Using Artificial Intelligence to improve prediction and prevention of violence

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 unhindered 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 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) 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-
AIS offers the team a clear simple language in which to discuss incidents and ongoing care needs. 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 real-life 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 imminent violence or ways to intervene. The eHARM allows for a broad spectrum of arenas in which it can be used.

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 fluctuating stages – past, present and future – offer a wide scope of assessment and implementation for the management of violent behaviour. The few versions of eHARM allow for a range of risk management processes that captures the discussion 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.

CONCLUSION
This 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 fluctuating 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 tools can be used within a variety of settings, such as inpatient or outpatient and group homes. 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 fluctuating 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 research team have developed the Electronic Hamilton Anxiety of Risk Management (eHARM) platform, an innovative risk assessment and management tool which can be used in a variety of mental health areas.

References

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

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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 Natural 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.

Personal Response
What inspired you to conduct this research?

Violence risk assessment and management has progressed significantly over the years but had plateaued 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.