A similar approach was used to gain big data validity of the other two versions: youth and correctional. These tools provide a structured format and process for professional judgements on risk and management of violence.

AIS is a method for describing and rating aggression using an accessible common style of language to provide a cumulative and graphic picture of a patient's record of aggression. This is to facilitate interpretation of the level of aggression experienced by the patient and any patterns, including improvement or escalation. A two-part code, initially a number from 1 to 9, is assigned to a behaviour, with 1 being rude or argumentative and 9 indicating physical assault with injury. The second part of the scale ascribes a letter referring to the staff intervention: N, P, V and PC. N is no intervention, P is physical intervention, V is verbal intervention and PC refers to police called. This simple coding facilitates staff discussion about risk and management with a common accessible language. It also provides a concise and simple method for documentation.

***Unlike existing tools, eHARM allows for the prediction of violence at an individual level.***

The four versions of the Electronic Hamilton Anatomy of Risk Management (eHARM) platform are online structured

Poorly managed violence can result in seious physical and psychological harm to both patient and staff.

Photographee.eu/Shutterstock.com

clinical assessment tools to support decisions regarding risk of violence in mental health arenas. They combine historic (such as previous violent behaviour), static (stable factors that do not change over time) and dynamic, changeable factors to predict imminent and short-term risk. Many traditional risk assessment approaches rely on historical or static factors, which can be time consuming to complete, but offer little information about more imminent violence or ways to intervene. In comparison, dynamic risk assessments perform better for short-term predictions of violence and identify points of intervention.

eHARM brings together all the information available in assessing, fostering, and facilitating the documentation of team members' discussions related to risk. It offers a continuous risk assessment and management process. There are three fluent stages to the assessment: Past, Current, and Future. The assessor/s move from exploring the past historical factors to what is happening currently for the patient to arrive at an estimate of future risk of violence. This is similar to other risk assessments; however, eHARM works through a multi-professional team-based approach. AIS offers the team a clear simple language in which to discuss incidents and ongoing care needs supported by a documentation process that captures these discussions and facilitates easy access to the information when required. This understanding is the basis for the formulation of risk management strategies and forms the individualised patient report.

The eHARM aggregator is a separate component within the eHARM where the individual reports can be downloaded as non-identifiable data. This can facilitate research analyses at a group level which enlightens the establishment of trends in behavioural patterns and treatment. The eHARM aggregator allows for cross system research, quality improvement, and service planning with no additional effort.

***AIS offers the team a clear simple language in which to discuss incidents and ongoing care needs.***

eHARM is a ground-breaking innovation in psychiatry, with its team-based approach, and the recent application to big data risk assessment processes. The Aggressive Incident Scale is an easy-to-use scale to measure aggressive incidents combined with the patient level eHARM and the eHARM aggregator. Dr Chaimowitz, Dr Mamak and Dr Moulden have developed a rigorous suite of risk assessment and management tools. The tools can be used within a variety of mental health areas, from general psychiatry to forensic services and in a variety of settings, such as inpatient or outpatient and group homes.

**CONCLUSION**

The eHARM platform proves to be a significant advancement in the risk assessment and risk management field. Its three components – AIS, eHARM and eHARM aggregator – and three fluent stages – past, present and future – offer a wide scope of assessment and implementation for the management of violent behaviour. The four versions of eHARM allow for a broad spectrum of arenas in which it can be used.

The use of big data through machine learning provides this tool with the empirical research to provide confidence in use for clinicians and its simple language facilitates robust team based clinical practice. This research has also proved useful in understanding reoffence scenarios and age-related violence through the development of the youth and correctional versions. Using this tool, a mental health professional can more accurately predict the presence of violence, escalation, desistance, and changes in the type of violence of individuals as well as groups, and formulate appropriate risk management responses to ultimate prevent future aggression.

The eHARM allows for seamless risk management, research, program planning, and quality improvement.




# Behind the Research

Gary Chaimowitz

**E:** gchaimow@stjoes.ca **E:** chaimow@mcmaster.ca **T:** +1 905-522-1155 ext. 35424 **Fax:** +1 905 3815606
**W:** https://psychiatry.mcmaster.ca/home **FPI:** https://www.forensicpsychiatryinstitute.com/ **IJRR:** https://mulpress.mcmaster.ca/ijrr
**R&R:** https://www.riskandrecoveryconference.com/ **HARM:** https://www.ais-harm.com/ @ForensicPsychIn
**Forensic Psychiatry Program:** https://bit.ly/2T79JKA **International Forensic Psychiatry Lecture Series:** https://bit.ly/2T8GRBI

Mini Mamak

Heather Moulden

## Research Objectives

The research team have developed the Electronic Hamilton Anatomy of Risk Management (eHARM) platform, an innovative risk assessment and management tool which can be used in a variety of mental health areas.

## Detail

**Address**
Dr Gary Chaimowitz
Head of Service Forensic Psychiatry Program
St. Joseph's Healthcare Hamilton, West 5th Campus
100 West 5th Street, Hamilton, ON L8N 3K7
Canada

**Bio**

**Gary Chaimowitz** is a Professor in the Department of Psychiatry and Behavioural Neurosciences at McMaster University in Hamilton. He is the Head of Service, Forensic Psychiatry Program at St. Joseph's Healthcare. He is widely published and has been awarded recognition and held key leadership positions in multiple professional organizations. Currently a member of the Ontario and Nunavut Review Boards, Dr Chaimowitz is a member of the Forensic Psychiatry Specialty Examination Committee of the Royal College of Physician and Surgeons of Canada.

**Mini Mamak** is the Senior Psychologist in the Forensic Psychiatry Program at St. Joseph's Healthcare Hamilton. She is an Associate Clinical Professor with the Department of Psychiatry and Behavioural Neurosciences. Her research area of interest includes risk assessment and violence risk assessment. Dr Mamak works with various police services in training and education.

**Heather Moulden** is a clinical forensic psychologist at St. Joseph's Healthcare, an Associate Clinical Professor with the Department of Psychiatry and Behavioural Neurosciences, and Associate Member in the Department of Psychology, Neuroscience and Behaviour at McMaster University. Her research and clinical interests include problematic sexual behaviour, enhancing forensic rehabilitation, and diagnostic issues relevant to risk and treatment.

**Funding**
- Janssen provided seed funding
- St. Joseph's Healthcare Hamilton

**Collaborators**
- Devon Watts
- Andrew Olagunju
- Alana Cook
- Kaitlyn Mullally
- Casey Upfold
- Luiza Gea
- Dylan Gatner
- Sebastien Prat

## References

Chaimowitz, G.A., Mamak, M. (2018). AIS – HARM. [online]. Available at: https://www.ais-harm.com/ [Accessed 06/05/21]

Chaimowitz, G.A., Mamak, M., Moulden, H.M., Furimsky, I., Olagunju, A.T. (2020). Implementation of risk assessment tools in psychiatric services. *American Society for Healthcare Risk Management,* 40(1), 33-43. Available at: https://doi.org/10.1002/jhrm.21405

Cook, A.N., Moulden, H.M., Mamak, M., Lalani, S., Messina, K., Chaimowitz, G. (2018). Validating the Hamilton Anatomy of Risk Management–Forensic Version and the Aggressive Incidents Scale. *Assessment*, 25(4), 432–445. Available at: https://doi.org/10.1177/1073191116653828

Gatner, D.T., Moulden, H.M., Mamak, M., Chaimowitz, G.A. (2021). At Risk of What? Understanding Forensic Psychiatric Inpatient Aggression through a Violence Risk Scenario Planning Lens. *International Journal of Forensic Mental Health.* Available at: https://doi.org/10.1080/14999013.2021.1899343

Watts, D., Moulden, H., Mamak, M., Upfold, C., Chaimowitz, G., Kapczinski, F. (2021). Predicting offenses among individuals with psychiatric disorders - A machine learning approach. *Journal of Psychiatric Research,* 138, 146-154. Available at: https://doi.org/10.1016/j.jpsychires.2021.03.026

## Personal Response

***What inspired you to conduct this research?***

"Violence risk assessment and management has progressed significantly over the years but had plateau'd at the level of structured professional judgment tools. We saw an opportunity to advance the field by incorporating both team-based risk assessment and management, as well utilising the advances that big data and analytics offers health care. The AIS, eHARM and eHARM Aggregator was the result."