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Prospective Analysis of Police Use of Force in Four Canadian Cities:

Nature of events and their outcomes

Christine Hall, MD, MSc, FRCPC
Department of Emergency Medicine, Vancouver Island Health Authority
Faculty of Medicine, Department of Emergency Medicine, University of British Columbia
Faculty of Medicine, Department of Community Health Sciences, University of Calgary

Kristine Votova, PhD
Research and Capacity Building, Vancouver Island Health Authority

Scientific Authority:
Donna Wood
DRDC Centre for Security Science

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Contractor Report
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Principal Authors

Original signed by [Principal Author]

Christine Hall, MD, MSc, FRCPC

Principal Investigator

Approved by

Original signed by Donna Wood

Donna Wood

DRDC Centre for Security Science

Approved for release by

Original signed by M. Williamson

Dr. Mark Williamson

DRDC Centre for Security Science, DRP Chair

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Abstract

The purpose of the study was to document the situational and subject specific characteristics surrounding police restraint in the Canadian population of persons who resist police interaction and undergo police restraint and to determine the outcome (mortality) proximal to police restraint for those persons. This report defines the scope of the study, the methodology, results, and impact of the body of knowledge for police forces in Canada and international communities. The report details the supporting data with tables, figures, and evidence- based conclusions. The report includes recommendations and way forward.

Résume

L'objectif de la présente étude est d'établir les caractéristiques situationnelles et particulières entourant la question des mesures de contrainte prises par la police sur les éléments de la population canadienne qui résistent à toute interaction avec la police et font l'objet de mesures de contrainte, et de déterminer les conséquences (décès) pouvant découler de l'application des contraintes en question sur ces personnes. Le présent rapport définit la portée de l'étude, la méthodologie, les résultats et l'impact de l'ensemble des connaissances pour les forces policières au Canada et ailleurs dans le monde. Il fournit en détail des données justificatives sous forme de tableaux, de figures et de conclusions fondées sur des preuves. Le rapport comprend en outre des recommandations et les prochaines étapes.

Executive summary

Prospective Analysis of Police Use of Force in Four Canadian Cities: Nature of events and their outcomes Christine Hall; Kristine Votova; DRDC CSS CR 2013-011 August 2013

Introduction/background: Despite widespread public and police interest in outcomes surrounding police use of force, the incidence of and clinical characteristics suggestive of impending sudden death in association with police use of force has not been prospectively documented using standardized methodology. The RESTRAINT study (Risk of dEath in Subjects That Resist: Assessment of Incidence and Nature of fAtal events) is the only prospective epidemiologic study of police use of force, including all use of force modalities, with a focus on sudden in custody death in North America.

Methodology: The RESTRAINT study was a multi-site prospective study in four urban centres in Canada and reflects the use of force experience of seven independent municipal police agencies. Data were collected on the situational and subject-specific characteristics of persons undergoing police use of force and their associated medical outcomes. Use of force was defined as the use of any police use of force modality/action above soft hands physical control. All force options above simple joint locks were included in our study whether they occurred alone or in combination with other force options and regardless of outcome. Cohort inclusion criteria included: any individual subject aged 18 and older for who police use of force occurred as part of the police-public interaction.

Predetermined study data points were included in each agency's standardized use of force report form and were recorded in real time by patrol officers as they completed their use of force reporting. That data was then abstracted to study data forms either by the agency's use of force coordinator or by specifically trained research data clerks. For subjects undergoing medical assessment and/or assistance, research data clerks obtained paramedical (ambulance) and/or emergency department health records by linking police data with unique study id.

Privacy and research ethics restrictions were strictly adhered to and prevented the RESTRAINT study from evaluating police use of force in minors, tracking repeat encounters with the same individuals and evaluating whether race/ethnicity is a factor in use of force incidence or outcome.

Results: Initial results from the RESTRAINT study demonstrate that police use of force is rare; 99.9% of police public interactions do not include police use of force. Police use of force occurs predominantly in individuals who are intoxicated and/or emotionally distressed, that the features of excited delirium can be easily documented by patrol officers in the field, and that 16.6% of individuals in use of force events are subsequently

transported to hospital with further assessment for physical injuries, mental health assessment, assessment of intoxicants or some combination of these.

In our study, despite the high profile of intoxicants and mental distress, the majority of individuals undergoing police use of force had few if any features of excited delirium documented by police officers. Even though 24% of the cohort had no features of excited delirium present at the time of police use of force, 1 in 8 use of force events included a subject who displayed 3 or more concomitant features of excited delirium. Analysis is ongoing to determine the exact profile of injuries, mental illness and intoxications in subjects undergoing police use of force.

RESTRAINT has also demonstrated that it is possible to prospectively document the location of conducted energy weapon deployments (including the pairing of darts) in subjects[i] undergoing conducted energy weapon activation. We began collecting data on dart location part way through study enrollment and we have information on dart location in 115 of 336 probe mode deployments (34%). At least one dart struck the patient's anterior chest in 40/115 (34.8%); both darts struck any part of the subject's anterior chest in 8/115 probe deployments (7%). No subject died with darts to the chest in any configuration.

We have documented that death following police use of force is rare (0.14% of police use of force) and sudden in custody death even more so (0.02% of police use of force). In all, 7 deaths occurred; one of which was a sudden, unexpected death in a subject with all 10 features of excited delirium. Since there was a single documented case of sudden in custody death in this study, we were not able to determine which features of excited delirium are predictive of sudden death in custody or to determine a precise case definition and fatality rate.

Significance:

RESTRAINT is a real-world study; data were collected by officers involved in the use of force event during or shortly after the use of force. The process and outcomes related to RESTRAINT will be used to inform law enforcement agencies, the medical community and lay public about the epidemiology of police use of force, medical outcomes following police use of force including frequency of death, and to assist in determining a case definition and incidence of excited delirium. The study data collection tool was a comprehensive but succinct method for reporting subject characteristics and situational features surrounding police use of force that could serve as the template for standardization of police use of force documentation in Canada and elsewhere. Police agencies from around North America and the UK have interest in acquiring the data instrument developed for the RESTRAINT study to facilitate standardization of reporting of police use of force such that data are robust and comparable.

This study, through rigorous study design and the generation of peer reviewed publication, has already gained international recognition at the International Law Enforcement Forum meetings as well as by the Association of Chief Police Officers in the UK and has resulted in several large scale collaborations and references to our work, including the Seattle Working Group on Excited Delirium (sponsored by Penn State), the Less Lethal Weapons Medical Safety Advisory Board (sponsored by the National Institute of Justice), the American College of Emergency Physicians committee for the White Paper on Excited Delirium and the Council of Canadian Academies (CCA) Assessment on the Medical and Physiological Impacts of Conducted Energy Weapons. Preliminary knowledge gained through the development, implementation and conduct of the RESTRAINT study has been presented at inquests including the Braidwood Inquiry and at the BC Special Committee for the Investigation of Conducted Energy Weapons in 2013. It is anticipated that further results from the RESTRAINT study will be similarly effective in understanding and guiding police use of force assessments.

Future plans:

We believe that the work originated in the RESTRAINT study should continue and each of the participating agencies involved in our study plans to continue to collect their own data. It is our belief that situational factors related to use of force should be explored further and expanded to investigate whether specific vulnerable populations (minors, ethnic groups, subjects with multiple police encounters) are at higher risk of police use of force or injuries/death from it. For example, there has been a public suggestion that First Nations peoples may be over-represented in police use of force in Canada, but privacy and ethical restrictions meant that our study could not address this issue. Human Research Ethics Boards and public interest groups will need to work closely with researchers to overcome privacy and consent barriers in order to scientifically evaluate the specific risks experienced by vulnerable populations.

Without any evidence to guide sample size prediction, it was our expectation that the very large sample size generated by the RESTRAINT study would be sufficient to examine predictors of sudden in custody death. The RESTRAINT study has provided important information for future investigators in documenting that police use of force is rare in urban settings. From our work, we can now say with certainty that an adequate sample size to investigate sudden in custody death further will require assessment of many thousands of police use of force events, beyond the approximately 5000 events collected here over a period of about six years, and will require multi-agency involvement to be conducted effectively. Despite ongoing interest by the agencies involved in our study, financial support and future investment is required to continue this work at this level and to sustain the reporting needs of agencies.

Standardized reporting of use of force across police jurisdictions, with rigorous methodology would enable the generation of such a data set during daily police practice, with data that could be compared within and between agencies. Similarly, through

standardized reporting of the actual dart location for conducted energy weapon deployments it would be possible to calculate the relative risk of death or injury by deployment type and nature; data which is not currently available. Canada provides the ideal national environment in which to accomplish these investigations since jurisdictional issues and the presence of multiple police agencies within the same jurisdiction makes the USA a much more difficult environment for such study to occur. Canada is well positioned to lead the way in understanding police use of force and its outcomes in North America and has begun to do so with RESTRAINT.

The data included in this report represent preliminary analysis of our cohort for summary purposes, it must be noted that comprehensive, multifaceted analyses of these data is just beginning. There are intricacies in the understanding of these data that are not represented here; not all interplay between factors has been analyzed and our specific evaluation of medical findings for manuscript preparation has just begun.

Sommaire

Prospective Analysis of Police Use of Force in Four Canadian Cities: Nature of events and their outcomes Christine Hall; Kristine Votova; DRDC CSS CR 2013-011 Aout 2013

Introduction/aperçu : Malgré le vif intérêt du public et des services policiers pour les résultats qui concernent le recours à la force policière, aucune méthodologie standardisée n'a été utilisée afin de documenter prospectivement la fréquence et les caractéristiques cliniques de la mort subite imminente associée au recours à la force policière. L'étude RESTRAINT (Risk of dEath in Subjects That Resist: Assessment of Incidence and Nature of faTal events [risque de mort chez les personnes qui résistent à leur attestation : évaluation de la fréquence et de la nature des issues fatales]) est la seule étude épidémiologique prospective sur le recours à la force policière, y compris toutes les formes d'utilisation de la force, avec un accent mis sur la mort subite sous garde en Amérique du Nord.

Méthodologie : L'étude RESTRAINT a été menée dans quatre régions urbaines canadiennes et porte sur les utilisations du recours à la force de sept services policiers municipaux indépendants. On a recueilli des données sur les caractéristiques circonstancielles et les caractéristiques individuelles des personnes qui ont subi le recours à la force policière ainsi que sur les issues médicales connexes. Le recours à la force a été défini comme l'utilisation de toute action de recours à la force qui est plus puissante que le contrôle physique modéré. On a inclus dans notre étude toutes les options du recours à la force au-delà des blocages articulaires simples, qu'ils aient eu lieu seul ou conjointement avec d'autres options du recours à la force, et ce, peu importe les résultats. Les critères d'inclusion relatifs aux cohortes comprennent : tout sujet humain d'au moins 18 ans qui a subi le recours à la force policière dans le cadre de l'interaction entre le public et la police.

Des points prédéterminés pour les données d'étude ont été inclus dans le formulaire de rapport uniforme sur le recours à la force de chaque service policier. Ils ont été également inscrits en temps réel par les patrouilleurs pendant qu'ils remplissaient leurs rapports sur le recours à la force. Ces données ont été ensuite extraites afin d'étudier les formulaires de données remplis par le coordinateur du recours à la force nommé par son service policier ou par des commis aux données de recherche qualifiés. Dans le cas des individus qui subissent une évaluation médicale et/ou reçoivent de l'aide médicale, les commis aux données de recherche ont obtenu les dossiers médicaux du service des urgences et/ou les dossiers paramédicaux en associant les données policières aux identificateurs d'étude uniques.

Les restrictions en matière du respect de la vie privée et de l'éthique de la recherche ont été rigoureusement respectées. En raison de ces restrictions, on n'a pas pu évaluer, dans

le cadre de l'étude RESTRAINT, le recours à la force policière contre les mineurs, de repérer des rencontres multiples avec les mêmes individus et d'évaluer si la race et l'ethnicité sont des facteurs dans la fréquence ou le résultat du recours à la force.

Résultats : Les premiers résultats de l'étude RESTRAINT démontrent que le recours à la force policière est rare. On indique que 99,9 p. 100 des interactions entre la police et le public n'impliquent pas de recours à la force policière et que le recours à la force policière se produit principalement lorsque des individus sont en état d'ébriété et/ou ont des troubles émotifs (des caractéristiques du délire aigu qui peuvent facilement être consignées par les patrouilleurs sur place). De plus, 16,6 p. 100 des individus impliqués dans des événements de recours à la force sont par la suite hospitalisés pour des blessures physiques ainsi que pour obtenir une évaluation de la santé mentale et une évaluation des substances intoxicantes consommées ou la combinaison de celles-ci.

Dans notre étude, malgré la présence importante de cas de substances intoxicantes et de cas de souffrance psychologique, la majorité des individus qui ont subi le recours à la force policière présentaient peu ou pas de caractéristiques du délire aigu consignées par les policiers. Même si 24 p. 100 de la cohorte ne présentait aucune caractéristique du délire aigu au moment du recours à la force policière, 1 événement de recours à la force policière sur 8 impliquait un individu présentant au moins trois caractéristiques associées au délire aigu. L'analyse est en cours afin de déterminer le profil exact des blessures, des maladies mentales et de l'intoxication parmi les individus qui ont subi le recours à la force policière.

L'étude RESTRAINT a également démontré la possibilité de consigner prospectivement l'emplacement du déploiement d'armes à impulsions (y compris le jumelage de fléchettes) sur des individus[1] qui subissent l'utilisation d'arme à impulsions. On a commencé à recueillir des données sur les emplacements des fléchettes peu après le début du recrutement dans l'étude et on a obtenu des renseignements sur l'emplacement des fléchettes dans 115 utilisations en mode à sondes sur 336 (34 p. 100). Au moins une fléchette a frappé la poitrine du patient dans 40 cas sur 115 (34,8 p. 100); les deux fléchettes ont frappé une partie de la poitrine de l'individu dans 8 cas sur 115 des utilisations en mode à sondes (7 p. 100). Aucun individu n'est mort en raison de blessures subies par les fléchettes, quelle que soit la circonstance.

On a consigné que la mort à la suite du recours à la force policière est rare (0,14 p. 100 des cas de recours à la force policière) et que la mort subite sous garde est encore plus rare (0,02 p. 100 des cas de recours à la force policière). En tout, 7 décès sont survenus; un était une mort soudaine et inattendue d'un individu qui présentait toutes les 10

[1] Le mot « individu » est utilisé dans tout le rapport dans le contexte d'une interaction public-police, afin de respecter l'utilisation du terme de l'application de la loi « sujet », « sujet d'intérêt » ou « personne susceptible d'être arrêtée ». On consent que l'utilisation du mot « individu » ait une connotation différente dans le contexte de recherche classique et on n'a pas l'intention de désigner les personnes qui subissent le recours à la force policière comme des sujets de recherche.

caractéristiques du délire aigu. Puisqu'il y avait un cas consigné de mort subite sous garde dans cette étude, on n'a pas été en mesure de déterminer quelles caractéristiques du délire aigu peuvent permettre de prédire la mort subite sous garde ou d'établir une définition de cas précis et un taux de mortalité.

Importance :
L'étude RESTRAINT est une étude menée dans le monde réel; les policiers qui ont recueilli les données avaient été impliqués dans des cas de recours à la force, pendant ou peu de temps après le recours à la force. Le processus et les résultats liés à l'étude RESTRAINT seront utilisés pour informer les agences de maintien de l'ordre, la communauté médicale et le grand public sur l'épidémiologie du recours à la force policière, les issues médicales à la suite du recours à la force policière, y compris la fréquence des décès, ainsi que pour faciliter l'établissement d'une définition de cas et de la fréquence du délire aigu. L'outil de collecte de données pour l'étude était complet, mais offrait une méthode restreinte pour rapporter les caractéristiques des individus et les caractéristiques situationnelles nécessaires entourant le recours à la force policière pour servir de gabarit pour la normalisation de la documentation sur le recours à la force policière au Canada et partout dans le monde. Les services policiers à travers l'Amérique du Nord et dans le Royaume-Uni ont avantage à acquérir l'instrument de données conçu pour l'étude RESTRAINT pour faciliter la normalisation des rapports sur le recours à la force policière afin que les données soient fiables et comparables.

Cette étude, à l'aide d'un modèle d'étude rigoureux et la création de publication évaluée par les pairs, a déjà attiré la reconnaissance internationale dans les réunions du forum international sur l'application de la loi et par l'association des chefs de police du Royaume-Uni, en plus d'engendrer plusieurs grandes collaborations et relations avec notre travail, y compris le groupe de travail de Seattle sur le délire aigu (parrainé par l'Université d'État de Pennsylvanie), le conseil consultatif sur la sécurité médicale des armes à létalité atténuée (parrainé par le National Institute of Justice), le livre blanc sur le délire agité de l'American College of Emergency Physicians et l'évaluation des effets médicaux et physiologiques des armes à impulsions effectuée par le Conseil des académies canadiennes. Des connaissances préliminaires obtenues à partir de l'élaboration, la mise en œuvre et la réalisation de l'étude RESTRAINT ont été présentées sur demande lors de la commission d'enquête Braidwood et du Comité spécial d'enquête sur l'utilisation des armes à impulsions en Colombie-Britannique (2013). On prévoit aussi que d'autres résultats de l'étude RESTRAINT seront également utiles afin de comprendre et de guider les évaluations des cas de recours à la force policière.

Plan pour l'avenir :

On croit que le travail tiré de l'étude RESTRAINT devrait continuer et que chacun des organismes participant à l'étude devrait continuer de recueillir leurs propres données. On estime que les facteurs situationnels liés au recours à la force devraient être examinés plus en profondeur et étendus afin de déterminer si certaines populations vulnérables (les

mineurs, les groupes ethniques, les individus qui ont un historique de nombreuses confrontations avec la police) risquent davantage d'être sujettes au recours à la force policière (blessures ou décès résultant). Par exemple, selon la croyance populaire, les membres des Premières Nations subiraient plus souvent le recours à la force policière au Canada; toutefois, les restrictions en matière du respect de la vie privée et de l'éthique de la recherche ne permettent pas de traiter cette question. Les comités d'éthique en matière de recherche sur les humains et les groupes d'intérêt public devront travailler étroitement avec les chercheurs pour surmonter les restrictions liées au respect de la vie privée et au consentement afin d'évaluer scientifiquement les risques précis que vivent les populations vulnérables.

Sans les données de base pour guider la prévision de la taille de l'échantillon, on s'attendait à ce que la très grande taille de l'échantillon généré dans le cadre de l'étude RESTRAINT soit suffisante pour examiner les facteurs de prédisposition à la mort subite sous garde. L'étude RESTRAINT a fourni des renseignements importants que d'autres chercheurs pourront utiliser pour démontrer que l'utilisation de la force policière est rare en milieu urbain. D'après le travail accompli, on peut maintenant affirmer avec certitude que la taille adéquate de l'échantillon nécessaire pour mener une enquête sur la mort subite sous garde devra contenir des milliers de cas de recours à la force policière en plus des 5 000 cas consignés dans la présente étude, et ce, pendant une période d'environ six ans. De plus, cela exigera la participation de plusieurs organismes afin d'assurer l'efficacité du travail. Malgré l'intérêt continu des organismes qui ont participé à notre étude, le soutien financier et les investissements futurs sont nécessaires pour poursuivre le travail à ce niveau et pour maintenir les besoins d'établissement de rapports des organismes.

L'établissement de rapports uniformisés sur le recours à la force dans l'ensemble des services de police (à l'aide d'une méthodologie rigoureuse), permettrait la création d'un ensemble de données recherchées dans le cadre des tâches policières quotidiennes. Par la suite, ces données pourraient être comparées à d'autres données de l'organisme et entre les organismes. De même, grâce à des rapports uniformisés sur l'emplacement réel des fléchettes lors de l'utilisation d'une arme à impulsions, il serait possible de calculer le risque relatif de décès ou de blessure par type d'utilisation et nature – ce genre de données n'est pas disponible actuellement. Le Canada offre un environnement national idéal pour mener ces enquêtes. Contrairement aux États-Unis, le Canada ne présente pas de problème lié aux compétences et à la présence de plusieurs services policiers au sein d'une même juridiction (environnement dans lequel il est beaucoup plus difficile de mener une telle étude). Il est bien placé pour prendre la tête des efforts de compréhension entourant le recours à la force policière et ses résultats en Amérique du Nord. Le tout a commencé grâce à l'étude RESTRAINT.

Les données contenues dans ce rapport représentent une analyse préliminaire de la cohorte aux fins de synthèse. Il faut noter que les analyses complètes et à volets multiples de ces données ne font que commencer. Certains détails de la compréhension de ces données n'ont pas été présentés dans l'étude. On n'a pas analysé toutes les interactions entre les facteurs et on vient de commencer l'évaluation spécifique des conclusions médicales pour la préparation du rapport.

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Significant in-kind contributions were provided by participating police agencies, including the Chiefs, Inspectors, Staff Sergeants, use of force coordinators and administrative assistants of the police agencies involved in order to complete data collection in the field and record it in real time. Contributions on the philosophical level are in-measurable; we would be remiss if we failed to acknowledge the overwhelming spirit of cooperation, appreciation for the importance of the project and genuine interest in protecting the scientific integrity of the data that we experienced in working with the involved agencies. Special thanks go to the Use of Force Coordinators at each police agency who was instrumental in coordinating timely and comprehensive data for the RESTRAINT study team. We also wish to thank the patrol officers in each agency who consistently provided relevant, accurate and timely data to this project without complaint despite large call volumes and multiple other responsibilities.

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1 Introduction

Deaths proximal to police restraint are devastating for all concerned, are extensively reported in the media and invoke serious and immediate concerns for the general public, for medical practitioners and for police personnel. Recent concerns regarding deaths of individuals after the use of the Taser® (generically called a conducted energy weapon) by police are a case in point. Despite the upsetting nature of deaths proximal to police restraint, scientific investigations of these deaths have been largely limited to local investigations or inquiries and post hoc reporting of adverse outcomes with the resultant wide media coverage by both local and national news agencies and independent watchdog organizations. The frequency of police use of force (across modalities in general duty policing) and the clinical characteristics associated with sudden death following police use of force have not been prospectively documented in any population utilizing standardized methodology. Despite widespread public and police interest in outcomes proximal to police restraint, no national or international databases have been scientifically created, maintained and evaluated to understand death proximal to police restraint and determine whether there are features of the subject and/or the situation that are predictive of a fatal outcome.

Much anecdotal attention has been paid to the method of police restraint when an individual suddenly dies proximal to police restraint. Literature is rife with theory generation and debate surrounding the rationale for these deaths as it relates to the use of force.[1-7] Police agencies have been criticized, individual police officers have been charged criminally with unnecessary, unskillful, or overuse of force; and many revisions to police policy have been undertaken in an attempt to mitigate risk to subjects being arrested while still protecting the public interest by subduing unruly individuals. Multiple methods of restraint have been implicated in unexpected death, ranging from close proximity measures (including neck holds, restraint by multiple officers, and strikes with batons or other impact weapons), and methods to subdue from a distance such as pepper spray or conducted energy weapon utilization, up to and including the use of lethal weapons[1-3, 5-24]

Despite multiple methodologies and adaptations employed to restrain individuals, sudden death still occurs and there is a notion that sudden death proximal to police restraint may even be on the rise. While frequency of police use of force might be expected to increase as both the absolute population and the use of illicit stimulant drug use (such as methamphetamines) increases, the idea that the number of deaths proximal to police restraint is disproportionately increasing is fueled by publication bias as the lay media and watchdog agencies report every fatal event while failing to report the number of events during which police encounters include police use of force[25]. However, even police services are unsure whether there is a true increasing incidence of sudden death proximal to police restraint or for any specific modality. It is unknown whether any

single method of police restraint, such as conducted energy weapons, pepper spray, or neck holds can be directly implicated in deaths proximal to police restraint.

The lack of scientific investigation into the issue of death proximal to police restraint has enabled widespread theorizing and lay press interpretation of previously published articles surrounding sudden death. This practice adds to confusion and fears for both the lay public and for police services nationally. For example, in their November, 2004 website publication, Amnesty International outlined multiple events regarding police custody events in Canada and the USA, specifically surrounding conducted energy weapon use[25]. Within the context of that article there are multiple segmental quotes from previously published pathophysiology articles surrounding death by positional asphyxia which, in spite of heavy scientific criticism and debate, are used as evidence to support Amnesty International's firm stance against conducted energy weapon use by police personnel. Such abstraction of ambiguous data surrounding one method of restraint to argue against the use of another is scientifically invalid and, therefore, misleading.

Unfortunately, the startling similarity of the context of sudden in custody deaths is largely ignored while the method of restraint is heavily criticized. Yet, no scientifically robust data exists to determine whether there are situational or individual features that predict a mortality outcome, or whether the existence of a certain set of features might determine which method should or should not be used to subdue an individual.

The incidence of sudden and unexpected deaths proximal to police restraint first came to the attention of law enforcement in the early 1980's, when a number of deaths associated with police use of force and restraint began to be reported in the medical literature.[20, 26-28] As sympathomimetic illicit drug use increases and violent behavior subsequently increases, it is not unreasonable to expect more adverse outcomes in association with drug intoxicated individuals, however prospective formal study has not been undertaken in a prehospital police environment.[26-32] Specific interest in methods of police restraint is currently focused on conducted energy weapon utilization, whereas interest in and criticism of neck holds, use of multiple officer restraint, pepper spray, position of maximal restraint use and lethal force such as firearms has been historically common.[1, 8-13, 23, 24, 33-40]

1.1 Number of in custody deaths

It is reported that in the United States of America alone, there are an estimated 200+ in-custody deaths of similar circumstances every year. [41] This is, however, little more than a guess since prior to 2003 no official statistics were reported and data is subject to the differences between individual law enforcement agencies. Since January 2003, federal legislation was passed in the United States requiring all law enforcement agencies to not only report but also categorize all in-custody deaths. Despite this legislation, data has not been forthcoming due, in part, to lack of administration of the database. In Canada, there is no central national repository that collects statistics on sudden and unexpected death

proximal to police restraint. Although most provincial coroners do keep statistics on deaths associated with law enforcement interaction, most do not break down these deaths into specific categories. As such, all deaths, including shootings, suicides and deaths from natural causes while in police custody or in custodial cells, are combined with unexpected and sudden in custody death at the scene and all counted as death proximal to police restraint.[42]

Some provinces in Canada have begun to try and capture this data. Data from the province of Ontario, extrapolated to the national population suggests that there are between 6-10 sudden and unexpected deaths proximal to restraint by law enforcement in Canada each year.[42] Lay publications suggest to readers that this number is a vast underestimation without providing detail. In many jurisdictions, the specific features of the situation and the individual undergoing police use of force are not collected prospectively; many details are not recorded. Since systematically collected data regarding persons undergoing police use of force does not currently exist in Canada, and there is wide variability in the reporting of police use of force between the provinces and between police agencies in general, it is not known whether the number of persons with sudden death proximal to police restraint is significant or limited to a very small proportion of those subjects engaged physically with police officers.

1.2 Characteristics of the subject and the role of excited delirium

One condition that may be predictive of sudden prehospital death proximal to police restraint is excited delirium.[5, 43-47] Historically, when pathologists have been unable to determine a clear pathophysiologic cause of death proximal to police restraint, the death has often been reported as being caused by positional asphyxia suggesting that the arresting officers had subjected the individual to forces or procedures that precluded effective ventilation and respiration. [2, 3, 8, 10-12, 14, 16, 48, 49] Since 1995, pathologists have recognized that there is significant question as to whether excited deliriums as well as positional asphyxia were both processes at work in the sudden death of restrained individuals.[50]

While Ross et al did hypothesize that the state of excited delirium had more to do with the sudden death than the nature of the restraint process, further papers to define the exact role of excited delirium in pre-hospital sudden death have not been forthcoming and the controversy continues.[15] Part of the limitation in evaluating this process is the relative inability or reluctance to study the effects of custody and restraint in the actual persons suffering the condition. Most previous investigators have attempted to simulate the rigors of the resisting police interaction and restraint process in normal healthy individuals in order to determine the biochemical processes leading to death.[1, 2, 14, 36, 48, 51] Most reported cases of sudden and unexpected death proximal to restraint involve young men in an "excited" state or one of "agitated delirium" as a result of psychiatric illness and/or intoxication from illegal drugs. These individuals are combative, violent, and struggle, sometimes sustaining traumatic injuries as a result of confrontation with law enforcement

before being subdued.[2, 17, 43, 52] Few authors have prospectively documented the frequency with which any of these features are encountered in the law enforcement environment, or their association with sudden death.[44] Lack of such information prevents adequate planning of investigational or interventional strategies.

1.3 Method of restraint

Much debate has occurred in medical research about the exact mechanism of death, its association with positioning and restraint and other implicative features leading to many litigation procedures and controversy surrounding police management of these cases.

Physical restraint has been long thought to be the most basic method of restraint and may be a precursor to alternate use of force modalities in many cases. Previous works have documented concerns with restraint stress on the subject with the worst outcome being positional asphyxia thought to be associated with hogtie restraint (also called maximal restraint positioning) or multiple officer restraint.[2, 8-12, 14, 49] Positional or postural holds have been the restraints most frequently implicated in unexpected death. Those being restrained have often been place prone on the floor or street with their wrists or ankles bound.[3, 5, 16] The most extreme example of prone position restraint is referred to as "hog tying" or the "position of maximal restraint" or "hobbling", in which the person is positioned prone with ankles and wrists bound together at the back of the torso. There is some ambiguity in the nomenclature "hobbling" since in Canada, the term "hobbling" refers to the binding of the subjects ankles together but not bound to the subjects wrists behind the back, in effect the application of "ankle cuffs" using flex cuffs or zip ties.

In a series by Pollanen in 1998, all cases of death associated with excited delirium were also restrained for violent activity and hyperactivity with the subject being placed prone in 18 (86%), or with pressure on the neck in 3 subjects (18%).[5] Other authors have both supported [10-12, 23, 53] and rejected [2, 14, 22, 54] the positional asphyxia and choke hold theories. Concerns surrounding deaths when subjects were restrained in the prone position have led many law enforcement agencies to develop policies avoiding prone positioning in subjects undergoing police restraint with little, if any evidence, surrounding the outcome of prone positioning in the police environment at large. Prone positioning is frequently implicated as a causal factor when sudden in custody death occurs, even though early works by Reay et al have been followed by more rigorous study that does not support Reay's findings.[2, 14, 54]

Methods of police restraint that do not involve direct physical contact and allow control of the subject from a distance have also been reported to cause adverse outcomes. Pepper spray incapacitation has also been implicated as contributory to the unexpected death of people with excitation, excited delirium and underlying heart disease.[1, 8, 36, 55] While it is impossible for the arresting officer to determine the presence or absence of coronary disease at the time of the struggle, it is not uncommon that cardiac disease such as myopathy or coronary artery disease is reported in the autopsy of victims who have died

proximal to police restraint with pepper spray.[53] Whether the underlying state of psychiatric distress may play a part in such deaths is suggested but unexplored.[56]

1.4 Conducted energy weapons

Tasers®, or conducted energy weapons (CEW) are hand-held electronic immobilizing devices that rely upon over-riding the body's electro-muscular current to eliminate voluntary muscle control. For the purposes of this document, the term CEW will be used to refer to either the Taser ® manufactured by Taser International or any one of a number of Taser-like conducted energy weapons planned to be manufactured and distributed by other companies. The CEW represents one of the levels of intermediate force available to police services at this time; it is a public misconception that the CEW is an alternative to a firearm since its use is not restricted to an effort to avoid lethal force or firearms deployment and its use is not always appropriate when an officer is in a lethal force situation. However, if the CEW is ineffective, in some circumstances officers are justified in using lethal weapons.

While there is no official site of death following CEW record, perusal of publicly available web and blog sites, as well as evaluation of medical publications reveals that there have been over 750 cases in the United States and Canada of death of a subject in association with altercations involving a police CEW deployment from the mid 1980s to May 15, 2013, thirty-one of which are from Canadian police agencies. The number of altercations or even CEW weapon utilizations serving as the denominator for these events is not available in standardized fashion and researchers and the public alike are reliant on public sites and media reports for the details of these events in general. Such information is necessarily affected by publication bias, measurement bias and a lack of comprehensive data on which to make an informed decision or assessment.

In 2013 Zipes published a case series of 7 highly selected cases of subject death following CEW deployment and suggested that there is a direct association between probe deployment to the chest and the generation of ventricular fibrillation in the subjects.[57] While this retrospective case series study of a very small number of highly selected cases can offer the hypothesis that there may be an association between probe/dart deployment to the chest and subsequent ventricular fibrillation, the nature and strength of that association requires evaluation through rigorous methodology that includes specific documentation of the location of conducted energy weapons deployment on the subject in those who have lived as well as those who have died. Determination of the relative risks of CEW and other modalities will not come from the isolated evaluation of subjects who have died. For CEW, locations of darts/deployments and the pairing of those darts both in subjects who have lived and in subjects who have died is pivotal in understanding the effects of transcardiac and deployments. Bozeman et al have documented that the risk of death following CEW deployment is very low and have now begun to evaluate dart location in their studies.[58-62]

It is unknown what characteristics of CEW use, if any, are predictive of poor outcome in the situations in which they are used by police officers. In some circumstances, utilization of conducted energy weapon probe/dart applications is carried out after other control mechanisms have failed.[63] Whether such combination functions as a marker for the severity of the agitation or as a causative factor is unstudied.

2 Purpose

The purpose of the study was to document situational and subject specific characteristics surrounding police use of force for Canadian citizens in a police-public interaction that included police use of force. Our aim was to determine the frequency of police use of force overall and to determine the proportion of subjects who suffered injury or death following police use of force. For all persons suffering unexpected death, characteristics associated with the use of force event and with subject presentation were planned to be evaluated for their association with the mortality of the subject involved. We also planned to document the relative risk of death in persons experiencing characteristics suggestive of excited delirium prior to and during the use of force process as compared to persons who undergo police use of force but do not have features of excited delirium.

We understood that the systematic collection of data surrounding death proximal to police restraint could help clarify the frequency and nature of police use of force and subsequent injury and/or in-custody mortality. Understanding the predictive factors of death, would inform police practice and thus reduce the potential harm involved in police-public interactions.

The study protocol was originally planned to be implemented in 12 major urban centers in Canada over the study period (2009-2013), to build a national data base from which population statistics may be estimated. This was to build on the work done in the first study center since 2006. However, due to extensive delays with the protocol review by Human Research Ethics Boards/ Institutional Review Boards in the selected study sites, the study protocol was amended to include four Canadian urban locations with seven police agencies providing police services; the study budget was provided accordingly. The extreme difficulty and protracted time consumption associated with submitting a protocol of this intensity in this subject matter through multiple scientific and ethical review boards in multiple cities was one of the most important lessons learned in the completion of this protocol. While the delays were long as ethics review boards ensured that subject protection and study integrity was high (often taking many months of review), the scientific strength of the protocol was a key feature in the acceptance of this study across the number of review boards involved.

This study set out to address the following research questions:

1. What is the frequency of police use of force and of death proximal to police use of force in the prehospital setting in Canada and its provinces, beginning in one province and then advancing to three other provinces for a total of four urban mid-size to large cities?

2. What is the fatality rate for persons undergoing police use of force in the four selected urban Canadian cities?

3. What are the common features of excited delirium documented in subjects undergoing police use of force in Canada and its provinces in the four selected urban Canadian cities?

4. What is the case fatality rate for persons undergoing police use of force and exhibiting features of excited delirium proximal to police restraint in the prehospital setting in the four selected urban Canadian cities?

5. What is the difference in the relative risk of prehospital death following police use of force in persons suspected of suffering signs of excited delirium as compared to those who are not suffering signs of excited delirium prior to or during police interaction in the four selected urban Canadian cities?

6. What features or set of features, including methods of restraint, are predictive of morbidity and mortality in persons who undergo police use of force in the prehospital setting in the four selected urban Canadian cities?

3 Methodology

3.1 Study Design

The conceptual framework for this study was a descriptive evaluation of a prospective, multicenter, consecutive observational cohort of persons undergoing police use of force in the prehospital setting. Data were collected from all 7 study agencies (with staggered starts) from August 1, 2006 to March 31, 2013.

3.2 Study population

Subjects involved were adults (or persons thought to be of adult age by the involved officer(s)) aged 18 and older, in whom police use of force occurred as a part of the police-public interaction.

3.2.1 Inclusion Criteria

- adult subjects aged 18 years or greater, or in cases where age is not directly known, are thought to be 18 years or greater by the involved officer(s)
- police use of force applied during the course of the police public interacion, defined as any application of force above soft hands physical control regardless of the modality and whether the modality was used alone or in combination with another force modality.
- police use of force occurred as a part of the police public interaction, regardless of the outcome of that use of force
- police report would normally be filled out for the incident in question, whether or not the subject is formally arrested and charged

3.2.2 Exclusion Criteria:

- age under 18, or thought by the arresting officer to be under 18
- interaction with police that would not ordinarily generate police report i.e. simple conversation
- police use of force above soft hands physical control did not occur

3.3 Consent by study participants

Because of the sensitive nature of collection of data surrounding subjects involved in confrontations with police agencies, we consulted with research and medical ethics experts[ii] to fully appreciate and honor the ethical dilemmas posed by undertaking this study.

A waiver of consent by subjects for this study was requested and approved by the Institutional Review Boards in each site. Among other important rationale for waiver of consent, Institutional Review Boards agreed that this research posed minimal risk to subjects. In summary, minimal risk occurred because the study was an observational study with no patient/subject interaction between the research team and subject and no additional information was recorded about subjects beyond that which is already recorded by emergency health-care providers. Data being collected on the subject was already part of the police record and the relevant medical records. From a legal perspective, there was no information recorded for the study that was not already present on the EMS records and/or the emergency health-care record, and both these documents can be subpoenaed and used as evidence in a court proceeding. Therefore, the fact that these data are recorded and analyzed for the study does not pose an additional burden on the subject and does not pose any legal risk.

3.4 Data Sources

Data were collected from two main sources of information

- police record of the use of force event
- medical information from EMS providers, emergency room visits, and coroners reports where relevant.

3.4.1 Police data

Information from police was information that police officers were recording as part of agency-specific protocol, regardless of study activity. (i.e., there was to be no information on the study data sheet that should not also be part of the official police record) , but in a standardized format for the study. For even further subject protection, subject data were anonymized when received at the data collection centre. No data recording ethnicity/race of the subject was permitted to be recorded as a result of institutional review board restrictions imposed prior to the outset of the study. Data surrounding police use of force in minors was similarly excluded from study collection due to institutional review board restrictions. Data sheets will be destroyed according to research data storage requirements at each of the participating institutions.

3.4.2 Medical Data

Medical information came from three sources: the Emergency Medical Services (EMS); the Emergency Department (ED) visit, and Medical Examiner (ME) report where relevant. No additional testing or information was requested of subjects or required by the study, beyond that which is already recorded by emergency health-care providers. Further, there was no information recorded for the study that was not already present on

the EMS records and/or the emergency health-care record. Since both these documents can be subpoenaed and used as evidence in a court proceeding, the collection of this data and its preservation in the study database did not pose any additional legal risk to subjects. Most importantly, the subject data was de-identified at the source, after linkage with police records. While this was important for preserving privacy for the subject, inability to retain subject identifiers prevented tracking of repeat encounters with the same individual in subsequent use of force events.

4 Results

4.1 RESTRAINT Study Site and Police Agency Characteristics

Study Site	Approximate City Population	Number of Sworn Officers per Agency
A	1,200,000	2069
B	80,000	243
C	110,000	152
D	18,000	25
E	16,000	23
F	766,000	719
G	390,100	526

Table 1: RESTRAINT Study site, police agency characteristics (coded to prevent identification as required by Human Research Ethics Board approval for publicly available documents).

4.2 Use of Force Frequency and Modalities

4.2.1 Frequency of Use of Force Events

Over the study period, (August, 2006-March, 2013), there were 4992 use of force events captured in the seven police agencies in select Canadian urban centres. (See Table 3) These 4992 use of force events occurred in 3,594,812 police public interactions, or 0.14% of police public interactions. The precision of our estimate is high with a 95% confidence interval of the estimate at (0.135%, 0.14%). Denominator data on police public encounters from Site G and Site E is excluded from this analysis as it is still pending at the time of writing of this report. Thus our estimation of use of force is over-estimated. Data from Site G will be gained prior to medical manuscript preparation. Table 2 reflects the distribution of use of force events between the agencies in our study with the exception of Site E which was a small agency that contributed 3 use of force events in the entire cohort. Site E was unable to provide a denominator of all police activities in the interval of the study and Site G's information is pending. In order to bias our study in favour of overestimating use of force, the three use of force events are included in our numerator despite the absence of a relative denominator. Overall, use of force was rare in all agencies; with the highest proportion at 0.6% of all police public interactions.

To summarize, in 7 police agencies in 4 provinces, over 99% of police public interactions between an officer and a member of the public did not include police use of force.

	Site A 2006-2012	Site B 2010-2012	Site C 2010-2012	Site D 2010-2012	Site E 2010-2012	Site F July 2012-March 2013	Site G 2012
Use of force events	**3150**	**922**	**199**	**18**	**3**	**117**	**583**
Police-public interactions*	**3.25 million**	**145,038**	**84,809**	**14,109**	**n/a**	**100,856**	**Data pending**
Proportion with use of force	**0.1%**	**0.6%**	**0.2%**	**0.1%**	**n/a**	**0.1%**	**n/a**
NO use of force	**99.9%**	**99.4%**	**99.8%**	**99.9%**	**n/a**	**99.9%**	**n/a**

Table 2: Use of Force by Site and by Year

*Number of interactions provided by police agency, includes all calls for police assistance, minus cancelled calls, traffic stops, and private investigations.

4.2.2 Restraint Modality

The type of force modality used in the public-police event was recorded by officers on the RESTRAINT form. More than one modality could be listed per event. Verbal de-escalation and handcuffs were documented in the majority of force events but are not considered use of force for the purposes of subsequent analysis.

Force modality	Frequency	Percentage (%)
Physical/stuns/strikes	3844	77%
Hobble	780	15.6%
Vascular Neck Restraint	331	6.6%
"OC" spray	180	3.6%
Conducted Energy Weapon	745	14.9%
Firearm pointed	509	10.2%
Other restraint tool	168	3.4%
ARWEN/BeanBag Rounds	14	0.3%
Police Canine (K9)	120	2.4%
Spit Hood	288	5.8%

Table 3.Type of restraint modality used, all sites, all events

A single modality was used in 59.6% of all 4992 events. Multiple use of force modalities occurred in 40.4% of all force events.

For firearm pointed, 74 firearms pointed occurred as lethal force overwatch (LFO) for conducted energy weapon deployments.

Of the 745 CEW deployments, the mode of deployment was recorded in 565. Of those, 103 did not include actual current activation but consisted of display of the laser light sighting only. In the remaining 462 actual activations of the device(s), 336 included the use of CEW probes and 126 included contact stun deployments. When CEW was used in any fashion it was used alone in just under half of the events (44.7%). In the remaining 55.3% of CEW deployments, CEW was used in conjunction with another restraint modality.

We began to collect data on the location of conducted energy weapons deployments on the subject's body late in the study when emerging research suggested such knowledge was important. Of 336 probe mode deployments, we have information on dart location in 115 (34%). At least one dart struck the patient's anterior chest in 40/115 (34.8%) of the probe deployments; both darts struck any part of the subject's anterior chest in 8/115 probe deployments (7%). No subject died with darts to the chest in any configuration.

For subjects undergoing drive stun/contact stun deployments, location was recorded in only 26 of 126 (20%) and none of those involved applications to the subject's chest.

4.3 Situational Characteristics

4.3.1 Nature of Police Call

For all use of force events, intoxication (drug or alcohol) is the most frequently reported reason for police to be dispatched to a scene/residence.

	Frequency	%
Age	Median 30 years	(range 18-75 years)
Males*	4315	87%
Weapons	330	6.6%
Assault	515	10.3%
B&E	363	7.3%
Disturbance	873	17.5%
Mental Health	348	7.0%
APU event	62	1.2%
Intoxicated (drugs and/or alcohol)	1122	22.5%
Domestic	480	9.6%
Vehicle related	458	9.2%
Other call	1008	20.2%
Unknown	724	14.5%

Table 4: Nature of Police Call

*Subject's gender unknown in 30 cases

4.4 Subject Characteristics

4.4.1 Police-assessed subject comorbidities at the scene

Standardized data included documentation of police assessment of suspected drug intoxication, suspected alcohol intoxication or the presence of mental disturbance/emotional disturbance alone or in combination. Over 80% of subjects involved were assessed as intoxicated, emotionally disturbed or both. Of the comorbidities recorded, alcohol intoxication alone or in combination with other comorbidities was the most commonly documented. It is understood that there is no ability to confirm the presence of these comorbidities at the scene with certainty for the majority of individuals but these assessments represent the context in which police officers encounter subjects and make decisions around use of force.

Comorbidity	Frequency	%*
Alcohol intoxication	3035	60.8
Drug intoxication	1266	25.4
Emotional distress/mental illness	1069	21.4
No comorbidities	279	5.6
Unknown if comorbidity	442	8.9

Table 5 Police assessment of subject comorbidities at the scene, alone or in combination

*Note: Characteristics are not mutually exclusive, total will exceed 100% since subjects could be assessed as having more than one characteristic at a time.

Further analyses of these comorbidities revealed that in 40% of events, alcohol intoxication alone was involved. Emotionally distressed person/mental illness alone occurred in 8% of cases, and suspected drug intoxication alone was a factor in 7.6% of events.

These data will be further explored in future to determine the correlation between police officer assessment in the field and medical assessment for the individuals brought to Emergency Department (ED) care.

4.4.2 Subject Features of Excited Delirium

Police officers systematically recorded whether any of the following subject features of excited delirium were present before or during the use of force event. Data were available for these features in 4599 of use of force events, the remainder were indicated as "unknown" with respect to these specific subject features.

Feature	**N**	**%**
Naked/partially clothed	268	5.4
No response to pain	549	11.1
No response police presence	1193	24.2
Constant physical activity	881	17.8
Doesn't tire despite heavy physical exertion	325	6.6
Superhuman strength	339	6.9
Sweating profusely	190	3.9
Excessive heat to touch	109	2.2
Glass attraction	105	2.1
Rapid breathing	246	7.0
None of the above	1228	24.9

Table 6 Subject Features of Excited Delirium (N=4599)

The table above reflects the frequency with which each of the features was documented across the entire cohort.

4.4.2.1 2 or fewer concomitant features of Excited Delirium:

Further analysis revealed that in 89% (4093/4599) of use of force events, subjects demonstrated a total of 2 or fewer concomitant features. Of those, 1228 people, or 24.9% of the use of force cohort overall had no excited delirium features evident. Thus, the majority of use of force events occurred in individuals documented by officers to have very few or no features of excited delirium. This finding that should reassure those who have concern that teaching officers about excited delirium or providing police officers with a list of features to consider will cause those officers to document that excited delirium was present in most use of force events.

4.4.2.2 3 or more concomitant features of Excited Delirium:

Just over 12% (570/4599) of police use of force events included subjects with 3 or more concomitant features of excited delirium. In other words, 1 in 8 use of force events in our study included an individual with 3 or more concomitant signs of Excited Delirium. This number translates into approximately 1 in 5,000 police public interactions overall including subjects who have 3 or more concomitant features of excited delirium during the course of our study. It is not known how many individuals with three or more concomitant features of Excited Delirium do not undergo police use of force.

A very small number of subjects in police use of force events exhibited a large number of (6 or more) concomitant features at the same time, 2.3% (108/4599). The circumstance of having 6 or more concomitant features would describe an individual who is highly abnormal, and who is in a state that could only be described as a medical emergency. In our study, 1 in 43 use of force events involved a subject with a very high number of concomitant features of excited delirium. From our data, considering the denominator of police public interactions, 1 in 25,000 police public interactions overall could be anticipated to involve subjects with 6 or more characteristics of excited delirium. However, it is not known how many similar individuals do not undergo police use of force.

4.4.3 Subject Injury

Of 4992 subjects of police use of force, 830 subjects (16.6%) were transported to Emergency Department (ED) either by police or EMS vehicle and had a retrievable medical health record which could be reviewed by the study investigators. While a total of 1153 (23.0%) of subjects were recorded by police officers as being transported to ED/hospital by either police or EMS vehicle, hospital records were only available for 830 subjects (16.6%). The reasons for the discrepancy include but are not limited to: error in police recording destination; subject brought to hospital but left before being assessed in the emergency department thus no health record generated, subject identity unknown or no provincial health number by which to search the medical record, alias used at the time

of medical treatment and subsequently corrected in the health record making that record untraceable for us; misfiled/lost records.

Preliminary analysis finds that of 830 subjects transported for ED assessment with retrievable medical record, 426 (51.0%) were documented by ED physicians to be suffering from mental distress, either alone or in combination with injury and/or intoxicants.

Preliminary analysis finds that of 830 subjects transported for ED assessment with retrievable medical record, 490 (59%) were documented by ED physicians to be intoxicated with drugs, alcohol or both, alone or in combination with physical injury and mental illness.

For the 830 subjects that had a medical record, detailed assessment of the specific injury profile documented by ED physicians is ongoing at the time of writing this report. Preliminary analysis finds that ,of the 830 subjects who were seen by an ED physician, 476 (57.3%) were documented by the physician as having a physical injury of some description (ranging from bruised and lacerations to more significant injury) either alone or in combination with mental distress and/or intoxication.

It is possible that an individual who was injured was not brought to hospital and we are unable quantify how often that occurred. Privacy regulations prevented researchers from searching hospital records for any time longer than the 24 hour period in which the use of force event occurred. We, therefore, could not uncover initially unreported injuries in subjects who sought care later.

Detailed statistical evaluation of the injuries seen in subject following police use of force is underway at the time of this report. It is important to note that ED physicians had limited ability to determine, or often made no reference to, whether an injury was present before the use of force or occurred during that event. Thus, subsequent evaluation of subject injury will be biased in favor of finding that a subject was injured as a result of use of force.

4.4.4 Subject Death

Over the study period there were 4992 use of force events consecutively recorded across a total of 3,594,812 police public interactions in the 7 involved agencies. A total of 7 subjects died (7/4992). The seven subject deaths represent 0.14% of police use of force in our study. Because of the large sample size, our estimate of the frequency of death following police use of force is extremely precise and lies within a 95% Confidence interval that ranges from 0.06% to 0.2%. Translating this statistic into a lay person's interpretation, we are confident that at worst 99.8% and at best 99.94% of police use of force does not result in subject death. This is the first time that quantification of the proportion of use of force events that end in subject death has occurred with appropriate research methodology.

Six of the deaths in our study were as a result of police use of firearms and the other was a sudden in custody death in the context of excited delirium. Thus, unanticipated, sudden in custody death without the use of any firearm occurred in 1/4992 use of force events, or a total of 0.02% of all use of force events. Even though our statistics include a single sudden in custody death, we are able to state with precision that we are 95% confident that the true real world proportion of police use of force events that end with sudden, unexpected in custody death can be anticipated to be between 0.005% and 0.1% of police use of force, or a maximum of one tenth of one percent of police use of force. In other words, at worst 99.9% of police use of force events can be anticipated to conclude without a sudden, unexpected sudden in custody death.

Although the single sudden in custody death in our cohort occurred in an individual exhibiting all 10 features of excited delirium, we are unable to appropriately evaluate which feature or set of features could be predictive of sudden in custody death with a single death to evaluate.. We can state that the proportion of individuals with 3 or more concomitant features of excited delirium who subsequently died following a use of force event is 1/540 or 0.19% With our sample size, we can say that we are 95% confident that the true proportion of individuals with 3 or more features of excited delirium who die suddenly and unexpectedly following police use of force lies between as low as 0.005% and high as 1%.

Because a single death occurred in our study, we are unable to assess the risk profile of one force modality over another in the prediction of sudden in custody death or the risk of combined use of force modalities. Lastly, we are unable to assess whether one modality or another is of greater risk in the context of excited delirium. In Canada, the establishment of a data base of sudden in custody death would allow at least retrospective evaluation of predictive features. Ongoing collection of standardized data would enable determination of relative risks of force modalities.

4.4.5 Prone Positioning

Officers were asked to document the final resting position of subjects following the use of force. It is understood that many subjects will be in prone position transiently during use of force events, and that most subjects will be placed prone during the process of applying handcuffs. Officers can and did record the final position of the subject at the conclusion of the use of force event; in other words, the position in which the subject was maintained while awaiting transport/further disposition.

No agency participating in our study had a specific policy on subject positioning during the study enrollment period. In our study, 2070/4992 subjects or 41.5% were documented to remain in a prone position. The remaining 2922/4992 or 58.5% were in a position other than prone: side lying, face up, sitting, kneeling or standing. There was an

equal distribution of subjects who had features of excited delirium and an equal distribution of subjects who had undergone CEW deployment between the groups.

In our study no person who remained in the prone position at the conclusion of the use of force died (0/2070; 0%) and the unexpected sudden in custody death that occurred involved a subject who was clearly documented to be in the side lying position up to and including the moment of collapse by all witnesses at the scene (1/2922; 0.03%). The 95% confidence interval for the difference in proportion of death between prone and non-prone positioning ranges from -0.2% to +0.2%. Thus, statistically there is no difference between the groups, with a high degree of precision. Our study, with its very large sample size of real world subjects in each of the prone or not prone groups, demonstrates that many thousands of individuals would need to be evaluated for positioning in order to more precisely document the negligible difference between the groups in terms of subject death. Even if such a study could be constructed, the documentation of such small statistical difference is unlikely to have any actual operational/clinical significance for the health and safety of subjects of police use of force.

5 Knowledge Translation

5.1 Knowledge Translation to End Users

5.1.1 Internal reporting of use of force

There are increasing social expectations for transparent police reporting and police agencies are expected to be open to audit at the local, municipal, provincial and federal levels. Unfortunately, there remains a heavy inference that auditing practice is only for the purposes of discipline, reprimand or the detection of violations of policy. Our study emphasizes the value in use of force reporting that is consistent, trackable and scientifically robust. There is little doubt that understanding the profile of one's practice enables policy and procedure to be guided by evidence rather than over responsiveness to anecdote/isolated cases. Our data supports the notion that "there is safety in the truth and the truth is in the data" (Hall, 2010) in terms of police use of force reporting. Our study documents that stringent evaluation of police use of force is possible and finds the profile to be favorable from a public consumer standpoint, a police administrator standpoint and from the perspective of the officer on the street who may be evaluated or criticized against an unknown standard.

It is important to note that while our study cannot determine the appropriateness of any particular use of force, we documented that police use of force has a stable profile that is documentable and can be scientifically evaluated.

In order to do so, systematic data collection must be an all day, every day event that includes all use of force events and not just those considered extremes. Engagement of patrol staff in the personal importance of these data is essential in gaining interest and compliance from patrol officers.

5.1.2 Crafting the Subject Behavior Officer Response (use of force) form

Police agencies all have their own internal reporting system for use of force events. However, there is a remarkable difference between agencies not only in what data is collected, but how it is collected, stored, analyzed and reported. It is currently impossible to compare statistics between municipal and federal agencies, or even municipal agencies across jurisdictions because of different thresholds for reporting use of force, differences in the information contained within the use of force report and even the definition of when a modality is considered to have been used may be different. There are important gaps in data collection that need to be rectified in order to understand the national profile of police use of force, or in some cases, the local profile.

- The threshold of use of force reporting must be defined and be consistent between agencies in order to compare events. In our study, use of force was defined to have

occurred once any use of force above a simple joint lock was utilized, regardless of whether that force was used alone or in combination with another modality (modalities).

- We found electronic use of force forms to be most effective for officer compliance and for ease of analysis; the use of paper forms generates a workload that is intolerant for officers, coordinators and data collators alike. Use of paper forms generates the need for hand collation and entry of data into separate data basing for analysis. Electronic items, with proper platforming, can be abstracted to database management systems.
- To avoid measurement/recording bias, all forms should have a check-box option that includes yes, no and unknown. Blanks or missing data should not be construed as negative responses and missing data needs to be clarified. Ideally, in electronic formats, each field should have a mandatory completion of all elements (including the ability to say "unknown") before the officer can move on to the next part of the form.
- Data elements that are essential must be supplied to officers such that they know which elements must be included in standard documentation. Reliance on officer's opinions of what is important can lead to inconsistency in reporting key elements. Giving officers a framework or list of important details to document does not compel them to find those things present.
- To avoid recording/measurement bias, all necessary and relevant data elements should be collected in brief and user friendly format to improve compliance with all facets of the data instrument. For the purposes of our study, all relevant data surrounding use of force events could have been included on a single sided, one page report form. That form was subsequently separated into relevant sections and buried within the normal use of force report to keep report length to a minimum.
- Forms that require multiple pages or multiple duplicate sections are cumbersome to complete and can be difficult to analyze. We found that existing use of force reporting is variable and often includes electronic forms with many multiple separate tabs, many pull-down windows and much repetition of elements which leads to frustration, exhaustion and non compliance through missing information.
- To avoid measurement bias, data surrounding subject features at the time of the police-public interaction should be included for all subjects, and not restricted to those subjects who the officer believes to be in a state of excited delirium.
- While the use of open-comment/free text boxes for officers to report any additional pieces of information that are not captured on the form is desirable, it must be acknowledged that the scientific analysis of free text entries can be difficult and free text should be considered adjunctive to more structured parts of the report when quantitative data analysis is the goal.

- CEW dart/probe location should be recorded. Standardization of the recording of this information is essential to track the outcomes of various dart locations for individuals undergoing CEW deployment. In the current climate of inquiry into the safety profile of CEW deployment, absence of this information from the field eliminates the ability to document the specific risk of chest and non chest deployments in the field. This data is not difficult to record and is essential to the understanding of the safety implications of this weapon in the context in which it is used.
- The CEW information should include
  - Specific locations of chest and non-chest deployments (e.g., grid of human body with quadrants indicating location on the body)
  - Which darts are paired It is impossible to understand which darts were paired through analysis of dart marks alone or during autopsy.
  - If a dart misses the subject it must be recorded as such rather than excluded so that failed deployments can be understood.

5.2 Real-time reporting

It is essential that use of force events are reported in real time (during or end of shift) and that procedures to ensure real-time reporting are maintained. Delays can generate recall bias, and delayed transcription of forms for databasing becomes overwhelming. Having an external pressure (such as a deadline for reporting) to ensure data sets are complete was helpful in our study both for reporting agencies and data entry personnel.

5.3 Internal data analysis

Regular internal data collection and analysis is important in not only ensuring that data sets are complete but in tracking trends, worrisome events or identifying sudden changes in practice. When data is complete and analysis regularly scheduled, trends can be identified and ready information is available to police administrators to provide to the public. The caveat to this concept is that data should not be analyzed so often that normal oscillations in frequency, etc. are misinterpreted as major changes requiring intervention.

Long term collection of data enables the documentation of the pattern of use of force within police agencies. For example, in one study agency intense media attention to police use of force from month to month resulted in the erroneous assumption that use of force was not only “up” but was “out of control” according to media reports of individual cases without consideration for a denominator of use of force. We were able to supply the study site with review of their data for recent months and over the long term, demonstrating that use of force was stable and rare. Additionally, data from that site compared favorably with the aggregate data from the study on the whole. Public misinformation was corrected with certainty, in real time.

It must be understood that large scale/long term data is needed to understand rare outcomes. Data of the required magnitude to evaluate rare outcomes is unlikely to come from a single site even when very large agencies are considered.

5.4 Data linking between police, EMS and hospitals

Nationally there is no data linking between police and EMS, police and hospital, or even EMS to hospital which means that EMS agencies have limited or no ability to determine how often they are called into service for police related activity. Similarly, unless these data are collected prospectively, police agencies are currently unable to determine how often subjects of police interest are examined and/or transported by EMS agencies.

For police agencies, privacy laws preclude further knowledge of subject health and welfare once the subject has been transported to hospital. Outside of research efforts such as ours, police agencies in Canada have no ability to document, evaluate and understand the profile of subjects' physical outcomes of use of force.

For medical providers, lack of data linkage precludes evaluation of subject injury as compared to police use of force.

5.5 Knowledge Translation for Criminology and Medical Researchers

5.5.1 Getting buy-in from participating police agencies

The essential element for the completion of a broad scale population-based police project is trust and the engagement of the administrative and patrol personnel in the importance of the project at the personal and professional level. In the completion of our study we made ourselves available for inquiry, comment, criticism and discussion. We were diligent in demonstrating interest in the true understanding of the issues at hand rather than proving of one point or another; one of the benefits of clinical equipoise in the evaluation of police use of force. In turn, police agencies provided us with diligently recorded data across a wide variety of police public interactions responded promptly to queries and embraced the scientific requirements of such rigorous data collection.

5.5.2 Research administration

This study would not have been possible without a competent, organized project manager. The project manager must have overarching vision, impeccable communication skills, and be able to multi task across a broad range of tasks and individuals while being able to assimilate new information efficiently.

All research study staff must demonstrate high integrity, be held to a confidentiality agreement and pass a police record check. Project managers must ensure that study staff are kept abreast of changes and emerging trends such that staff remain involved and invigorated by working on the project.

5.5.3 Primary Data Collection, Data Linkage and Warehousing

Large scale research projects that involve primary data collection across multiple sites are highly dependent on the site-specific research data clerks to record/input the data. To establish systematic and accurate data collection, protocols for and codebooks on how to handle data are essential and were one of the key features of our study. This avoids individual interpretation by clerks. Careful logbooks of process completion must be kept with de-identified data only and these logbooks need to be shared with the project manager on a regular basis so that the manager can audit the data collection process at each site.

It is also important that only the project manager and principal investigator have access to the entire data base. Forms should be submitted on a single entry page that stores the information away from the data clerk's subsequent access. Correction of errors and editing must be supervised to track employee accuracy and performance and to ensure an accurate data audit trail.

The costs associated with data warehousing services can be extraordinary. We found that save for the design and implementation of a database, data warehousing services beyond that initial start-up may be unnecessary as new databasing programs continue to evolve. We used a data warehouse service for processing 75% of our data collected, and ensured that our data were 20% double entered to check accuracy and consistency. If data warehousing services are used, it is important to establish when and how weekly updates on large scale projects must be done, how costs are incurred and how data entry will be monitored to enable data assessment in regular intervals.

6 Conclusion

Real-world research in police practice has its challenges but the results are rewarding and informative and will help guide future research efforts and policies and procedures surrounding police use of force. Privacy restrictions prevented the analysis of features of the police public interaction that are likely to be extremely important, including use of force in minors, documentation of the ethnicity of subjects undergoing police use of force and the number of subjects with multiple encounters with police over the study period. Each of these issues may represent a subject group at particularly high risk that must be studied in future.

The general public may be reassured by the finding that over 99% of police public interactions do not include police use of force and that 99.86% of police use of force events did not end in subject death. When police officers do use force, the vast majority of subjects involved are either intoxicated with drugs and/or alcohol, suffering from mental distress or some combination thereof. The presence of intoxicants inherently alters the police public interaction and intuitively alters the effectiveness of crisis intervention techniques. In our study ~8% of police use of force events involved subjects described by officers as being emotionally distressed without street evidence of intoxication. We are unable to comment how many similarly afflicted individuals do not undergo use of force.

The known features of excited delirium can be prospectively documented and providing officers with a list of the known features does not compel them to find features present. We found that 1 in 8 police use of force events involves an individual with 3 or more concomitant features of excited delirium. The only subject who died in our cohort exhibited all 10 published features of excited delirium. With a single death in our cohort we are unable to determine whether a feature or set of features accurately predicts sudden in custody death and further study is warranted.

Approximately 16% of subjects were assessed in emergency departments following police use of force. Evaluation of the injury profile following police use of force is underway at the time of this report.

Sudden in custody death is extremely rare and we documented its presence in 0.02% of use of force events. In other words, 99.98% of police use of force events is not anticipated to end in a sudden in custody death. There is no difference in the proportion of subjects in prone vs. other positions in terms of sudden in custody death. In our study no subject died with one or more conducted energy weapon probes to the chest.

Further study across a very large cohort of consecutive prospectively collected police use of force events is required to determine the predictors of sudden in custody death. A registry of all unexpected in custody deaths in Canada and North America, regardless of force modality, would assist greatly in the understanding of sudden in custody death.

Annex A Project Team

Project Champion: Steve Palmer, Director, Science and Technology Transition, DRDC

Project Champion: Pierre Brassard, M.A.P, CD; Consulting analyst, École nationale de police du Québec

Lead federal department: Canadian Police Research Centre, Canadian Safety and Security Program

PROJECT PERFORMANCE SUMMARY

Schedule Performance Summary: Variances in schedule were related to two main issues. The first being the extensive delay in the Human Research Ethics Board (HREB) and Institutional Review Board (IRB) submission processes at academic institutions and site-specific health authorities.

Cost Performance Summary: The total awarded contract amount for this project was $571,666.20. Required cash flow to complete the project was $563,850.51. The cost variance was reflected in materials/supplies, as there was a much heavier electronic component for communication and data collection than originally anticipated, which alleviated our need for postal and courier expenses.

In-kind costs came in at $155,800, well over the projected $96,000.00. The variance is due to two things. First, the initial in-kind costs related to law enforcement involvement at the coordinator/supervisor level were initially underestimated. The purpose was for each participating police agency to provide one dedicated use of force supervisor/coordinator dedicated to RESTRAINT. This projected amount of $96,000 was calculated based on an hourly rate of $32.00 for 2 years (100 weeks) at 6 hours per week, at five sites. The actual amount of hours dedicated to RESTRAINT varied by agency, with the two smaller agencies dedicating only 1 hour per week over three years (150 weeks) at a rate of $32.00 ($9,600). The larger agencies accounted for most of the in-kind services. For three agencies that contributed data for three years (not counting the period of 2006-2009 that Site A collected data), the in-kind costs were $86,400. The remaining two sites were dependent on their start date with one agency collecting one year of data ($9,600) and the other 9 months of data ($7,200). The total in-kind amount for law enforcement agencies was $112,800.

Second, we also did not consider the in-kind contribution from VIHA in the projected $96,000, which included office space, computer, phone, fax and printer. VIHA provided the space and use of the equipment over a period of 36 months, at an estimated $1,200.00 per month for a total of $43,000.

Annex C Publications, Conference Proceedings and Invited Presentations

Publications

Frequency of Signs of Excited Delirium Syndrome in Subjects Undergoing Police Use of Force: a descriptive evaluation of a prospective, consecutive cohort. (2013). **Hall, C.A**., Butler, C., Kader, A., Fick, G.H., Vilke, G.M. *Journal of Forensic and Legal Medicine*, 20: 102-107.

Incidence and outcome of prone positioning following police use of force in a prospective, consecutive cohort of subjects. (2012) **Hall, C.A.**, McHale, A.M.D., Kader, A.S., Stewart, L.C., MacCarthy, C.S., Fick, G.H. *Journal of Forensic and Legal Medicine*, 19: 83-89

Conference Proceedings

Hall C, Andrusiek D L, Votova K, Randhawa K. Use of force in police-public encounters and medical outcomes: Issues with linking police and emergency medical services (EMS) data. Canadian Association of Emergency Physicians, Niagara, Ontario. June 2, 2012.

Votova K, Randhawa G, Hall C A. From the streets to the Emergency Department: Transfer modality and medical outcomes for mental health subjects following police use of force. Canadian Association of Health Services and Policy Research. Montreal, Quebec, Canada. June 1, 2012.

Invited National Presentations

2013 October 2013 (pending)
RCMP Commanders conference
Police use of force and standardized reporting: understanding what you do.
Abbotsford, BC

2012 Expert Committee on Conducted Energy Weapons
Canadian Academy of Health Sciences
August 2012-present

Calgary Police Commission: Sudden In Custody Death: Myths and Misconceptions
Feb 28, 2012

2011 Alberta Association of Chiefs of Police
Presenter: RESTRAINT Study and Issues in Use of Force and Sudden In Custody Death

February 10, 2011
Red Deer, AB

Calgary Police Executive
Presenter: RESTRAINT, EDP, ExD, Proning, CEW deaths
Calgary, AB
August 23, 2011

Alberta Association of Chiefs of Police
Presenter: Sudden In Custody Death
November 9, 2011
Calgary, AB

2009 Calgary Police Service
Professional Standards Division Annual Conference
Presenter: Excited Delirium and Sudden In Custody Death
Calgary, AB

RCMP Major Crimes, K Division
Annual Officer Safety/Training/Standards Conference
Presenter: The controversy, the reality, and sudden in custody deaths. Agitated and delirious subjects
Prince George, BC
May 6, 2009

2008 Canadian Institute for the Prevention of In Custody Death
Presenter: Excited delirium: Emergency or emerging excuse?
Niagara Falls, Ontario
May 2008

Canadian Institute for the Prevention of In Custody Death
Presenter: Taser and the medical research: What is new?
Niagara Falls, Ontario
May 2008

Presenter: CEW Update 2008
June 19, 2008
Ottawa, ON

Invited International Presentations:

2013 November 2013 (pending)
Association of Chief Police Officers
Prospective data recording: what can be learned from use of force analysis?

Birmingham, England, UK

International Law Enforcement Forum
Police use of force and sudden in custody death
A preliminary look at data from the RESTRAINT study
Penn State, April 2013

2012 Institute for the Prevention of In Custody Death
Presenter: Use of Force: By Patrol Officers, For Patrol Officers
Las Vegas, Nevada
November 2012

Association of Chiefs of Police, United Kingdom
Presentation; Sudden In Custody Death
Farnham, England February 2012

London Metropolitan Police, London, England
Sudden In Custody Death: information for police administrators, police officers, investigators and triservices prehospital personnel
London, England February 2012

2011 Committee on Excited Delirium, Penn State University
Committee Member and Invited Presenter
Seattle, WA April 12, 2011

International Law Enforcement Forum, Forum member 2009-present
Invited Presentations on: Sudden In Custody Death: Excited Delirium and Defining the real risks of police use of force: Guiding principles
New Westminster, BC May 2011

2009 Less Lethal Weapon Committee, National Institute of Justice, USA
Committee Member and Annual Meeting
Presenter: The Canadian Experience in Police Use of Force
Santa Monica, CA January 26, 2009

International Law Enforcement Forum
Invited Panelist
National Policing Improvement Agency
Bramshill, UK October 13-15, 2009

Less Lethal Weapons Committee
National Institute of Justice
Annual Meeting: Orlando, Florida Sept 21-24, 2009

American College of Emergency Physicians Committee on Excited Delirium
Committee member and co author
Planning meeting: Dallas, Texas, May 2009
White paper on Excited Delirium published Fall 2009
Evaluation of In Custody Deaths in the USA
Invited Speaker
National Institute of Justice Spring 2009

National Association of Medical Examiners meeting
Presenter: Epidemiology and outcomes: The Canadian experience
Annapolis, MD March 5, 2009

List of symbols/abbreviations/acronyms/initialisms

CPRC	Canadian Police Research Centre
SBOR	Subject Behavior/Office Response
R&D	Research & Development
FOIPP	Freedom of Information and Protection of Privacy Act
CEW	Conducted Energy Weapon
LFO	Lethal Force Overwatch
ED	Emergency Department
EMS	Emergency Medical Services
UofF	Use of Force
RESTRAINT	Risk of dEath in Subjects That Resist: Assessment of Incidence and Nature of fAtal events

Reference List

1. Chan TC VGCJea. Pepper spray's effects on a suspect's ability to breathe. 1-7. 2001. National Institute of Justice: Research in Brief, US Department of Justice, Washington, DC.
   Ref Type: Report

2. Chan TC, Vilke GM, Neuman T. Reexamination of custody restraint position and positional asphyxia. Am J Forensic Med Pathol 1998; 19(3):201-205.

3. O'Halloran RL, Lewman LV. Restraint asphyxiation in excited delirium. Am J Forensic Med Pathol 1993; 14(4):289-295.

4. Paterson B, Bradley P, Stark C, Saddler D, Leadbetter D, Allen D. Deaths associated with restraint use in health and social care in the UK. The results of a preliminary survey. J Psychiatr Ment Health Nurs 2003; 10(1):3-15.

5. Pollanen MS, Chiasson DA, Cairns JT, Young JG. Unexpected death related to restraint for excited delirium: a retrospective study of deaths in police custody and in the community. CMAJ 1998; 158(12):1603-1607.

6. Stratton SJ, Rogers C, Brickett K, Gruzinski G. Factors associated with sudden death of individuals requiring restraint for excited delirium. Am J Emerg Med 2001; 19(3):187-191.

7. Stratton SJ, Rogers C, Green K. Sudden death in individuals in hobble restraints during paramedic transport. Ann Emerg Med 1995; 25(5):710-712.

8. Reay DT. Death in custody. Clin Lab Med 1998; 18(1):1-22.

9. Luke JL, Reay DT. The perils of investigating and certifying deaths in police custody. Am J Forensic Med Pathol 1992; 13(2):98-100.

10. Reay DT. Positional asphyxia during law enforcement transport. Am J Forensic Med Pathol 1993; 14(2):170-171.

11. Reay DT, Hazelwood RR. Death in military police custody and confinement. Mil Med 1970; 135(9):765-771.

12. Reay DT, Huber J, Fligner CL, Watson WA. Effects of positional restraint on oxygen saturation and heart rate following exercise. Am J Forensic Med Pathol 1988; 9(1):16.

13. Reay DT, Eisele JW. Death from law enforcement neck holds. Am J Forensic Med Pathol 1982; 3:253-258.

14. Chan TC, Vilke GM, Neuman T, Clausen JL. Restraint position and positional asphyxia. Ann Emerg Med 1997; 30(5):578-586.

15. Ross DL. Factors associated with excited delirium deaths in police custody. Mod Pathol 1998; 11(11):1127-1137.

16. O'Halloran RL, Frank JG. Asphyxial death during prone restraint revisited: a report of 21 cases. Am J Forensic Med Pathol 2000; 21(1):39-52.

17. Mirchandani HG, Rorke LB, Sekula-Perlman A, Hood IC. Cocaine-induced agitated delirium, forceful struggle, and minor head injury. A further definition of sudden death during restraint. Am J Forensic Med Pathol 1994; 15(2):95-99.

18. Mercy JA, Heath CW, Jr., Rosenberg ML. Mortality associated with the use of upper-body control holds by police. Violence Vict 1990; 5(3):215-222.

19. Koiwai EK. Deaths allegedly caused by the use of "choke holds" (shime-waza). J Forensic Sci 1987; 32(2):419-432.

20. Milliken D. Death by restraint. CMAJ 1998; 158(12):1611-1612.

21. Miles SH. Restraints and sudden death. J Am Geriatr Soc 1993; 41(9):1013.

22. Parkes J. Sudden death during restraint: a study to measure the effect of restraint positions on the rate of recovery from exercise. Med Sci Law 2000; 40(1):39-44.

23. Roeggla M, Wagner A, Muellner M et al. Cardiorespiratory consequences to hobble restraint. Wien Klin Wochenschr 1997; 109(10):359-361.

24. Laposata EA. Positional asphyxia during law enforcement transport. Am J Forensic Med Pathol 1993; 14(1):86-87.

25. Amnesty International Library. Amnesty International. Excessive and Lethal Force? Amnesty International's concerns about deaths and ill treatment involving police use of TASERs. 11-3-2004.
Ref Type: Internet Communication

26. Wetli CV, Fishbain DA. Cocaine-induced psychosis and sudden death in recreational cocaine users. J Forensic Sci 1985; 30(3):873-880.

27. Wetli CV, Wright RK. Death caused by recreational cocaine use. JAMA 1979; 241(23):2519-2522.

28. Wetli CV, Mash D, Karch SB. Cocaine-associated agitated delirium and the neuroleptic malignant syndrome. Am J Emerg Med 1996; 14(4):425-428.

29. Escobedo LG, Ruttenber AJ, Agocs MM, Anda RF, Wetli CV. Emerging patterns of cocaine use and the epidemic of cocaine overdose deaths in Dade County, Florida. Arch Pathol Lab Med 1991; 115(9):900-905.

30. Gruszecki AC, McGwin G, Robinson A, Davis GG. Unexplained Sudden Death and the Likelihood of Drug Abuse. J Forensic Sci 2005; 50(2):1-4.

31. Henry JA. Metabolic consequences of drug misuse. Br J Anesthesia 2000; 85(1):136-142.

32. Lange RA, Hillis LD. Cardiovascular complications of cocaine use. N Engl J Med 2001; 345(5):351-358.

33. Reay DT, Eisele JW. Law Enforcement Neck Holds. Am J Forensic Med Pathol 1986; 7:177.

34. Chute DJ SJ. Injury patterns in a plastic (AR-1) baton fatality. Am J Forensic Med Pathol 1998; 19:226-229.

35. Ritchie AJ GJ. Life threatening injuries to the chest caused by plastic bullets: a report on 90 patients. Br J Surg 1975; 62:480-486.

36. Chan TC VGCJeal. The effect of oleoresin capsicum pepper spray inhalation on respiratory function. J Forensic Sci 2002; 47:299-300.

37. Hamilton A. From Zap to Zzzz. TIME . 28-3-2005.
Ref Type: Magazine Article

38. Kornblum R RS. Effects of the Taser in fatalities involving police confrontation. J Forensic Sci 1991; 36:434-438.

39. Ordog GJ, Wasserberger J, Schlater T, Balasubramanium S. Electronic gun (Taser) injuries. Ann Emerg Med 1987; 16(1):73-78.

40. McDaniel W SRNMBJ. Cardiac Safety of Neuromuscular incapacitating devices. PACE [1 (suppl)], s284-s287. 2005.
Ref Type: Abstract

41. Lee BK, Vittinghoff E, Whiteman D, Park M, Lau LL, Tseng ZH. Relation of Taser (electrical stun gun) deployment to increase in in-custody sudden deaths. Am J Cardiol 2009; 103(6):877-880.

42. Wobeser WL DJBBFP. Causes of death among people in custody in Ontario, 1990-1999. CMAJ 2002; 167(10):1109-1113.

43. DeBard ML, et al. White Paper Report on Excited Delirium. 9-11-2009. ACEP Excited Delirium Task Force.
Ref Type: Report

44. Hall CA, Kader AS, nielle McHale AM, Stewart L, Fick GH, Vilke GM. Frequency of signs of excited delirium syndrome in subjects undergoing police use of force: Descriptive evaluation of a prospective, consecutive cohort. J Forensic Leg Med 2013; 20(2):102-107.

45. Takeuchi A, Ahern TL, Henderson SO. Excited delirium. West J Emerg Med 2011; 12(1):77-83.

46. Vilke GM, Payne-James J, Karch SB. Excited delirium syndrome (ExDS): redefining an old diagnosis. J Forensic Leg Med 2012; 19(1):7-11.

47. Morrison A, Sadler D. Death of a psychiatric patient during physical restraint. Excited delirium--a case report. Med Sci Law 2001; 41(1):46-50.

48. Chan TC, Neuman T, Vilke GM, Clausen J, Clark RF. Metabolic acidosis in restraint-associated cardiac arrest. Acad Emerg Med 1999; 6(10):1075-1076.

49. Bell MD, Rao VJ, Wetli CV, Rodriguez RN. Positional asphyxiation in adults. A series of 30 cases from the Dade and Broward County Florida Medical Examiner Offices from 1982 to 1990. Am J Forensic Med Pathol 1992; 13(2):101-107.

50. Karch SB, Wetli CV. Agitated delirium versus positional asphyxia. Ann Emerg Med 1995; 26(6):760-761.

51. Schmidt P, Snowden T. The effects of positional restraint on heart rate and oxygen saturation. J Emerg Med 1999; 17(5):777-782.

52. Vilke GM, Debard ML, Chan TC et al. Excited Delirium Syndrome (ExDS): Defining Based on a Review of the Literature. J Emerg Med 2011.

53. Hick JL, Smith SW, Lynch MT. Metabolic acidosis in restraint-associated cardiac arrest: a case series. Acad Emerg Med 1999; 6(3):239-243.

54. Hall CA, McHale AMD, Kader AS, Stewart LC, MacCarthy CS, Fick GH. Incidence and Outcome of Prone Positioning Following Police Use of Force in a Prospective, Consecutive Cohort of Subjects. Journal of Forensic and Legal Medicine 2012; 19(2):83-89.

55. Steffee CH ea. Oleoresin capsicum (pepper) spray and "in-custody deaths". Am J Forensic Med Pathol 1995; 16(3):185-192.

56. Karch SB, Stephens BG. Acute excited states and sudden death. Acute excited states are not caused by high blood concentrations of cocaine. BMJ 1998; 316(7138):1171.

57. Zipes DP. Sudden cardiac arrest and death following application of shocks from a TASER electronic control device. Circulation 2012; 125(20):2417-2422.

58. Bozeman WP, Hauda WE, Heck JJ, Graham DD, Jr., Martin BP, Winslow JE. Safety and injury profile of conducted electrical weapons used by law enforcement officers against criminal suspects. Ann Emerg Med 2009; 53(4):480-489.

59. William P Bozeman MD et al. **Injury Profile of TASER Electrical Conducted Energy Weapons (CEWs). Departments of Emergency Medicine: Wake Forest University, Virginia Commonwealth University, Louisiana State University, University of Nevada Medical Center.** Annals of Emergency Medicine . 2007.

60. Bozeman WP, Teacher E, Winslow JE. Transcardiac conducted electrical weapon (TASER) probe deployments: incidence and outcomes. J Emerg Med 2012; 43(6):970-975.

61. Bozeman WP. Additional information on taser safety. Ann Emerg Med 2009; 54(5):758-759.

62. Bozeman WP, Barnes DG, Jr., Winslow JE, III, Johnson JC, III, Phillips CH, Alson R. Immediate cardiovascular effects of the Taser X26 conducted electrical weapon. Emerg Med J 2009; 26(8):567-570.

63. Manojlovic D, Hall C, Laur D et al. Technical Report TR-01-2006. Review of Conducted Energy Devices. TR-01-2006. 2005. Canadian Police Research Centre. Ref Type: Report

64. Pauls MA, Downie J. Shooting ourselves in the foot: why mandatory reporting of gunshot woulds is a bad idea. CMAJ 2005; 170(8):1255-1256.

65. Pauls MA. The moral of the study. CMAJ 2003; 168(13):1643-1644.

66. Pauls MA, Hutchinson RC. Bioethics for Clinicians: 28. Protestant Ethics. CMAJ 2002; 166(3):339-343.

67. Pauls MA, Singer PA, Dubinsky I. Communicating advance directives from long-term care facilities to emergency departments. J Emerg Med 200; 21(1):83-89.

68. Rolleston F, Armour C, Stipich N. Development of a Tri-Council code of conduct for research involving humans. J Int Bioethique 1997; 8(1-2):67-70.

[i] The word 'subject' is used throughout this report in the context of the public-police interaction, such that we are keeping with the law enforcement use of the term 'police subject', as in 'subject to search...' , 'subject of interest' or 'subject to arrest'. We are aware that the use of the word 'subject' has different connotations in the classical research context and it is not our intention to refer to persons undergoing police use of force as research subjects.

[ii] Dr. Merril Pauls is an ethicist and an emergency room physician, and a nationally recognized author of ethical literature, editorials and position papers.[64-67] Dr. Francis Rolleston, PhD, is an internationally known expert in ethics and participated in the development of the Tri Council Code of Conduct in the ethical treatment of study subjects.[68]

DOCUMENT CONTROL DATA

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The purpose of the study was to document the situational and subject specific characteristics surrounding police restraint in the Canadian population of persons who resist police interaction and undergo police restraint and to determine the outcome (mortality) proximal to police restraint for those persons. This report defines the scope of the study, the methodology, results, and impact of the body of knowledge for police forces in Canada and international communities. The report details the supporting data with tables, figures, and evidence- based conclusions. The report includes recommendations and way forward.

L'objectif de la présente étude est d'établir les caractéristiques situationnelles et particulières entourant la question des mesures de contrainte prises par la police sur les éléments de la population canadienne qui résistent à toute interaction avec la police et font l'objet de mesures de contrainte, et de déterminer les conséquences (décès) pouvant découler de l'application des contraintes en question sur ces personnes. Le présent rapport définit la portée de l'étude, la méthodologie, les résultats et l'impact de l'ensemble des connaissances pour les forces policières au Canada et ailleurs dans le monde. Il fournit en détail des données justificatives sous forme de tableaux, de figures et de conclusions fondées sur des preuves. Le rapport comprend en outre des recommandations et les prochaines étapes.

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Use of Force; Policing; Restraint; In-custody death; Excited delirium