

STUDENT CAPSTONE PRESENTATION PROGRAM



SATURDAY, APRIL 8TH, 2023



UNIVERSITY OF
TORONTO
MISSISSAUGA

**FORENSIC SCIENCE
PROGRAM**

THE 27TH ANNUAL FORENSIC SCIENCE DAY

ITINERARY & CONTENTS

8:30 AM REGISTRATION & COFFEE

Instructional Centre Atrium

9:00 AM OPENING REMARKS & WELCOMING ADDRESS

Remarks and presentations will be held simultaneously in IB110 and IB120.

Please refer to this program for each room's itinerary.

IB110: DR. TRACY ROGERS

Director, Forensic Science Program

Department of Anthropology, University of Toronto
Mississauga

IB120: DR. KAREN WOODALL

Acting Director, Forensic Science Program
University of Toronto Mississauga



**FORENSIC SCIENCE
PROGRAM**



THE 27TH ANNUAL FORENSIC SCIENCE DAY

ROOM ONE: IB110

Session Themes: Anthropology, Death Investigation, Psychology, The Justice System

9:10 AM **RESEARCH INTERNSHIP PRESENTATIONS**

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PhD Candidate, Department of Anthropology, University of Toronto

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PhD Candidate, Department of Anthropology, University of Toronto

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FORENSIC SCIENCE AT THE UNIVERSITY OF TORONTO MISSISSAUGA

The UTM Forensic Science Program attracts some of the brightest students from across the country and the world to take part in our unique educational experience. Applied learning, combined with a first class science degree, is the keystone of their education. All graduates of the Forensic Science Specialist Programs at UTM complete a capstone experience that applies their acquired skills and knowledge, preparing each student for the next step in their own unique career pathway.

Successful capstone experiences benefit the student, the mentor, and the agency through an exchange of ideas, learning opportunities, and new solutions for current problems.

Forensic Science Day is the culmination of these partnerships. The guidance of our mentors contribute to the growth of our students' professional skills, in combination with in-class experiences such as the submission process of ethics approval, job interview training, CV development, and a mock trial. Many of these students and their mentors present and/or publish their research at conferences and in peer-reviewed journals. It is our pleasure today to thank the mentors, and to praise the initiative and efforts of these exemplary students.

Today, we celebrate the hard work and success of our specialist degree students





FSC481Y5

**RESEARCH INTERNSHIP
IN FORENSIC SCIENCE
ROOM ONE: IB110**

SESSION CHAIR: SHELBY SCOTT

PhD Candidate, Department of Anthropology
University of Toronto

KAYLEE LUSTIG

Evaluating the ability of a human remains detection dog to locate human tissue in sub-zero temperatures – A case study

ABSTRACT

Purpose: This case study examined whether the use of human remains detection (HRD) dogs is a viable option to be utilized for searches in environments exposed to temperatures below 0° Celsius. Understanding the temperature limitations of HRD dogs is significant to determine if searches for human remains can be effectively conducted during the winter or if they require warmer conditions.

Background: Law enforcement agencies can utilize a canine's sense of smell to locate human remains, however, sub-zero temperatures can negatively impact the ability of HRD dogs to detect decompositional odours.

Methodology: Three PVC containers containing samples of human tissue were placed around a stormwater management pond. One sample was placed on the surface of the ground and two were submerged in water (depth = 3.8cm and 17.1cm). A fourth empty PVC container was placed on the ground to act as a control. The containers were left outdoors for 17 hours before a single HRD dog began searching for the samples.

Results: The HRD dog was able to accurately locate the ground sample and one water sample (3.8cm). The control PVC was ignored by the HRD dog. The handler was able to identify an area of interest for the second water sample (17.1cm) based on the behaviour of the dog.

Conclusion: Sub-zero temperature searches can allow for human remains and associated evidence to be recovered faster. Further research can examine additional temperature limits to allow for effective HRD searches year-round.

Keywords: forensic science, missing persons, decomposition, human remains, law enforcement, police canine, volatile organic compounds.

Supervisor: Mark Hansen, Detective Constable, Peel Regional Police Canine Unit

KATYA ISABELLA GODWIN

Metric sex assessment from the sternum: a non-population-specific method using computed tomography (CT)

ABSTRACT

Purpose: The purpose of this research was to develop a metric method for sex assessment from the sternum on individuals of unknown ancestry using post-mortem computed tomography (CT) scans from the New Mexico Decedent Image Database (NMDID). Although the sternum is not the most frequently recovered bone, having the ability to assess sex accurately regardless of element or ancestry contributes to identification. **Background:** Presently, all metric methods for sex assessment of the sternum are population specific. This method's development on CT scans makes it non-invasive and efficient in jurisdictions where post-mortem CT scans are conducted. **Methodology:** Five measurements of the sternum and manubrium were collected from 110 CT scans (55 male, 55 female) of known sex. Only individuals over the age of 25 were included; individuals with known pathology or abnormality were excluded. Inter- and intra- observer testing was conducted via an unpaired t-test. Univariate and multivariate discriminate function analysis was performed to obtain predictive equations for sex. All equations were cross validated. **Results:** T-tests conducted for inter- and intra-observer error shows no statistically significant difference between the original measurements ($p>0.05$) and the new groups. Accuracies of the univariate equations ranged from 64.5% to 82.7%. For multivariate equations, accuracies ranged from 71.8% to 81.8%. The cross-validated accuracies ranged 64.5% from to 81.8%. **Conclusion:** The results of the present study indicate that sex can be predicted with >80% accuracy in individuals of unknown ancestry.

Keywords: forensic science, forensic anthropology, sex assessment, computed tomography, biological profile.

Supervisor: Shelby Scott, Ph.D. Candidate, Forensic Science Program, University of Toronto Mississauga

Estimating adult age using CT scans of the proximal femur

ABSTRACT

Purpose: This research aims to determine if Kim's scoring method of adult age estimation can be converted to CT scans from radiographs. This would allow for greater accessibility and adaptability when performing age estimation. **Background:** Estimating age at death is an important aspect in the identification process of remains. Though many methods rely on the pelvis when assessing age postcranially, Kim's method analyzes and scores traits of femoral radiographs (cortical bone, primary and secondary trabeculae, medullary cavity, cavitation). **Methodology:** To test this, 120 CT scans (60m, 60f) from the NMDID were analyzed and scored. The accuracy and inaccuracy values from these scores were compared through two series of chi-square tests, one comparing imaging technologies, the other comparing sex. **Results:** From this study traits demonstrated acceptable levels of accuracy (greater than 80%) and interobserver error (less than 10%) with the exception of cavitation (Accuracy; cortical, 83.3%; primary trabecular, 86.7%; secondary trabecular, 81.7%; medullary cavity, 84.2%; cavitation 75.8%)(Interobserver error; cortical, 1.0%; secondary trabecular, 7.7%; medullary cavity, 5.8%; trabecular bone, 18.2%; cavitation, 11.6%). Chi-square tests demonstrate that accuracy obtained using radiographs (Kim) versus CT (Novogradac) are all significantly different except cortical bone, whereas there was no significant difference noticed when testing for sex (males vs females). **Conclusion:** Kim's method can be successfully converted into CT scans. All but cavitation meets the accuracy threshold. There is a decrease in accuracy between CT and radiograph, likely due to the difference in population.

Keywords: forensic anthropology, forensic identification, adult age estimation, scoring methodology, biological profiling

Supervisor: Tracy Rogers, Associate Professor; Forensic Science Program Director, University of Toronto Mississauga

SAMANTHA RIBEY

Evaluating summary skeletal age at death methods using the proximal femur

ABSTRACT

Purpose: The purpose of this research was to establish a standardized way to combine age ranges from summary age estimation methods using Kim 2022. This was accomplished by evaluating three different approaches to combining trait scores, using radiographs of the proximal femur from the UTM Radiograph Database, to determine which offered the most accurate/precise final age interval. Establishing a standard for the discipline is significant to ensure that there is regulation of results obtained. **Background:** Kim revised a 5 trait summary age method to create clearer trait descriptions and more statistically defined age ranges, as previous methods have shown poor interobserver reliability. The approaches evaluated using Kim's method included the averaging, high/low, and point with standard deviation. **Methodology:** The sample for this research consisted of radiographs of the proximal femur (n = 50) of individuals 19-99 years old from the UTM Radiograph Database. Accuracy was measured by whether the true age fell within or outside of the final age interval. Precision was measured by the narrowness of the final age interval. Accuracy was weighed more heavily than precision for identification purposes. **Results:** The averaging approach is the most accurate (96%) when using Kim's method. Both the high/low (44%) and the point with standard deviation (60%) approaches failed to meet accuracies acceptable in forensic anthropology (>80%). **Conclusion:** This study provides a framework for standardizing the combination of age ranges in age estimation. Future research should focus on testing different methods of summary age estimation.

Keywords: forensic science, forensic anthropology, age estimation, summary age, proximal femur, radiographs

Supervisor: Tracy Rogers, Associate Professor; Forensic Science Program Director, University of Toronto Mississauga

SAMANTHA PAVLIDIS

Mandibular placement for facial approximation generation of mandible-less remains

ABSTRACT

Purpose: The purpose of this research is to develop an easy method of mandible estimation for facial approximation generation by analyzing the alignment of mandibular and facial landmarks in a sample of individuals from the same sex and ancestry. This research is significant, as it will provide forensic artists with an accurate and easily understandable/utilizable method, without needing a scientific background. **Background:** Facial approximations are reliant on the presence and condition of the bones of the skull. However, missing mandibles are common in forensic cases and there are no accurate or easy methods for mandible estimation. The most commonly used method was proposed in 1957 for orthodontic treatment.

Methodology: 18 adult European male skulls with little to no damage were examined. From each skull, 5 mandibular and facial landmark alignments were taken (mandibular symphysis, lateral surface of ascending ramus, lateral most point of mandibular body, chin point(s), and mental foramen) and compared. **Results:** Notice

able patterns in all 5 alignments were observed. There were similarities in over 75% of the sample for each mandibular landmark alignment. **Conclusion:** Using mandible exemplars for each sex and ancestry, the patterns in this study can be used to align exemplars with the cranium of an individual as a general guideline for the facial approximation generation. Future research must be done into creating or obtaining these exemplars as well as testing the method with forensic artists to determine its accuracy and validity.

Keywords: forensic science, forensic artist, facial approximation, facial landmark alignment, forensic art, mandible estimation

Supervisor: Duncan Way, Detective Constable, Forensic Artist, Peel Regional Police

Proposing amber as a substitute for formalin preservation

ABSTRACT

Purpose: The purpose of this research is to propose amber as a substitute for formalin through the evaluation of tissue shrinkage. The significance of this is to provide a safer, more efficient preservation solution for forensic pathology. **Background:** Formalin is a carcinogen known to cause swelling, shrinkage, and discolouration of tissue, leading to inaccurate or false diagnoses. Amber consists of low potassium dextran glucose, honey, and coconut oil, effectively preserving the cellular composition of tissues while preventing natural processes of decay. **Methodology:** Five deceased individuals provided one skin, muscle, and fat tissue each ($n=15$). The tissues were cut in half widthwise and measured by their length, width, and height. One half of the tissue was placed in amber and the other respective half was placed in formalin. The tissues were measured by their length, width, and height again after 24 hours and 48 hours of tissue preservation. **Results:** With a set level of significance of $p=0.01$, Wilcoxon paired signed rank tests indicate that formalin causes statistically significant differences in tissue dimensions after 24 hours ($W=-1003$, $p=<0.0001$) and 48 hours ($W=-1001$, $p=<0.0001$). Wilcoxon paired signed rank tests indicate that amber causes statistically significant differences in tissue dimensions after 24 hours ($W=-570.0$, $p=0.0006$), and a statistically non-significant difference after 48 hours ($W=-363.0$, $p=0.0399$). **Conclusion:** amber provided superior results to formalin regarding tissue loss, allowing for the proposal of amber as an alternative for formalin where tissue loss is a concern.

Keywords: forensic science, forensic pathology, amber, biomedical engineering, formalin, tissue preservation, tissue shrinkage

Supervisors: Diana Vucevic, MSc. Candidate, University of Toronto; Kieran Murphy, M.D., University Health Network

CASSIDY FERGUSON

Affect of embalming fluid on Osteopontin in human bone

ABSTRACT

Purpose: The purpose of this research is to determine if embalming fluid preserves Osteopontin in human bone, by comparing bone protein intensity in embalmed versus unembalmed remains through confocal microscopy and imaging software's such as Image-J and Carl Zeiss Zen, in order to determine the research uses of embalmed remains in forensic anthropology. **Background:** There is no previous research on the affect of embalming fluid at the histological level. There are areas that pose potential issues and potential benefits with the preservation of bone proteins when using embalmed remains in research. **Methodology:** Seven embalmed samples (from cadaver donors), and eight unembalmed samples (from live biopsies) were collected from the left iliac crest. The samples were labeled with Osteopontin antibody and AlexaFluor 555 stain. They were visualized under the confocal microscope and processed in Image-J to compare mean pixel intensity and protein count in each sample. **Results:** The average mean protein intensity in the unembalmed samples was 2110.93 (unitless). The embalmed samples will either reflect a similar or lower value through comparative tests. **Conclusion:** The threshold of protein intensity set by the unembalmed samples provides a method of determining how remains are used. If the embalmed samples are below the threshold, the remains do not show protein preservation, and therefore are beneficial for age estimation or post-mortem interval studies. If the embalmed samples are at a similar level as the threshold, then proteins have been preserved, and therefore are beneficial for fractology studies.

Keywords: forensic science, forensic anthropology, pathology, embalming, histology, protein preservation, Osteopontin

Supervisors: Ashley Smith, PhD Candidate, University of Toronto Mississauga; Tracy Rogers, Forensic Science Program Director and Associate Professor, University of Toronto Mississauga

LUCA DE GIACCO

Infant mortality rate at the Barrack Hill cemetery

ABSTRACT

Purpose: The purpose of this research is to evaluate infant mortality within a subset of the Barrack Hill Cemetery to determine if infant mortality rates follow a pattern of occurrence across culturally and temporally similar constraints. **Background:** The rate of infant mortality may provide insights into the surrounding life experience of parents and children as well as the sociocultural aspects of a community. It is well understood that subadults are poorly represented in the archaeological record; however, they are critical to understanding socially constructed and historically contingent steps in an individual's life course. **Methodology:** 66 bags of fragmented and commingled human skeletal remains were sorted and categorized by age grouping. A series of photographs were taken of each skeletal element along with detailed annotations. The minimum number of individuals (MNI) was calculated for subadults (N=33) and adults (N=87). Each subadult element was provide an age estimation using various metric and morphological assessment techniques. **Results:** The chi-squared test for independence has illustrated an association between Bow Baptist Church, Sheen's Burial Ground, and St. Mary & St. Michael's Burial Ground each compared to Barrack Hill. The adjusted residuals indicate the association primary lies within the 1–5-year age category irrespective of region. **Conclusion:** An association exists between burial ground and age category within 1-5 years. This is likely caused by despositional factors and disease prevalence with communities. Further historical and archaeological research are needed to understand the inconsistencies observed in subadult deaths

Keywords: forensic science, forensic anthropology, bioarchaeology, commingling, rate of infant mortality, subadults

Supervisor: Janet Young, Curator of Physical Anthropology, Canadian Museum of History

Factors contributing to the unintentional collection of ancestral bone during bone recovery

ABSTRACT

Purpose: The purpose of this research is to determine the taxon and context (location) contributing to the primary confusion of ancestral bone using the Holly legacy faunal collection to improve initial detection and prevent unintentional removal of ancestral bone from Huron-Wendat archaeology sites in Ontario. This research can aid archaeologists when discussing potential ancestral bones with Forensic Anthropologists, and further repatriation. **Background:** Ancestral and faunal bone are commonly conflated due to similar morphology. While The Huron-Wendat are known to bury their ancestors in ossuaries predicting context, but animal scavenging and age affect this prediction. **Methodology:** Two stages focused on larger fragments for morphology comparisons. First, faunal bones were sorted into five taxonomic classes, isolating potential ancestral bones using morphology assessments. Next, the isolated bones were further examined and identified as either ancestral, an identifiable mammalian species or unidentifiable, then assessed for animal scavenging. **Results:** No ancestral bones were found among the 4,197 sorted and 104 isolated. A statistical significance was noted between the context and the presence of scavenging ($p=2.7896E-0.5$, $p<0.05$), with Cramer's V indicating a moderate association ($v=0.48274$). **Conclusion:** Relationship between scavenging and context indicates animal scavenging can impact the context in which faunal bones are found, contributing to the primary confusion. More research and discussion will contribute to the unintentional removal of ancestral bone and the finishing of the Holly legacy collection itself.

Keywords: bioarchaeology, zooarchaeology, anthropology, faunal, forensic anthropology, Huron-Wendat, indigenous

Supervisors: Alicia Hawkins, Associate Professor, University of Toronto Mississauga; Trevor Orchard, Anthropology Lab Technician, University of Toronto Mississauga

COFFEE BREAK

Brief intermission, presentations resume at 11:10 AM



VERONICA UMEREZ

Missing persons and unidentified remains metadata management project

ABSTRACT

Purpose: This research aims to determine the similarities and differences in the standard operating procedure (SOP) submission process of missing persons (MP) agencies. This will be completed by identifying fields of information and compiling them into a table. This project will help create a seamless transition of information in a standardized format. This research is significant because it will create more predictable workflows and simplified processes. **Background:** SOPs are routine procedures each agency sets out to follow, to improve quality and operations. Different agencies utilize multiple forms as SOPs for their unidentified remains (UI) and MP cases, all of which are in various formats. **Methodology:** SOPs from eight MP agencies were analyzed for the fields of information present, to be compiled into a table. In-depth analyses were conducted on commonalities, which were fields that were present on more than one form. A proposed entry format for a specific field was recommended based on what can aid in the reduction of time and potential error. **Results:** A total of 393 fields were present, where 80 were commonalities. The data reveals that the majority of fields were manually entered in a text box, thus, proposed formats were suggested where possible. **Conclusion:** This research is the preliminary step to improving workflow in regard to SOPs of UI and MP cases. There is potential for this project to be integrated into a database to help reduce time, limit error, and provide standardization.

Keywords: forensic science, metadata, missing person, standard operating procedure, unidentified remains, workflow

Supervisors: Bonita Anders, Senior Manager, Ontario Forensic Pathology Service; Gabrielle Lee-Inniss, Forensic Service Technologist, Ontario Forensic Pathology Service

Anemia of a genetic etiology and its pathognomic signs

ABSTRACT

Purpose: To examine the relationship between anemia of a genetic etiology and potential pathognomic signs that would differentiate it from iron-deficiency anemia or other non-genetic causes in skeletal human remains. In forensic investigations, decedent remains can be highly decomposed. The ability to identify signs of genetic disease may allow investigators to narrow down a pool of missing persons and may provide a basis from which the identification processes can begin. **Background:** Information obtained from skeletal material can be a possible identifier in forensic cases. Along with genetic information, structural information, such as deformities in the skeleton, can be obtained from the remains. For example, Thalassemia is a condition in which changes in gross anatomical structure are common; variation from 'normal' histomorphometric measurements of bone can indicate the presence of anemia. Furthermore, genetically mediated anemia may also result in the deposition of iron in remodelling bone, providing evidence of a genetic condition.

Methodology: The sample consists of 10-15 archaeological samples of ribs from individuals excavated at the 3rd-4th century site known as Apollonia. Thin sections of samples were made and stained using Prussian Blue stain, which indicates the presence of iron. The bones were visualized under a light microscope, and histomorphometric measurements were taken. **Results:** Analysis is ongoing, however, currently it appears that the Prussian Blue stain is adhering to bone cement lines. **Conclusion:** Pending quantification, analysis of staining indicators, and histomorphometric results will determine the significance of this finding.

Keywords: forensic science, forensic anthropology, iron-deficiency anemia, thalassemia, Prussian Blue stain, histomorphometry,

Supervisor: Lelia Watamaniuk, Sessional Instructor, University of Toronto Mississauga

KARL VIEBOCK

Incidence of nitazene compounds within Ontario death investigation

ABSTRACT

Purpose: The purpose of this research is to analyze Coroners' death investigations in Ontario between 2021-05-30, and 2022-04-30 noting the incidence of nitazenes in toxicology analyses and the relation to cause of death (COD), in order to inform further research.

Background: Nitazene compounds (2-benzylbenzimidazole) were first identified in Toronto's unregulated drug supply May of 2021. Between October and December of 2021, 16% of fentanyl samples in Toronto noted additional nitazene presence, 24% of which were linked to an overdose. Presenting log P values of 4.1-5.1 in comparison to 4.28, etonitazene and Isotonitazene possess a lipophilicity analogous to fentanyl. High lipophilicity increases the rate of penetration of the substance into the central nervous system, reducing the ability for intervention, leading to overdose. **Methodology:** By analyzing 3270 cases present across the Ontario Coroner Death Investigation Systems (QuinC and CIS) between 2021-05-30, and 2022-04-30, the age, sex, region of death, direct location of death, COD, presence/absence, and concentration of nitazene compounds were collected. **Results:** Full statistical analyses of the results are pending. The preliminary statistics display that 0.026% of all drug toxicity cases included a nitazene compound, 19.77% were included in the cause of death (COD), and 5.81% were noted as a possible COD in addition to other substance. **Conclusion:** Initial data implies a possible under-reporting of nitazenes in the CODs subsequently causing the data to not be accurately registered within the population mortality rate data, removing information necessary for public health safety.

Keywords: forensic science, forensic pathology, forensic toxicology, cause of death, death investigation, nitazene, Ontario

Supervisor: Linda Kocovski, Forensic Pathologist, Ontario Forensic Pathology Service.

AMY PARK

Investigating the prevalence of cannabis in work-related deaths in Ontario during periods before and after cannabis legalization.

ABSTRACT

Purpose: The purpose of this research is to examine work-related deaths from October 16, 2014, to October 16, 2022. This results in an 8-year period, 4 years before cannabis legalization and 4 years after cannabis legalization. The research will be conducted through the data collection of retrospective case files. This research aims to determine a baseline for all work-related deaths in Ontario during the 8-year period as well as determine if there are avenues to improve public health and safety. **Background:** Cannabis was legalized on October 17, 2018, under the Cannabis Act. Delta-9-tetrahydrocannabinol (THC) is the psychoactive constituent of focus. A work-related death is any death that occurs at a workplace in Ontario. **Methodology:** Over the course of 10 weeks, data was collected on-site at the Ontario Forensic Pathology Service on an Excel file. The case files were derived from two online databases: CIS and QuinC. All data was aggregated to ensure anonymity and confidentiality. The variables of interest were year of death, sex of decedent, age of decedent, occupation of decedent, manner and cause of death classification, and THC presence. **Results:** There were a total of 1616 work-related deaths in Ontario during this 8-year period. The statistical analysis for this research is still ongoing. **Conclusion:** Although no official conclusions can be drawn at this time, a baseline for all work-related deaths in Ontario has been established.

Keywords: forensic science, forensic pathology, cannabis, Ontario, THC, workplace death, work-related death

Supervisor: Linda Kocovski, Forensic Pathologist, Ontario Forensic Pathology Service.

Current beliefs on ethical conduct regarding DNA sources: a critical literature review

ABSTRACT

Purpose: This research aims to establish the nature and degree of knowledge that exists regarding the ethical treatment of DNA sources collected during a medicolegal autopsy, and considerations in maintaining the privacy of personal decedent information within a medicolegal context. **Background:** Legal standards outline the parameters in which medicolegal practitioners are allowed to operate, while ethical guidelines contemplate whether practitioners should implement further criterion. Discourse between legal and ethical standards creates ambiguity that has posed an ongoing controversy within medicolegal investigations. **Methodology:** This study gauged the number of articles that exist regarding the ethical treatment of DNA sources through a scoping review within PubMed and Google Scholar. Once identified, an article's relevancy to the research question was assessed. Articles underwent a critical literature review, where discussed themes regarding the ethical treatment and analysis of either human tissue samples and/or genetic information was documented through a meta-analysis. **Results:** Out of the 149 total articles identified through the scoping review, 27 were included within the critical review, which revealed a total of 9 major themes. The critical review also identified DNA source analogs in terms of policy content, the most notable being dried blood spots collected for clinical testing. **Conclusion:** This research marks one of the first successful attempts at identifying and critically analyzing pre-existing literature to supplement discussions regarding the ethical treatment of DNA sources in a medicolegal context.

Keywords: forensic science, forensic pathology, DNA source, ethics, medicolegal autopsy

Supervisors: Amber Manocchio, Manager of Forensic Evidence, Ontario Forensic Pathology Service; Richard Pang, Forensic Services Technologist, Ontario Forensic Pathology Service

PHILLIPA OXLEY

Determining the limitations of ANDE Rapid DNA

ABSTRACT

Purpose: The purpose of my research is to determine the factors that affect the success of a feasible ANDE™ ID profile. This will be done using case data provided by the Ontario Forensic Pathology Services (OFPS). The variables being tested are sex, age, postmortem interval (PMI), weight, sample type, cause of death (COD), condition of body, insect/animal activity, and environment. The goal of this research is to establish the limitations of ANDE™ Rapid DNA technology and methodology. **Background:** ANDE™ Rapid DNA is a relatively new technology and requires thorough research before being implemented into the field of forensics. ANDE™ has been applied to casework and been successful in instances of disaster victim identification (DVI) scenarios, along with tests to determine its reliability and reproducibility. Currently, the OFPS uses ANDE™ for tentatively identified individuals when no other methods of positive identification are available. **Methodology:** In this research 22 cases were sent for DNA analysis through ANDE™. The data was collected through the database 'FPATH' where the variables were organized into EXCEL. The cases were organized by each variable sequentially from when the decedents were first processed by the OFPS. **Results:** Odds Ratio statistical tests showed the variables had a significant likelihood of producing a successful ANDE™ DNA profile. **Conclusion:** The motivation of this research is to establish a standard protocol regarding the best cases to apply the use of ANDE™. By implementing ANDE™ into forensics it could lead to an overall increase in correct identification of deceased individuals.

Keywords: forensic science, forensic pathology, forensic anthropology, forensic biology, forensic identification

Supervisors: Kylee Best, Forensic Human Remains Analyst Identification Team, Ontario Forensic Pathology Services; Constance Bradley, Forensic Autopsy Services Manager, Ontario Forensic Pathology Services

LUNCH BREAK

A 60 minute recess at the Blind Duck Pub, UTM Student Centre.



**Forensic Science Day resumes at 1:30 PM
with the Poster Session in the Atrium of the (IB)
Instructional Centre**

POSTER SESSION

30 minutes in the Instructional Centre Atrium.



Speaker presentations resume at 2:00 PM

JULIA (TZU HSUAN) TANG

Factors of wrongful convictions in Canada and the United States of America

ABSTRACT

Purpose: The purpose of this study was to determine whether there are systematic factors causing wrongful convictions in Canada and the United States of America. The significance of the study was to provide resources on factors causing wrongful convictions, mitigate miscarriages of justice, and assist the legal system in remaining fair and effective. **Background:** There is limited literature on wrongful convictions following cases convicted in 2013. This research will provide resources on recent convictions. The research is interested in the following 6 factors: official misconduct, false confession, mistaken eye-witness identification, false or misleading forensic evidence, perjury or false accusation, and inadequate legal defense. **Methods:** The research examines 15 of the most recent Canadian and American wrongfully convicted cases by coding Court decisions and using the National Registry of Exonerations. The factor of the wrongful conviction was documented on a google sheets. **Results:** Chi-square results indicate that no factor is more prominent in either of the legal systems $\chi^2(5, N = 55) = 8.48, p=.132$. No statistically significant difference was observed. **Conclusion:** None of the six factors of wrongful convictions occurred statistically more or less in either of the legal systems. Based on descriptive statistics, official misconduct was seen as the most prominent factor of wrongful convictions with 42.8% in Canada, and 29.6% in America. The least prominent factor in both countries was false confessions, 3.57% in Canada and 11.1% in America.

Keywords: wrongful convictions, American legal system, Canadian legal system, factors of wrongful convictions, miscarriages of justice

Supervisor: Craig Fraser, Ontario Review Board, University of Toronto Mississauga, Ontario Ministry of the Attorney General

Determining the risk factors of wrongful convictions in Canada

ABSTRACT

Purpose: The purpose of this research is to determine if different crime categories are more susceptible to certain wrongful conviction risk factors in Canada. A better mapping of crime specific risk factors is an important aspect of understanding what drives wrongful convictions. **Background:** There has been limited research into wrongful convictions in Canada, partially due to a lack of complete data about the scope of the problem and its causes in Canada are currently unknown as it is extremely difficult for incarcerated individuals to establish innocence. Exonerations are the most trustworthy measure of quantifying wrongful convictions.

Methodology: Court transcripts and case summaries were retrieved from a total of 102 Canadian criminally exonerated individuals and created a dataset by coding each case for demographics, crimes, wrongful conviction contributors, etc. **Results:** Official misconduct was the most prevalent risk factor and was observed in 75.49% of wrongful conviction cases. Chi-square test of independence indicated there is no statistically significant relation between type of crime and the various identified risk factors ($\chi^2=14.70$, d.f.=12, $p\text{-value}=0.258$).

Conclusion: It can be concluded that each type of crime is equally susceptible to each wrongful conviction risk factor.

Keywords: forensic science, Canada, exonerations, risk factors, wrongful convictions

Supervisor: Rasmus Rosenburg Larsen, Assistant Professor, University of Toronto Mississauga

How age plays a role in Canadian cases of wrongful conviction

ABSTRACT

Purpose: The purpose of this research is to examine how exoneree age plays a role in Canadian exonerations by reviewing trial transcripts. This research is significant as few studies have examined misconduct in youth court cases. **Background:** Most wrongful conviction research involving young offenders focuses on false confessions due to the suggestibility associated with ongoing cognitive development. **Methodology:** A sample of youth ($n = 68$) and adult ($n = 100$) exonerees were identified using LexisNexis and coded according to the National Registry of Exonerations (NRE). The NRE captures demographic and misconduct data related to the conviction. After data collection, a chi-square test and odds ratio were used to determine the difference in misconduct between youth and adult samples. Finally, interrater reliability was calculated for the five coders working with this dataset. **Results:** The most common causes of misconduct were judicial misconduct (for youth cases), and police misconduct (for adult cases). There was a significant difference between both samples when looking at the type of crime committed. Adult exonerees were more likely to have been wrongfully convicted of murder, and youth or juvenile exonerees were more likely to have been wrongfully convicted of burglary/unlawful entry and traffic offences. Furthermore, wrongful conviction cases involving adults were more likely to involve all misconduct factors, excluding judicial misconduct. **Conclusion:** Judges should receive additional training for cases involving young offenders to prevent future wrongful convictions.

Keywords: forensic science, exoneration, forensic psychology, young offenders, wrongful conviction

Supervisor: Rasmus Rosenburg Larsen, Assistant Professor, University of Toronto Mississauga

Wrongful convictions in Canada: A critical analysis of mistaken eyewitness identification and race

ABSTRACT

Purpose: The purpose of this study is to determine how mistaken eyewitness identification (MWID) and race contribute to wrongful convictions. Analyzing exonerations can highlight underlying trends to combat cognitive biases in the legal system. **Background:** 50% of American exonerations caused by MWIDs involve cross-racial identification (Garret, 2017). Due to a lack of comparable research, it is unknown if the frequency is similar in Canada. Analyzing Canadian exonerations for indicators of CRE should fill this gap.

Methodology: 82 Canadian exonerees were identified, excluding pending cases and federal pardons. Case summaries were located using online legal databases and news outlets, and coded according to the code manual of the National Registry of Exonerations and documented on Google Sheets. **Results:** The data suggests that 32.93% of Canadian exonerations are due to MWIDs. There is a higher rate of MWIDs in white exonerees (62.96%) than any other race (Indigenous = 14.81%; Black = 3.70%; Asian, Hispanic, biracial, other = 0.00%). Race of the suspect was unknown in an alarming number of cases (18.52%). Complete statistical analysis is pending. **Conclusion:** The findings support the importance of understanding CRE to prevent wrongful convictions since racial differences in MWID clearly exist. A limitation is the lack of information regarding eyewitness race. This information should be documented since CRE cannot be addressed if it cannot be measured. Further research must be conducted to identify if CRE is a major underlying cause of wrongful convictions.

Keywords: forensic science, forensic psychology, cross-racial effect, exonerations, mistaken witness identification, race, wrongful convictions

Supervisor: Rasmus Rosenburg Larsen, Assistant Professor, University of Toronto Mississauga

Investigation of influence from disguise-usage by perpetrators and the weapon-focus effect on eyewitness misidentification

ABSTRACT

Purpose: To investigate whether disguise-usage by perpetrators and the weapon-focus effect contribute to eyewitness misidentification in Canadian wrongful convictions. This research contributes information to under-researched areas of Canadian wrongful convictions.

Background: Current Canadian information is based on few high-profile cases such as the Sophonow Inquiry. This research includes variety to improve generalizability. The weapon-focus effect is consistently observed in laboratories, but validity has been lacking for uncontrolled environments. **Methodology:** The coding manual used to create The National Registry of Exonerations was followed. A database was created by searching LexisNexis Quicklaw and the internet, to identify Canadian exonerees and manually code each case for wrongful conviction and eyewitness misidentification factors. Those with eyewitness involvement were included in the sample of 35.

Results: The Chi-Square test of independence indicates a significant influence of weapon presence on eyewitness misidentification ($\chi^2 = 7.056178052$, $p\text{-value} = 0.007899234519$, $d.f = 1$). There was insufficient data to statistically analyze disguise cases. **Conclusion:** The weapon-focus effect influences eyewitness misidentification in Canadian wrongful convictions, however replication is needed with larger sample sizes. With replication and identification of more influences, a technique for calculating the probability of eyewitness misidentification is a possibility. Disguise cases involved alternate mishandlings of eyewitness evidence.

Keywords: forensic science, forensic psychology, wrongful convictions, eyewitness misidentification, weapon-focus effect, disguise-usage

Supervisor: Rasmus Rosenburg Larsen, Assistant Professor, University of Toronto Mississauga

Conditions of correctional facilities in Canada and their effects on recidivism rates

ABSTRACT

Purpose: The purpose of this research was to examine the current conditions in the physical and social environments at correctional facilities in Canada and determine their impact on the recidivism rates of inmates. The research was conducted to get a better understanding of which conditions promote a decrease in recidivism rates, which would mean increased public safety and decreased social and personal costs. **Background:** Certain factors in the social and physical environments of a person can increase the chance that this person will reoffend. Harsh physical environment, insufficient healthcare, abusive attitudes towards inmates from guards, and human rights violations of inmates are linked with an increased chance of reoffending. Therefore, certain conditions within correctional facilities may predispose inmates to continue committing crimes. **Methodology:** The sample of the research consisted of 27 correctional facilities. The research used the PRISMA approach for conducting systematic reviews. After the published documents were collected, the conditions and recidivism rates of each facility were identified. **Results:** The results of the Chi-Square analyses showed that the relationship between the conditions and recidivism rates is not significant ($\chi^2 = 4.53$, $df=8$, $p=0.8$). Conditions in correctional facilities are not a factor in predicting recidivism rates. **Conclusion:** Future research should focus on expanding the sample size and locating more recent data on recidivism rates in Canada. Also, other factors might be more significant in predicting recidivism. For example, the availability and quality of community environment and social support.

Keywords: forensic science, forensic psychology, correctional facilities, conditions, recidivism rates

Supervisor: Jose Sanchez, Sessional Lecturer, Forensic Science Program, University of Toronto Mississauga

COFFEE BREAK

Brief intermission, presentations resume at 3:15 PM



Incarceration and access to mental health services by race and sex

ABSTRACT

Purpose: The purpose of this research is to determine if there are significant differences in mental health access based on gender and ethnicity in those incarcerated with severe mental illness in the GTA. This research is significant, as it will help health care and law professionals understand how social determinants impact incarcerated individuals that have been diagnosed with severe mental illnesses and who are ethnic minorities. **Background:** Ethnic minorities and those diagnosed with severe mental health disorders are vastly overrepresented in the Canadian justice system and unique social determinants of health play a large role in the incarceration of these populations. **Methodology:** The sample population consisted of individuals referred to the Forensic Early Intervention Service (FEIS) from two jails in Toronto (n=5174) who completed the Jail Screening Assessment Tool (JSAT). Relationships between ethnicity, sex and prior access to mental health care were analysed for significance using Chi-squared test ($p < .05$). **Results:** Chi-Squared Tests showed a significant relationship was found between access to mental health care and ethnicity in both male and female populations, $X^2 (5, N = 3646) = 0.004, p < .05$ and $X^2 (3, N = 993) = 0.021, p < .05$, respectively). **Conclusion:** While a relationship exists between gender and access to mental health care as well as ethnicity and mental health care, there is potential in researching other social determinants of health that may negatively impact these populations such as employment, education levels, and income.

Keywords: forensic science, forensic psychology, ethnicity, incarceration, mental health, severe mental illness, sex, Toronto

Supervisor: Cory Gerritsen, Clinical Psychologist, Centre for Addiction and Mental Health

Barriers to accessing psychiatric services prior to NCR verdict

ABSTRACT

Purpose: The purpose of this research is to determine differences between individuals who did and did not access psychiatric services prior to coming under the purview of the Ontario Review Board. This was done by examining hospital reports from all individuals who have been admitted to a psychiatric hospital after being found Not Criminally Responsible on the basis of mental disorder (NCR) from March 1, 2022, to August 31, 2022. This was used to understand the barriers to accessing psychiatric services before an offence is committed and to inform how those services could better aid the underserved population. **Methodology:** Reports were assessed, and the variables examined included sex; age; primary, secondary, and tertiary diagnoses; primary and secondary index offences; prior contact with the criminal justice system, and prior contact with psychiatric services. These variables were analyzed using chi-square testing to examine the impact of each on the psychiatric history of the individual. **Results:** Chi-square tests have indicated that the obtained primary diagnosis is a statistically significant factor that impacts whether an individual had prior access to psychiatric services ($p = 0.002$, d.f. = 8). Additional chi-square results have indicated that no other variable impacted prior access to psychiatric services in a statistically significant manner. **Conclusion:** Understanding how psychiatric symptoms enable an individual to be more likely to receive help can inform on how to provide all individuals with equal access to psychiatric services prior to obtaining a verdict of NCR.

Keywords: forensic science, forensic psychiatry, forensic psychology, not criminally responsible

Supervisor: Justice Richard Schneider, Chair of the Ontario Review Board

ZARYA POWELL-THOMPSON

Toxic psychosis in relation to not criminally responsible on account of mental disorder

ABSTRACT

Purpose: To determine the symptoms and features informing the courts as to whether someone who commits an offence while toxically psychotic is acquitted, found criminally liable, or NCR. This was done by reviewing the decisions of the courts. This research assists in developing consistency in the law and with the incorporation of the clinical understanding of the psychiatric impact of mind-altering substances. **Background:** Substance/medication-induced psychosis is marked by hallucinations and/or delusions. Toxic psychosis is reality-testing problems caused by drugs, chemicals, or intrinsic metabolic states. A person is NCR if, due to mental disorder, they could not appreciate the nature and quality of the crime or did not know it was wrong. **Methodology:** Using LexisNexis, 100 cases from the Canadian courts concerning a defendant with an experience of crime and toxic psychosis between 01/01/2000 and 01/01/2023 were identified. **Results:** 2% acquitted, 18% NCR, and 80% convicted. 95% were male. 52% had a diagnosis of substance/medication-induced psychosis. 3% were under 18, 5% were 18/19, 22% in their 20s, 22% in their 30s, 11% in their 40s, and 2% in their 50s. 73% had a history of substance use and 62% of mental illness. Notable drugs involved include alcohol (36%), cocaine (31%), methamphetamine (30%), and cannabis (27%). There was a statistically significant result for verdict and diagnosis ($\chi^2 = 7.61$, $p = 0.02$). **Conclusion:** This research has the potential to aid the courts in future decision-making, as well as guide future research directions.

Keywords: forensic science, forensic psychology, crime, drugs, not criminally responsible, substance/medication-induced psychotic disorder, toxic psychosis

Supervisor: Michael Feindel, Assistant Crown Attorney, Ontario Review Board

Psychiatric diagnosis and Ontario Review Board duration

ABSTRACT

Purpose: The purpose of this research is to determine the average time that an accused found not criminally responsible (NCR) spends under the Ontario Review Board (ORB) based on psychiatric diagnosis and interactions between diagnosis, index offences and breaches of disposition orders, using 2005-2020 judicial decisions. This is significant as it provides insight into ORB decisions and helps the accused plan post-discharge support. **Background:** There is a lack of understanding from the general public and those directly involved with the ORB on the factors involved in judicial decisions. Ontario specific research into ORB durations is limited. **Methodology:** Data came from 254 randomly selected judicial decisions from Lexis Quicklaw, using search terms "verdict of NCR AND absolute discharge" and "it is ordered that the accused be discharged absolutely." The psychiatric diagnosis, diagnostic category, index offence severity, breaches of disposition order severity, and the duration under the ORB in months, was extracted from the decisions. **Results:** The average in months for disorders ($n=30$) and diagnostic categories ($n=5$) were calculated. The only significant differences in post-hoc analysis related to personality disorder ($F=6.08$, $d.f.=4$, $p<.001$). ANOVAs found no significant interaction between diagnostic category and index offence severity ($F=.08$, $d.f.=4$, $p=.988$), and a significant interaction between diagnostic category and breaches of disposition order severity ($F=5.8$, $d.f.=8$, $p<.001$). **Conclusion:** The results suggest that future research on ORB duration should focus on psychiatric diagnostic category and severity of breaches of disposition orders, with a larger sample size.

Keywords: forensic science, forensic psychology, breaches of disposition orders, index offence, psychiatric diagnosis

Supervisor: Liesha Earle, Assistant Crown Attorney, Ministry of Attorney General



FSC481Y5

**RESEARCH INTERNSHIP
IN FORENSIC SCIENCE
ROOM TWO: IB120**

SESSION CHAIR: GRACE GREGORY ALCOCK

PhD Candidate, Department of Anthropology
University of Toronto

CAMILLE ZANETTI

Utilizing thermal imaging to analyze thermal traces on car seats for forensic applications

ABSTRACT

Purpose: The purpose of this research is to determine if the sitting period will affect the duration of time that thermal traces last on different types of car seat materials by utilizing a thermal imaging camera that detects infrared radiations. This research is significant as it may aid in the development of a method that can be used at vehicle collision scenes to identify the number of passengers involved and their minimum sitting period before the collision based on their thermal traces. **Background:** During physical contact, heat from a body will transfer over to an object leaving behind a thermal trace, which eventually disappears. Thermal imaging cameras are used to visualize heat emissions, including thermal traces, however, no studies thus far have examined its forensic implications on car seats. **Methodology:** An individual sat on leather, faux leather, and nylon car seats for six different time periods each (5-30 mins) (n=18). The Bullard QXT thermal imaging camera was used to visualize the thermal traces and their duration period was recorded. **Results:** Spearman's Rank Correlation tests showed very strong positive correlations between the sitting periods and the duration that the thermal traces lasted for each of the car seat materials ($r_s=1$, $p=0.0028$). Statistically significant results were obtained ($p<0.05$). **Conclusion:** The relationship between the sitting periods and the thermal traces indicates that this method could be used for public safety and investigations. However, further research should be done to examine its reliability.

Keywords: forensic science, forensic identification, car seat materials, thermal imaging camera, thermal trace, vehicle collision

Supervisor: Robert Hofstetter, Detective, Peel Regional Police Forensic Identification Unit

Forensic Gait Analysis in eyewitness testimony: determining the ability of an eyewitness to perform gait analysis in human identification

ABSTRACT

Purpose: The purpose of this research is to determine the effectiveness of Forensic Gait Analysis in regards to the reliability of eyewitness testimony. This will be done in order to demonstrate the evidentiary weight of eyewitness testimony regarding gait in court. **Background:** Forensic Gait Analysis is still considered novel within Canada and little research has gone into the applications of gait analysis in regard to eyewitness testimony. While some research done has aimed to focus on untrained individuals performing Forensic Gait Analysis, the studies are newer and not as established. **Methodology:** From a sample size of $n=49$, groups of about 10 people aged 18-65 were recorded walking towards and away from a video camera. A mask as well as disguising clothing was provided. Each volunteer received 5 videos and were then asked to identify a specific groupmate. This process was repeated 5 times with different sets of videos. **Results:** About 61% of volunteers were able to identify a perfect score, whilst 22% identified 4/5 groupmates, 14% identified 3/5 groupmates, and 2% identified 2/5 groupmates. Chi-square results indicate that there is no statistically significant relationship between confidence in gait analysis and the ability of an individual to perform gait analysis ($X^2 = 6.91$, d.f. = 3, $p = 0.07$, $\alpha = 0.05$). **Conclusion:** This research has concluded that an untrained individual has the ability to identify someone based on gait, and further research has the potential to build upon these findings.

Keywords: forensic science, forensic gait analysis, admissibility of gait testimony, eyewitness testimony, human identification

Supervisor: Nicholas Harris, Detective Constable, Peel Regional Police

Wearable technology – is it reliable in forensic investigation?

ABSTRACT

Purpose: The purpose of this research is to determine if biometrics (i.e., heartrate & step count) observed from smartwatch devices are accurate to a comparable manual collection. This research is significant, in order to establish these novel devices as reliable in forensic investigations, regarding accepting or refuting testimonies and alibis. **Background:** Smartwatches readily collect biometric data using their accelerometer and gyroscope sensors. Smartwatches are growing in consumer demand, and it may be more common for accused's to be equipped with these devices at times relevant to the investigation. Some cases indicate positive outcomes when utilizing biometric data obtained through smartwatch devices, like heartrate trends. **Methodology:** This study utilized twenty smartwatches varying in brand and model from staff at the Peel Regional Police. Participants were required to walk, run, then walk again on a treadmill at designated speeds, each instance lasting one minute, and the trials were repeated twice ($n=40$). The step count was obtained by a visual count, and the heartrate was measured using an oximeter, to compare against both variables observed by the smartwatch, respectively. **Results:** Two-sample independent t -test results indicate that step count and heartrate observed from smartwatch devices do not differ from a manual collection ($t_{38} = 1.9908, p > 0.05$). **Conclusion:** Regardless of slight variance, the findings provide reasonable indication to the individual's real-time activity. These common devices have shown potential, although further related biometrics should be evaluated over longer periods in more realistic settings.

Keywords: forensic science, forensic identification, biometric, heartrate, smartwatch, step count, witness testimony

Supervisors: Nicholas Harris, Detective Constable, Peel Regional Police; Robert Hofstetter, Detective, Peel Regional Police

RILEY HOWARD

Evaluating the persistence of bloodstains on different non-porous flooring using BLUESTAR®

ABSTRACT

Purpose: The purpose of this research is to determine if bloodstain persistence on different non-porous flooring is impacted by pedestrian traffic after a timeframe of 24 hours. This research is significant, as it may be used to help date detected bloodstains and verify witness statements regarding cleanup attempts. **Background:** With novel shiny non-porous flooring being installed into houses, there is a demand in the forensic community to examine bloodstain's ability to last and be detected following cleanup in high traffic areas. **Methodology:** 100µl of pathogen-free sheep's blood was deposited on flooring consisting of vinyl, laminate, hardwood, engineered hardwood, and porcelain tile. Blood was cleaned up using a damp cloth and dried for 45 minutes. Two treatments, walking and no walking, were applied to 14 flooring types, and replicated three times (n=84). After 24 hours Bluestar was used to detect blood, and the impact of walking was analyzed. **Results:** The Fisher Exact test indicated no statistically significant difference in bloodstain persistence between walking test conditions ($p=0.11602$). Nonetheless, latent bloodstains on the shiny porcelain tile flooring type did not persist after treatments of walking. **Conclusion:** These findings suggest that cleanup on shiny porcelain tile is not expected to remain after 24 hours, and that detection from an unrelated bleeding incident is unlikely. Further research should be conducted with longer timeframes and increased walking to examine the potential for blood evidence to be lost with traffic.

Keywords: forensic science, forensic identification, bloodstain pattern analysis, blood cleanup, blood detection, bluestar, non-porous flooring, pedestrian traffic

Supervisor: Leslie Wyard, Detective Constable, Toronto Police Forensic Identification Service

TRUDY MCKNIGHT

ABO/Rh blood type field testing of dried bloodstains

ABSTRACT

Purpose: This research aims to ascertain the ability to accurately identify ABO/Rh blood groups from dried bloodstain samples and determine if there is a statistical difference between the results based on biological sex. This could benefit bloodstain pattern analysts as a method to distinguish between individuals with different blood types.

Background: ABO antigens are found on the membranes of RBCs. An individual's blood type is determined by the presence/absence of these antigens producing 4 phenotypes: A, B, AB, O. The +/- sign of a blood type refers to the presence/absence of the RhD protein.

Methodology: A lancet was used to draw blood from a finger. Blood was collected using a disposable pipette and deposited on an InTec test strip (fresh sample) and in a plastic container (dried sample). Fresh samples were evaluated immediately and dried samples were tested 24h later, after being hydrated with sterile water. **Result:** Compared to a critical value of 0.05, the Fisher's Exact test results suggest there is a significant correlation between the nature of the sample and the success of the test (d.f. = 1, $p < 0.000001$). This test also suggests there is no significant correlation with biological sex and the success of the test (d.f. = 1, $p = 1$). **Conclusion:** While this specific test does not succeed with dried bloodstains, it explores the limitations of using other methods that may be used to assist in presumptive testing in blood samples.

Keywords: forensic science, forensic biology, bloodstain pattern analysis (BPA), blood type, human identification, red blood cells (RBC)

Supervisor: Michelle Pflug, MSc/CBPA, Bloodstain Pattern Analysis Program Coordinator, Forensic Identification Instructor, Ontario Police College

SARUJAN SIVAKUMAR

Comparing the enhancement of bloody footwear impressions developed with lac dye and amido black

ABSTRACT

Purpose: The project aims to determine whether lac dye is a suitable alternative to methanol-based amido black solution in the enhancement of bloody footwear impressions by treating a depletion series of bloody footwear impressions on porous (unglazed porcelain tile) and non-porous (ceramic tile, laminate tile) surfaces.

Background: Methanol-based amido black solution is the leading reagent for enhancing blood impressions due to its effectiveness and affordability. Lac dye is a natural, novel amino acid reagent that is more affordable and safer for use compared to amido black solution.

Methodology: Bloody footwear impressions were deposited and enhanced on each flooring surface via spray application. The impressions are graded using a scoring criterion assessing the quality of enhancement, and then assigned as usable or non-usable impressions for identification. The nominal data is compared through a Fisher's exact test. **Results:** The results demonstrate that amido black can produce more usable impressions on ceramic tile ($P = 0.0015625$) than lac dye. However, for laminate tiles ($P = 0.20816$) and unglazed porcelain tiles ($P = 0.051629$), lac dye is equally as effective as amido black. **Conclusion:** Although lac dye was determined to be as effective to the methanol-based amido black solution in producing usable impressions on laminate and unglazed porcelain tiles, amido black demonstrates higher sensitivity and better visualization, therefore being the better option for enhancement. Future research should aim to optimize lac dye by testing a methanol-based lac dye solution for blood impression enhancement.

Keywords: forensic science, forensic identification, blood enhancement, amido black, lac dye

Supervisor: Wade Knaap, Forensic Identification Instructor, University of Toronto Mississauga

SIMRANDEEP PANNU

The comparative results of dust footwear impressions using the static lifter vs. the gel lifter, through a depletion series

ABSTRACT

Purpose: The purpose of this research is to determine which of the two methods, electrostatic dust print lifting or gel lifting is more effective in retrieving dust footwear impressions over a 12-step depletion series from paper and wood. This research is significant, as it will expand the current literature on the strengths and weaknesses of the static and gel lifters over a depletion. **Background:** Two-dimensional dust footprints, which are frequently discovered at crime scenes, are great pieces of evidence that can assist in forensic cases by identifying potential suspects and other individuals that were once present at the location of the crime. **Methodology:** For each of the substrates, 12 depletion steps were deposited and lifted using the distinct techniques ($n=48$). The impressions were then graded according to the number of randomly acquired characteristics (RACs) identified in comparison to the test impression by a forensic footwear expert. **Results:** Chi-square results indicate that the lift method is a factor that influences the number of identifiable RACs for paper ($X^2= 11.455$, $p= 0.0032559$; $df= 2$). While for wood, Chi-square results indicate the lift method is not a factor that influences the number of visible RACs ($X^2= 0.5625$, $p= 0.75484$, $df= 2$). **Conclusion:** The static lifter was more effective at retrieving high-quality footprints from even surfaces (paper) over a depletion series. This information is useful for forensic investigators as it may improve the recovery rates of dust impressions from crime scenes.

Keywords: forensic science, forensic identification, footwear impression, dust, electrostatic dust print lifter (ESDL), gelatin (gel) lifter, depletion series, crime scene investigation

Supervisor: Edward Adach, Detective, Toronto Police Service

Determining the accuracy of a virtual lead-in method

ABSTRACT

Purpose: The purpose of the research was to create a virtual lead-in method using a Spider Scanner in order to validate a new manner of determining the angle of impact of bullets in metal panels to simulate vehicles. **Background:** The majority of bullet impact angle research thus far use basic measuring methods, such as rods or measurements and mathematical formulas, that lack visual components. No study has yet to utilize 3D scanners or computer programs, such as 3D Studio Max. **Methodology:** A total of twelve shots were fired from a 9mm Glock handgun into 22-gauge sheet metal (n=12). Three shots were fired at a 10°, 15°, 30° and 45° angles each. A DSLR camera was then used to document the impact point in the metal sheets and scanned using the Artec Spider 3D Scanner. Using the Artec Studio and the 3D Studio Max software's, a mesh was created and then a transaction was taken to virtually measure the angle of entry. The virtual and known angles were compared, and relationships were extrapolated. **Results:** Preliminary data indicates the angles determined by the virtual method are off by an average of 3.90°, however, full statistical analyses of these results are pending. **Conclusion:** While the analysis is not yet complete, the accuracy of the virtual lead-in method is promising and offers visual components that could be beneficial during court room proceedings.

Keywords: forensic science, forensic identification, bullet impact angle, lead-in method, digital analysis, crime scene investigation, 3D Forensics

Supervisor: Eugene Liscio, P.Eng, 3D Forensic Analyst, ai2-3D

Observing how metal thickness affects methods for determining bullet impact angles

ABSTRACT

Purpose: The purpose of the research is to record changes to the shape of bullet impact angles based on different metal thicknesses by test firing at metal panels of various thickness to measure and record shape changes using the Ellipse method, to assess how the thickness of metal can affect the accuracy of methods used in shooting reconstructions. The significance of this research is to identify trends on how different thicknesses of metal increase or decrease the error rates in measuring bullet impact angles. **Background:** Bullet projectiles create an elliptical shape on surfaces that the Ellipse method uses to measure the angle of impact from. Different metal thickness can affect the accuracy of results by causing unwanted tearing and deformations. **Methodology:** A Glock .22 was fired 84 times at metal panels of various thicknesses at different angles. The impacts were photographed and put into CloudCompare to use the Ellipse method to measure the bullet impact angles. **Results:** No trends have been recorded as of yet, but preliminary findings suggest that thicker metal has more shape deformations causing inaccuracies and difficulties measuring elliptical bullet impacts. **Conclusion:** No current research has observed how metal thickness affects the accuracy of calculating bullet impact angles. This work provides the basis for numerous research projects including the use of 3D imaging to analyze shape deformations, testing the accuracy of the lead-in method, and how to correct for error rates of different thicknesses of metal.

Keywords: forensic science, shooting reconstructions, angle of impact, ellipse method, ricochet, sheet metal gauge thickness

Supervisors: Eugene Liscio, P.Eng, 3D forensic Analyst; Shannon Piette, Durham Regional Police, Constable

COFFEE BREAK

Brief intermission, presentations resume at 11:10 AM



3D laser scanner versus manual documentation

ABSTRACT

Purpose: The purpose of this research was to contrast the traditionally used manual documentation methods, baseline control-point, to the more novel method of documentation, the 3D laser scanner. The two documentation methods were compared qualitatively and quantitatively using four criteria (accuracy, versatility, efficiency, & court deliverability), under two given scenarios: a flat grass field, and an inclined/steep field. **Background:** Surveying and mapping techniques are the most used manual documentation methods by forensic investigators; with the result of this producing an accurate scale drawing of the crime scene. However, using such manual documentation methods is quite an extensive and time-consuming process. With the recent advances in technology, novel methods of documentation, such as the 3D laser scanner, are said to replace manual documentation methods. **Methodology:** All research material was provided by Durham Regional Police Service- FIS. The two mock scenes were conducted on a 3x3 metre field. A random distribution of simulated long and small bones were distributed across both mock scenes. The data collected from the scenes produced the necessary results for the research. **Results:** With respect to accuracy, the results are still pending. With respect to versatility, FARO is more versatile and easily accessible. With respect to efficiency (time), manual documentation was found to be more effective. As for court deliverables, the laser scanner (Scene2Go), provided the best and most accurate representation of the crime scene. **Conclusion:** This research has the potential to aid the field of forensic identification, in future decision-making, with respect to different crime scene investigations and using different documenting techniques in different scenes.

Keywords: forensic science, forensic identification, baseline control point, FARO laser scanner, surface scattered skeletal remains

Supervisor: Andrew Groves, Detective, Durham Regional Police Service; Bryce MacLean, Detective, Durham Regional Police Service

The use of liquid latex for the removal of debris and the recovery of fingerprint evidence from recovered stolen vehicles

ABSTRACT

Purpose: The purpose of this research is to determine whether fingerprint powder alone or liquid latex as a pre-treatment, is an effective fingerprint development technique to examine ungroomed fingerprints from the exterior surface of recovered stolen vehicles. This research compared the quality of the recovered fingerprints from both techniques. This research is significant as it investigated the real-world practicality of utilizing liquid latex as a pre-treatment for fingerprint recovery from vehicles covered in debris. **Background:** Past research thus far has studied groomed fingerprints on the lower exterior surfaces or glass exterior surfaces of vehicles. However, no research has studied ungroomed fingerprints on commonly handled exterior surfaces of vehicles, such as door handles. **Methodology:** The recovered stolen vehicles were first processed using fingerprint powder alone and then using liquid latex for the removal of debris and fingerprint powder. Liquid latex was applied using a foam roller in three layers. The recovered fingerprints ($n=24$) were photographed, lifted, and scored for quality using the 0-3 scoring system. **Results:** Fisher's exact test indicated that there is no statistically significant difference in the quality of the recovered fingerprints using the two fingerprint development techniques ($P=0.06865$). **Conclusion:** There exists no relationship between the quality of the recovered ungroomed fingerprint and the use of fingerprint powder alone or liquid latex as a pre-treatment. There is potential for liquid latex if there is sufficient debris and fingerprint powder is used before liquid latex application.

Keywords: forensic science, forensic identification, debris, latent fingerprints, liquid latex, vehicles

Supervisor: Michael Ho, Scenes of Crime Specialist, Peel Regional Police

FRANCESCA D'AMROSIO

Assessing the performance of Sciluminte on different surfaces

ABSTRACT

Purpose: The purpose of this research is to compare the latent fingerprint development quality of Sciluminate™ to traditional development methods of black granular powder and cyanoacrylate fuming with rhodamine 6G dye. This research is significant as Sciluminate™ can be used as an effective, quick, and clean alternative technique. **Background:** Current fluorescent powders exhibit low sensitivity, high background fluorescence, high toxicity and are less effective in high humidity conditions. Thus, the product Sciluminate™ can be introduced as an alternative technique to overcome these limitations. **Methodology:** Nine participants (3 F, 6 M) deposited a depletion series of 5 fingerprints on two sets of black garbage bags, empty cartridge casings, and paperboard packaging (n=270). One set from each surface was developed with Sciluminate™ while the other set was treated with the respective traditional method. Developed impressions were graded using the Bandey scale (0-4) then categorized as 'usable' (scores of 3-4) or 'non-usable' (scores of 0-2). **Results:** Using a 2x2 contingency table a two-tailed Fisher Exact test showed no significant difference in the frequencies of useable and non-usable prints between the two development methods for paperboard packaging and garbage bags ($P=1$ and $P=0.12739$ respectively) and a significant difference from the empty cartridge casings ($P<0.000001$). **Conclusion:** The quality of fingerprints developed by Sciluminate™ varied depending on the surface used within the study. Instances where quality was greater than and equal to traditional methods were observed. Additional testing is required to optimize and validate this technique.

Keywords: forensic science, forensic identification, fluorescent fingerprint powder, enhancement, latent fingerprints, nano-forensics

Supervisor: Jessica Piekny, Forensic Identification Civilian Technician, St. Thomas Police Service - FIS

MARUSA BAVAKARAN

The effectiveness of ThermanIN

ABSTRACT

Purpose: This research aims to test the effectiveness of ThermanIN in comparison to Ninhydrin. This research is significant, as it will explore the capabilities of ThermanIN, and determine whether the darkening limitation of Ninhydrin can be prevented. **Background:** Fingerprints are an important source of evidence that can be enhanced with different types of chemical developments. ThermanIN's solubility in apolar solvent could prevent the Ninhydrin discolouration limitation to receipts. **Methodology:** ThermanIN concentrations compared with depletion series of 10, using groomed prints from three donors (n=60). Prints processed through 1,2-indandione, cut, ½ through standard, ½ through increased/reduced. Increased concentrations compared to Ninhydrin, using eight donors providing a depletion series of 10 (n=80). **Results:** Chi-square results indicate that concentration is not a factor that influences the visibility of ridge detail ($X^2 = 0.16582$, d.f. = 2, $p = 0.92043$). During processing, the untreated indandione prints seemed to produce clearer prints than further treatment with ThermanIN or Ninhydrin. This was verified by chi square ($X^2 = 15.838$, d.f. = 2, $p = 0.00045671$). Unusual clarity led to a random sample of receipts from colleagues to check whether this reaction is more common than expected. None of the other receipts showed similar results. **Conclusion:** Some receipt papers react well with indandione alone and do not require further processing. In fact, additional processing produces worse results. Recommend checking quality at indandione stage in case no further processing is needed.

Keywords: forensic science, fingerprint enhancement, ninhydrin, themanIN, 1,2-indandione, thermal paper, receipts

Supervisors: Cameron Power, FIS Laboratory Specialist, Toronto Police Services; Jaclyn Slaney, FIS Laboratory Specialist, Toronto Police Services

Examining the effectiveness of novel infrared powders for developing latent fingerprints on Canadian polymer bank notes

ABSTRACT

Purpose: The purpose of this study is to examine the effectiveness of inexpensive and time-efficient techniques for developing latent fingerprints on Canadian polymer bank notes. This was done by comparing the Foster + Freeman fpNATURAL®1 and fpNATURAL®2 powders with and without a pre-treatment of cyanoacrylate fuming (CA). This research is significant because it can provide a new standardized fingerprint development technique that forensic investigators can use. **Background:** The recommended protocol for developing fingerprints on bank notes uses expensive and time-consuming laboratory equipment. A few studies have shown that inexpensive infrared powders can develop fingerprints on highly patterned surfaces. **Methodology:** A trial run was performed where 37 groomed fingerprints were randomly deposited across bank notes. For the experiment, 288 natural fingerprints were deposited by three donors in three regions on twenty-dollar Canadian polymer bank notes with a depletion series of four fingerprints. After aging for 24 hours or 7 days, fingerprints were developed, photographed, and graded 0-3 using the 3 levels of friction ridge detail, with scores of 0-1 labelled as not useful and 2-3 labelled as useful. **Results:** For the trial run, 33 of 37 fingerprints (89.2%) were identified as useful. For the experiment, 9 of 288 fingerprints (3.1%) were identified as useful. fpNATURAL®1 produced the highest number of useful fingerprints and both techniques with a pre-treatment of CA produced the lowest number of useful fingerprints. **Conclusion:** There is potential for fpNATURAL®1 and fpNATURAL®2 to be used in forensic investigations.

Keywords: forensic science, forensic identification, fingerprint powder, infrared, latent fingerprint development, polymer banknotes

Supervisor: Michael Eves, Detective Constable, Hamilton Police Service

NICOLE JUDD

Using full-spectrum photography to visualize latent fingerprints on difficult surfaces

ABSTRACT

Purpose: This research aims to determine if full-spectrum (IR/UV) photography can visualize latent fingerprints on difficult surfaces better than traditionally used digital-single-lens-reflex (DSLR) cameras. This research may be used to improve fingerprint recovery techniques and streamline the process of identifying and photographing fingerprints. **Background:** The majority of IR/UV photography has been used in forensic pathology and odontology subfields with limited use in fingerprint visualization. Studies have used IR/UV photography to visualize fingerprints on various surfaces with additional processing. This study is the first of its kind to look at the efficacy of visualizing latent fingerprints using IR/UV photography on stainless steel, soft plastic, and pig skin. **Methodology:** Donors deposited six fingerprints onto three substrates: stainless steel, soft plastic, pig skin. Each fingerprint was photographed with 5 different camera-light combinations before processing, then after with UV-fluorescent fingerprint powder. The total sample size consisted of 360 fingerprint photographs, each graded, and results analyzed using Kruskal Wallis tests. **Results:** Kruskal Wallis tests showed no statistically significant difference between camera type and fingerprint visualization both before and after processing. **Conclusion:** IR/UV photography is not more effective at visualizing latent fingerprints over traditionally used DSLR cameras. IR/UV cameras can capture more information than DSLR cameras which is of limited use in photographing latent prints. Future IR/UV research should be done on colorful/ high contrast surfaces and in cases with bruising or bite marks.

Keywords: forensic science, forensic photography, infrared, ultraviolet, full spectrum, fingerprint analysis, crime scene investigation

Supervisors: Wade Knaap, Assistant Professor, University of Toronto Mississauga; Amanda Lowe, Forensic Research and Training Analyst, Ontario Provincial Police

LUNCH BREAK

A 60 minute recess at the Blind Duck Pub, UTM Student Centre.



**Forensic Science Day resumes at 1:30 PM
with the Poster Session in the Atrium of the (IB)
Instructional Centre**

POSTER SESSION

30 minutes in the Instructional Centre Atrium.



Speaker presentations resume at 2:00 PM

ALEXIS KANTAROS RODRIGUES

The comparison of a slime compound containing fingerprint enhancement reagent Hungarian red to traditional Hungarian red

ABSTRACT

Purpose: The purpose of this research is to compare a slime compound containing Hungarian red to a traditional Hungarian red, by measuring the quality of detail of patent fingerprint impressions. Research on this new method of enhancement is significant as it will mitigate concerns regarding cost, detail disruption, and the environment. **Background:** Traditional Hungarian red is a commonly used chemical reagent for developing patent fingerprint impressions. Three studies have utilized a slime compound containing other chemical reagents, but no study has used a slime compound containing Hungarian red. **Methodology:** Using ethically sourced sheep blood, three donors deposited two depletion series on clear tape, glass, wood flooring, and tile. Each depletion contained four individual impressions (n=96). A slime compound containing Hungarian red was created and used to develop one of the depletions on each substrate, and traditional Hungarian red was used to develop the other. Impressions were submitted for a blind assessment using the Bandey Fingerprint Grading Scale. The scores were organized into usable or unusable, and the relationship between the method of enhancement and usability was analyzed. **Results:** The Bandey scores showed more usability for the Hungarian red slime. Fisher's Exact test showed no relationship between the method of enhancement and usability. **Conclusion:** This preliminary research supports the use of Hungarian red slime for patent fingerprint enhancement. Further research is necessary to determine its reliability in forensic investigation.

Keywords: forensic science, fingerprint impressions, patent fingerprint development, Hungarian red, depletion series, photography

Supervisors: Wade Knaap, Assistant Professor, University of Toronto Mississauga; Agata Gapinska-Serwin, Laboratory Technician, University of Toronto Mississauga

Contact versus contactless fingerprint development

ABSTRACT

Purpose: This research aims to investigate the effect of contact versus contactless fingerprint development on fingerprint clarity by comparing the powder-and-brush method to the recent sandblasting gun and fluorescent starch powder method. This is significant as it will investigate an alternative method to the commonly used contact development techniques to maintain fingerprint integrity, reducing cross-contamination and the elimination of potential touch deoxyribonucleic acid (DNA). **Background:** Contactless fingerprint development methods are used to reduce cross-contamination and preserve evidence. These methods do not require direct physical contact, reducing risk of damaging/altering evidence. However, the effectiveness in fingerprint clarity in comparison to contact methods has not been evaluated. **Methodology:** Participants deposited fingerprints on glass, stainless steel, and painted drywall in a depletion series of six, using a modified split design (n=54). The fingerprints aged for 24 hours and were then developed using two methods: powder-and-brush and sandblasting. Developed prints were photographed using a DSLR camera and rated using the Bandey Scale. **Results:** Results found that one method is not superior to the other in fingerprint clarity after development. **Conclusion:** While the quality of the fingerprints developed using both methods was comparable, the contactless method has the added benefit of preserving the integrity of the evidence by not making direct contact with it, thus minimizing cross-contamination. These findings have implications for forensic investigations, highlighting the importance of selecting appropriate fingerprint development methods to preserve and analyze evidence.

Keywords: forensic science, forensic identification, crime scene investigation, fingerprint analysis, fingerprint development

Supervisors: Amanda Lowe, Forensic Research and Training Analyst, Forensic Identification Services, Ontario Provincial Police; Wade Knaap, Assistant Professor, University of Toronto Mississauga

The quantitative and qualitative comparison of presumptive testing methods for saliva

ABSTRACT

Purpose: The SERATEC® Amylase Paper (SAP) and the SERATEC® Amylase Test (SAT) were compared against the Phadebas® Forensic Press test (PFPT) to determine which method is more efficient in detecting the enzyme α -amylase to localize saliva in forensic casework. This research can inform the decision of which presumptive test to use for α -amylase detection by identifying methods that do not affect DNA yield and quality. **Background:** The PFPT is a routinely utilized test despite potentially diluting DNA concentrations beyond detectable quantities. Limitations of the PFPT are not clearly explored and there is a lack of research evaluating the efficiency of the SAP and SAT. **Methodology:** Saliva samples diluted to 1:50, 1:100, and 1:200 were deposited onto denim and cotton-polyester samples ($n=60$). The samples underwent presumptive testing, and all results were recorded. DNA extraction was attempted for all samples and subsequently quantified. **Results:** Chi-squared analysis of the occurrence of positive results for the PFPT and SAP demonstrated statistically significant differences ($p = 0.008$). Mann-Whitney U-test comparisons for differences in DNA quantity from sample cuttings yielded no statistical significance ($p > 0.05$). No quantifiable DNA or positive indications of α -amylase were obtained from the SAT. **Conclusion:** There is no significant difference in the yields of DNA following presumptive testing; however, the SAP was more sensitive to α -amylase than the PFPT. The SAT displayed no observable results. Overall, there is insufficient evidence to favour the use of one presumptive test.

Keywords: forensic biology, saliva presumptive testing, Phadebas® Forensic Press test, SERATEC Amylase Paper, SERATEC® Amylase Test

Supervisors: Ashley Moo-Choy, MSc. Candidate, University of Toronto Mississauga; Nicole Novroski, Assistant Professor, University of Toronto Mississauga

Canine STR typing: A proof-of-concept study for Thermo Scientific's™ Canine Genotypes Panel 2.1 Multiplex Kit

ABSTRACT

Purpose: To evaluate the sensitivity, species-specificity, reproducibility, and mixture capabilities of Thermo Scientific's™ Canine Panel to assess its utility in a forensic setting. The panel's ability to genotype various pure and mixed-breed canine samples was assessed to determine if the profiles produced can be utilized for identity purposes. **Background:** As common pets, canine DNA may be encountered in various forensic investigations. Thermo Scientific™ offers one of the only commercially available canine panels for forensic use, making assessment of its ability to successfully generate complete profiles essential. **Methodology:** DNA was extracted from the buccal swab samples of five dogs (n=5). Samples were serially diluted and amplified in duplicate to assess kit sensitivity and reproducibility. To test the mixture capabilities of the kit, canine DNA was combined at ratios of 1:2 and 1:1:2. Finally, non-canine DNA samples were prepared to evaluate species-specificity and the resultant profiles were analyzed for completeness and quality. **Results:** Full profiles were generated for 4 out of 5 samples down to 0.5ng/μL, with allelic drop-out observed at 0.25ng/μL and 0.125ng/μL. Significant variance in mean RFU was observed between decreasing concentrations ($p = 6.00 \times 10^{-12}$). Replicate profiles exhibited concordance and all contributors were detected in the mixture samples. **Conclusion:** Several observed artifacts proved to complicate interpretation, and incomplete profiles were reported at low concentrations. To ensure the kit can be utilized for forensic casework, kit sensitivity should be increased, and presence of artifacts should be minimized.

Keywords: forensic biology, canine DNA, canine genotyping, electropherogram analysis, proof-of-concept, STR typing, validation.

Supervisors: Nicole Novroski, Assistant Professor, University of Toronto Mississauga

Comparing dog breed and identity determinations utilizing commercial canine DNA kits and STR genotyping

ABSTRACT

Purpose: The purpose of this research is to compare canine Deoxyribonucleic acid (DNA) kits including the ThermoFisher Canine Genotyping Panel 2.1, and commercial kits by Embark®, Wisdom Panel™, and DNA My Dog®. This research is significant as it highlights disparities between commercial kits, while reaffirming the value in Short Tandem Repeat (STR) based methods for canine identity determinations. **Background:** Canine DNA evidence may be valuable in a wide application of forensic related investigations, where STR loci are a known reliable identification tool. The rise of new technologies and high throughput sequencing has resulted in an increase of commercial DNA testing kits which must be critically evaluated for their potential use in forensic contexts. **Methodology:** Biological samples were genotyped for different dogs of different breeds (n=4). STR profiles were compared to a dataset to assess concordance between profiles. Additional samples were sent to commercial laboratories (n=3) for breed determinations. **Results:** For the purebred Great Dane, commercial kits were 100% consistent in their breed identifications. For the mixed breed Labrador, DNA My Dog® was not consistent with both Wisdom Panel™ and Embark®, which were the most concordant. However, the results of the Chi-Square test of homogeneity indicated a statistically significant difference between their percent breed compositions ($X^2=42.494$, $df = 18$, $\alpha=0.05$, $p<0.05$). **Conclusion:** Disparities amongst commercial kit breed identifications emphasize the importance of assessing the context of canine DNA related inquiries, while reinforcing the strengths of STR genotyping in the field.

Keywords: forensic science, forensic genetics, animal forensics, breed identification, canine, STR genotyping

Supervisor: Nicole Novroski, Assistant Professor, University of Toronto Mississauga

MICHELA MARCELLINO

Testing for evidence of recent selection at *SLCO* genes among diverse human populations

ABSTRACT

Purpose: Use VCFtools to test for indications of natural selection at 11 solute transporter genes (*SLCO*) in eight populations from the Human Genome Diversity Project (HGDP) and the 1000 Genomes Project (1kGP) that inform genetics of drug response. This will support the fields of forensic medicine, toxicology, and personalized medicine.

Background: Genetic variation in *SLCO*s may result in increased toxicity or adverse drug reactions. Due to the overrepresentation of Europeans in genetics research, this study focused on whether natural selection contributes to variation at *SLCO*s in Europeans differently than in diverse ancestries. Understanding these evolutionary effects informs population-specific drug response. **Methodology:** Using VCFtools, Tajima's *D* was calculated for 11 *SLCO*s in each population (seven HGDP and six 1kGP). *SLCO* *D* values greater or equal to the 5% of genomic *D* values were deemed statistically significant. **Results:** Balancing selection was detected at seven of the 11 genes. *SLCO6A1* exhibited consistent cross-population significance, with the largest being in the 1kGP East Asian population ($D_{gene} = 6.74$, $D_{genome} = 4.23$, 95% CI [4.21, 4.25]). Furthermore, *SLCO5A1* showed evidence of positive selection in two HGDP populations, of which America expressed the largest difference ($D_{gene} = -0.37$, $D_{genome} = 2.72$, 95% CI [2.71, 2.73]). **Conclusion:** Both positive and balancing selection contribute to *SLCO* variation differently in Europeans than in diverse ancestries. The inclusion of global and underrepresented populations is crucial to the understanding, accuracy, and future clinical implementations of pharmacogenomic research.

Keywords: forensic science, forensic toxicology, forensic medicine, drug response, genetic variation, human evolution, natural selection, pharmacogenes, population genetics, solute transporter genes, slco

Supervisors: Frank Wendt, Assistant Professor, University of Toronto Mississauga

COFFEE BREAK

Brief intermission, presentations resume at 3:15 PM



Association between genetic variants in *contactin* genes and suicidality

ABSTRACT

Purpose: The purpose of this research is to determine if there is an association between genetic variants in *contactin* genes (*CNTN*) and suicidality. Understanding the genetic liability of suicidal thought and behavior will promote early intervention and treatment. **Background:** Death by suicide is one of the leading causes of death among adolescents. Genome-wide association studies have identified loci that associate with suicidal ideation and behavior. One such group are the *CNTNs* which consist of six immunoglobulins (*CNTN1-6*) that are critical to neurodevelopment. **Methodology:** Genotypic and phenotypic data were obtained from the Philadelphia Neurodevelopment Cohort. Across the six *CNTNs*, 232 tandem repeat elements (TREs) were analyzed from 828 individuals who expressed current, previous, or no suicidal ideation. TREs were imputed into SNP arrays using a phased SNP-TRE haplotype reference panel from the 1000 Genomes Project. Generalized linear models were used to associate each TRE length with suicidality phenotypes and 13 covariates. **Results:** A significant interaction was observed between a *CNTN1* TRE and participant age with respect to current suicidal ideation (*CNTN1*-[T]_N-by-Age; $p = 0.0384$). Compared to the youngest age group, the middle (OR = 1.80, $p = 0.0514$) and oldest (OR = 3.82, $p = 0.0002$) participant groups had significantly higher odds of suicidal ideation as their TRE length expanded. **Conclusion:** The age of participants exhibits clear effects on the relationship between *CNTN1*-[T]_N and suicidal ideation. These findings highlight the genetic effects on suicidality and advance our understanding of death by suicide.

Keywords: forensic science, forensic genetics, behavioural genetics, *contactins*, psychiatry, suicide

Supervisor: Frank Wendt, Assistant Professor, University of Toronto

Evaluating the efficacy of adolescent opioid education workshops

ABSTRACT

Purpose: This research aims to determine the pedagogical value of educational workshops for high school students on the science of opioids to help understand adolescent perceptions of opioid use, while providing education to help them understand the harms associated with opioid misuse and ways to mitigate those harms.

Background: Opioids are analgesic drugs that have a high potential for abuse. Adolescents frequently lack knowledge about opioids but can suffer from problems with opioid misuse.

Methodology: An opioid education workshop was developed for high school students aged 16-18. Prior to participation in the workshop, participants took a 15-question survey to measure their current understanding of opioid use, overdoses, and the opioid crisis. After the 30-minute workshop, participants completed a 15-minute exit survey to assess their new understanding. **Results:** Information regarding current and post-workshop understanding/perception by adolescents with regards to opioid use as well as demographic data was obtained from 45 participants. Chi square results indicate that 4 of the 6 knowledge-based multiple-choice questions demonstrated a significant improvement after the workshop at $p < 0.05$. Similarly, Mann Whitney U test results show that all but 2 Likert scale questions also demonstrated a statistically significant improvement at $p < 0.05$. **Conclusion:** Based on these statistically significant increases made apparent through post-workshop survey responses, this study indicates that students' knowledge increased following the workshop and has helped further their current understanding of opioid use and the opioid crisis.

Keywords: forensic science, forensic toxicology, adolescent, education, opioid, opioid crisis

Supervisors: Karen Woodall, Assistant Professor, University of Toronto Mississauga; Murray Clayton, Program Officer, Outreach Coordinator, University of Toronto Mississauga

Evaluation of the effects of cold temperature on the reliability of roadside oral fluid drug testing

ABSTRACT

Purpose: The purpose of this research is to test the reliability of the Dräger DrugTest® 5000 (DDT 5000) and the Abbott SoToxa™ Mobile Test System (SMT) at temperatures below the operation guidelines reported by the manufacturers. This was done to determine if the test systems are reliable for presumptive roadside drug screening in Canada under cold temperature conditions. **Background:** Oral fluid drug testing is a method utilized for the detection of cannabis usage in individuals suspected of driving under the influence. If these tests are conducted in Canada, they may be subject to use at cold temperatures outside of the range they are approved for.

Methodology: Data collected from 23 individuals in temperatures outside of the ideal range (-15.6°C to 3.5°C) was compared to tests completed within the ideal temperature range of both the DDT 5000 and the SMT, which are both approved for use in Canada. **Results:** Data was collected from 8 male and 15 female participants, with 7 individuals who had indicated recent use of cannabis. Between 21.8°C to 23.0°C, 6 positive results and 17 negative results were observed. The DDT 5000 produced a single false negative result at 1.7°C, whereas the SMT produced a single false positive result at 2.2°C. **Conclusion:** The results from this study indicate that further research is required to determine if oral fluid drug testing is a valid method for the presumptive testing for THC at cold temperatures.

Keywords: forensic science, forensic toxicology, oral fluid drug testing, cannabis, drugs and driving, delta-9-tetrahydrocannabinol.

Supervisor: Karen Woodall, Assistant Professor, University of Toronto Mississauga.

Adsorption of THC, metabolites and related cannabinoids during Storage of Plasma Samples in Gel Separation Tubes

ABSTRACT

Purpose: This research aims to determine the stability of cannabinoids, including tetrahydrocannabinol (THC), over time when stored in gel separation tubes to inform the interpretation of toxicological findings in forensic casework. This is significant as it will address the gap in scientific literature relating to the adsorption of cannabinoids in gel separation tubes. **Background:** During impaired driving and death investigations, gel separation tubes may be collected from hospitals and submitted to forensic laboratories for toxicological analysis. Drugs in the plasma tend to adsorb to the gel separator which may result in underestimating their concentrations. **Methodology:** Samples of "blank" plasma were spiked with low and high concentrations of cannabinoids then aliquoted into non-plasma separator tubes (non-PST) and plasma separator tubes (PST) (n=72). At the end of each storage period, the plasma from both tube types were extracted then analysed by liquid chromatography – tandem mass spectrometry. **Results:** Statistically significant differences in cannabinoid concentrations ($P<0.05$) were observed between the non-PST and PST. All cannabinoids except carboxy THC (THC-COOH) showed a reduction in concentration in PST. Over a 3-week period, concentrations decreased for THC by 42% and 32%, cannabidiol (CBD) by 33% and 12%, cannabinol (CBN) by 46% and 28% and hydroxy THC (THC-OH) by 34% and 20%. **Conclusion:** The instability of cannabinoids must be considered in the toxicological interpretation of samples collected in gel separation tubes.

Keywords: forensic toxicology, death investigation, plasma, liquid chromatography, tandem mass spectrometry, tetrahydrocannabinol

Supervisors: Karen Woodall, Professor, University of Toronto Mississauga; Dale Pon, Forensic Scientist, Centre of Forensic Sciences; Chesia Giancola, Forensic Analytical Toxicologist, Centre of Forensic Sciences

POSTER SESSION PRESENTERS LIST

FSC483H5: COLLABORATIVE RESEARCH INTERNSHIP

FSC485: EXPERIENTIAL OPPORTUNITY IN FORENSIC SCIENCE



PAULINE ALEXANDER

How forensic expert evidence is used in the Ontario criminal justice system: a 5-year retrospective study

ABSTRACT

Purpose: The purpose of this study is to apply a quantitative and multidisciplinary approach to determine how forensic expert evidence is used in the Ontario criminal justice system. The significance of this research includes identifying trends in the use, admissibility, and inferences drawn by forensic science in Ontario criminal courts, while establishing a baseline of quantitative results for future research. **Background:** The National Research Council (NRC) highlighted that research into how forensic evidence is used in court is warranted. Currently, no quantitative studies exist on how forensic evidence is used in the Ontario criminal justice system. **Methodology:** This 5-year retrospective study will explore the use of forensic evidence in criminal trials and voir dieres in the Ontario Court of Justice (OCJ) and the Ontario Superior Court of Justice (ONSC) from January 1, 2018, to January 1, 2023. A total of 231 (n=231) Ontario criminal trial-level judgments will be assessed for the following: number of experts, evidence admissibility, forensic disciplines used, nature of inference made by forensic evidence, and inferences drawn. **Results:** This research is ongoing; thus, conclusions and analyses have not yet been drawn. **Conclusion:** Ultimately, the quantitative database developed from this research allows for trends to be drawn in the use of forensic evidence in Ontario in the last 5 years. This may be used as a reference for future research regarding forensic science in Ontario criminal courts.

Keywords: forensic science, admissibility, criminal trials, expert evidence, forensic evidence

Supervisor: Caitlin Pakosh, Assistant Crown Attorney, Instructor at the University of Toronto, Mississauga

NIKIELA BAPTISTE

The amalgamation of Nuclear Magnetic Resonance Spectroscopy and Computer-Assisted Structural Elucidation

ABSTRACT

Purpose: This research aims to determine the feasibility of the use of benchtop Nuclear Magnetic Resonance (NMR), coupled with Computer-Assisted Structural Elucidation (CASE), as a tool for the identification of novel psychoactive substances. This is significant, as it allows for the identification of a class of substances in which the current protocol used is inefficient. **Background:** Mass spectrometry paired with a chromatographic technique, gas chromatography (GC-MS) or liquid chromatography (LC-MS), is the current gold standard within forensic drug analysis. Concerning novel psychoactive substances, however, they are restricted by the availability of pre-existing libraries of mass spectra. Implementing NMR spectroscopy allows for determination of structural formulae of novel psychoactive substances as it does not require a reference library. The interpretation of NMR spectra is an obstacle as the principles are difficult to understand. CASE removes this barrier, allowing for artificial intelligence to interpret NMR spectra and produce the structure of compounds. **Methodology:** The samples used in this research were Dextromethorphan and Pseudoephedrine. Each was run on an 80 MHz and a 500 MHz NMR spectrometer. A 1d proton spectrum, 1d carbon spectrum, HSQC, HMBC and COSY were collected for each sample and inputted into the CASE software. **Conclusion:** The blind sample was determined to be Etonitazepyne. This technique has potential. Further research into its accuracy may lead to its validation.

Keywords: forensic science, forensic drug identification, forensic chemistry, nuclear magnetic resonance spectroscopy, computer-assisted structural elucidation, artificial intelligence

Supervisors: Ronald Soong, Senior Research Associate, University of Toronto Scarborough; Vivienne Luk, Ph.D., Assistant Professor, University of Toronto Mississauga

CHRISTINE GAOIRAN AND PALIG KEUHNELIAN

A promising automated method for the analysis of sexual assault evidence for Point-Of-Care testing

ABSTRACT

Purpose: This research aims to optimize and adapt the differential digestion (DD) protocol of sexual assault (SA) evidence onto a fieldable digital microfluidic device. Chemometrics informed the parameters of DNase concentration, cofactor (Ca^{2+} , Mg^{2+}) concentrations, and incubation times to maximize protocol efficiency while reducing analysis time. Adapting the optimized protocol to a fieldable platform for Point-Of-Care testing is significant in reducing long turnaround times and reducing SA evidence backlogs. **Background:** SA evidence requires a protocol, such as DD, to separate sperm from non-sperm cells before DNA analysis can be performed. **Methodology:** Chemometric analysis identified twelve trials were required for method optimization. Twelve trials ($n=3$) were conducted where DNase and cofactor concentrations and incubation times were varied simultaneously. **Results:** The ratio of autosomal to Y DNA (Auto:Y) was used to determine the separation efficiency of sperm from non-sperm. An Auto:Y ratio of less than 2 is considered an effective separation. It was determined that the optimized trial with 3 minutes of total incubation time, 20 Kunitz DNase, 10mM Ca^{2+} , and 25 mM Mg^{2+} yielded comparable results (Auto:Y= 1.24 ± 0.15) to the 40-minute original protocol (Auto:Y= 1.15 ± 0.21). A t-test determined no statistically significant difference between Auto:Y of the original and optimized protocol with a 95% region of acceptance ($t = 0.42$, $p = 0.70$). **Conclusion:** The reduction of incubation time by 92.5% while maintaining the Auto:Y below 2 allows the protocol to be performed on the digital microfluidic platform and for SA evidence to be analyzed closer to Point-Of-Care.

Keywords: forensic science, forensic chemistry, differential digestion, DNase, optimization, sexual assault evidence

Supervisors: Mohamed Elsayed, Ph.D. candidate, Dept of Electrical and Computer Engineering, University of Toronto; Advikaa Dosajh, MSc Candidate, Analytical Chemistry, University of Toronto; Vivienne Luk, Ph.D., Assistant Professor of Forensic Chemistry and Toxicology, University of Toronto

Anemia's correlation to sudden cardiac death

ABSTRACT

Purpose: The research aims to provide data to support a funding proposal to study the relationship between anemia and sudden cardiac death (SCD) by using death records in the New Mexico Decedent Image Database (NMDID), to determine the scope of decedents whose Cause of death (COD) may have been impacted by anemia. Identifying such a relationship might help with autopsy diagnosis and SCD prevention. This research is significant because SCD has a devastating impact on communities. **Background:** Anemia, where the body's red blood cell count drops below the normal level, is a typical condition among patients with cardiovascular disease. In a lot of research, anemia has been linked to many heart dysfunctions. We hypothesize that anemia is correlated with SCD and that demographic factors do contribute to the relationship. **Methodology:** We sampled 4200 individuals who died of natural causes in the NMDID and compared their primary COD, known diagnoses, and substance abuse disorder information to determine the number of decedents whose deaths may have had anemia as a contributing factor; this was compared to research in the literature implicating anemia and SCD. **Results:** This research is ongoing. In the current analysis, hypertension, diabetes, and coronary artery disease account for a substantial number of cardiac deaths. I expect that anemia is closely linked to coronary artery disease. **Conclusion:** Anemia strongly links cardiovascular disorders. Anemia increases the risk of SCD, supporting our funding request for SCD research.

Keywords: forensic science, Sudden Natural Death, forensic pathologist, anemia

Supervisors: Lilianna Watamaniuk, Forensic Anthropologist, Sessional Instructor, Forensic Sciences, University of Toronto at Mississauga

Expert forensic evidence in Ontario criminal trials: A 5-year retrospective study

ABSTRACT

Purpose: The purpose of this research is to better understand how forensic science is used within the Ontario criminal justice system through a 5-year retrospective analysis of trial judgments arising from the Ontario Court of Justice (OCJ) and the Ontario Superior Court of Justice (ONSC). This research is significant, as it will provide insight into the use of forensic expert evidence in Ontario criminal trials and inform the scientific and legal communities of the prevalent practices and trends in the use of forensic expert evidence. **Background:** Currently, there is a dearth of literature investigating the use of expert forensic evidence in Canadian trial courts. There are no studies that investigate trends in expert forensic evidence within Ontario trial courts, making the present study the first of its kind. **Methodology:** Trial-level decisions and voir dires (n = 231) arising from the OCJ and the ONSC have been collected for review using Lexis Advance Quicklaw. Information regarding the disciplines of testifying forensic experts, the legal issue requiring expert evidence, the inference that is being drawn from the expert evidence, and what party raised the expert evidence will be collected and statistically analyzed. **Results:** The collection of data from our sample is currently ongoing. Trends in the data cannot yet be established. **Conclusion:** As the results have not been found, implications of findings cannot yet be made.

Keywords: forensic science, forensic expert evidence, criminal trial, Ontario Court of Justice, Ontario Superior Court of Justice, retrospective study, trial judgment

Supervisors: Caitlin Pakosh, J.D., University of Toronto Mississauga

Anemia's correlation to central nervous system (CNS) related sudden natural death

ABSTRACT

Purpose: To establish the potential scale to which anemia was likely a factor in sudden natural deaths (SND) due to central nervous system (CNS) disorders, by analyzing death records in the New Mexico Decedent Image Database (NMDID), to provide data regarding the potential correlation between anemia and CNS-related SND for a subsequent funding proposal to further study this issue and improve diagnosis at autopsy. Anemia affected 1.74 billion people in 2019 and its role in SNDs may be significantly underestimated. **Background:** Anemia describes the body's inability to produce sufficient healthy red blood cells to meet oxygen demand. Variations include B12 and iron-deficiency induced anemia and sickle-cell anemia. CNS pathologies impede function of the brain and/or spinal cord, impacting movement, cognition, and body regulation. Studies have shown that anemia's impediment to brain-oxygen impacts cognition and CNS health, resulting in higher risk of dementia, Parkinson's, and Alzheimer's disease. **Methodology:** The MNDID included 4200 cases of SND, 156 of which had primary causes of death (COD) qualifying as CNS-related, including Alzheimer's, Amyotrophic lateral sclerosis (ALS), Aneurysm, Cerebrovascular, Epilepsy, and Parkinson's. These 156 records were compared to current research implicating anemia in worsening CNS disorders to calculate the rate of potential anemia cases. **Results:** Conclusions cannot yet be drawn as the study is ongoing, but most CODs showed correlation with anemia-associated diagnoses. **Conclusions:** We expect the number of decedents impacted to be supportive of our call for further research.

Keywords: forensic science, forensic pathology, anemia, central nervous system, sudden natural death

Supervisors: Lilianna Watamaniuk, Forensic Anthropologist, Ontario Forensic Pathology Service (Consultant)

DYLAN MCFARLANE-URBSZAT

Automation of DNA purification for sexual assault samples using digital microfluidics

ABSTRACT

Purpose: This research aims to develop a system to purify separated male DNA from sexual assault evidence using digital microfluidics (DMF) to increase efficiency and simplicity of sexual assault evidence analysis. **Background:** Processing of sexual assault evidence is a time consuming and complex process, resulting in a backlog of cases in forensic laboratories. One way to minimize this would be point of care testing, where preliminary analysis is conducted at a hospital rather than a forensic lab. This can be performed using Digital Microfluidics, a device that manipulates individual droplets of liquid allowing for complex chemical processes to be miniaturized and automated.

Methodology: Microfluidic devices were fabricated through the use of photolithography and an automated protocol was developed. After being processed on the DMF device, DNA concentration and purity was tested using qPCR. **Results:** Initial testing has shown that the purification method adapted to digital microfluidics, magnetic bead purification, results in comparable purity and DNA yield to the filtration method commonly applied at forensic laboratories. Additionally, the DMF chips have been successfully fabricated and the protocol has been fully developed and tested with inactive buffers. Testing using mock sexual assault samples, consisting of buccal swabs spiked with a 1:10 dilution of sperm, is currently being conducted. **Conclusion:** Next steps involve expanding this protocol to fully automate the process of sexual assault sample analysis, which would eventually allow this technology to be applied in hospitals across the country.

Keywords: forensic science, forensic chemistry, forensic biology, Digital Microfluidics, DNA purification, sexual assault evidence

Supervisors: Vivienne Luk, Assistant Professor, University of Toronto; Mohammed Elsayid, PHD candidate, University of Toronto; Aaron Wheeler, Professor, University of Toronto

NICOLE MODICA

Anemia's correlation to Sudden Natural Death due to endocrine and hematopoietic systems' disorders

ABSTRACT

Purpose: This research aims to establish the degree of correlation of anemia to Sudden Natural Death due to hematopoietic and endocrine system disorders, and if demographic factors contribute to this relationship, among decedents in the New Mexico Decedent Image Database (NMDID). Around 1.74 billion people are affected by anemia worldwide and new data is necessary to facilitate the identification of the primary causes of death correlated to anemia.

Background: Anemia is often associated with endocrine and hematopoietic system disorders. Their co-existence may lead to Sudden Natural Death. Currently, research shows that aplastic anemia is the most common form in the hematopoietic system, and it consists of a hypocellular bone marrow, a consequence of defective marrow environment and exposure to drugs, toxins, and infections. Concerning the endocrine system, research has shown that anemia is most commonly present in diabetic nephropathy cases (i.e., end-stage renal failure).

Methodology: A total of 4200 death records of individuals who died of Sudden Natural Death were selected from the NMDID and recorded in Excel. The frequency of hematopoietic and endocrine deaths was examined by the individuals' primary cause of death, known medical diagnoses, and substance abuse disorders. **Results:** The research is ongoing. Full analyses are pending. **Conclusion:** A substantial number of decedents with potentially fatal relationships between anemia and Sudden Natural Death due to endocrine and hematopoietic system disorders is expected to be observed after results are finalized.

Keywords: forensic science, forensic pathology, sudden natural death, primary cause of death, anemia

Supervisors: Lilianna Watamaniuk, Forensic Anthropologist, Ontario Forensic Pathology Service (Consultant), Program Instructor, Forensic Sciences Program, University of Toronto at Mississauga

The use of forensic science in the Ontario criminal justice system: a 5-year retrospective study

ABSTRACT

Purpose: The purpose of this study is to better understand how forensic science is used in the Ontario criminal justice system through a quantitative, multi-disciplinary approach. This study is significant as it aims to identify trends in the use, admissibility, and inferences drawn by forensic science in Ontario. **Background:** Forensic science plays an important role in judicial decision making by offering expert opinion testimony to support the theory of the Crown or the defense. There have been multiple calls for more research to understand how forensic evidence is used in court, including recommendations from the National Research Council (NRC). There are currently no studies in Ontario that explore the use of forensic science in criminal courts.

Methodology: This research conducts a 5-year retrospective study from January 1, 2018 to January 1, 2023, on trial-level cases and voir dires at the Ontario Court of Justice (OCJ) and the Ontario Superior Court of Justice (SCJ). An initial search yielded a sample size of 442 cases. After excluding appeal and non-criminal trial cases, the current sample size is 231 cases. The information from these cases will be categorized based on the forensic discipline that is called, the admissibility of the evidence, and the inferences drawn. **Results:** The results and analyses are on-going. **Conclusion:** This study can spark discussions regarding the trends in the use of forensic science in Ontario criminal courts and drive action towards further research in this field.

Keywords: forensic science, admissibility, criminal justice system, expert testimony, forensic evidence, Ontario

Supervisor: Caitlin Pakosh, Assistant Crown Attorney, Instructor at the University of Toronto Mississauga

RYAN PAWLOWSKI

Anemia and cortical bone porosity: evaluating CT scan imagery and parameters for detailed porosity assessment

ABSTRACT

Purpose: To examine CT Scans parameters used on decedents of various levels of decomposition, identifying optimal CT settings for cortical bone porosity assessment, to be used to facilitate future research into anemia's influence on cortical porosity of bone.

Background: Anemic conditions result in reduced quantities of hemoglobin, oxygen, and iron levels. Iron deficiency anemia manifests as osteoporosis, porosity, thick coarsened trabeculae, and thinning cortical bone that are visible in X-Rays. Bone homeostasis disruption results in decreased bone strength and an increased risk of fracture. Porosity has been successfully assessed using CT scans.

Methodology: Using available demographic information, n4900 anonymized individuals who died from Sudden Natural Death were identified in the New Mexico Decedent Image Database (NMDID). CT scans were taken using one of four parameters, depending on state of decomposition (none, mild, moderate, advanced), and portion available. 15 individuals of each category were selected based on CT protocol and age. Older individuals are included for base porosity measures. Porosity was measured using histomorphometric techniques for CT. **Results:** As a preliminary report, statistical results are not yet available. CT scans are being analyzed for porosity visibility.

Conclusion: The expected outcome is to identify optimal CT scan parameters for visualization of porosity. Future research can use said parameters to examine the relationship between anemia and cortical bone porosity in sudden death cases, and potentially accelerate the identification of anemia in death investigations.

Keywords: forensic science, forensic pathology, anemia, computed tomography, iron deficiency, porosity, sudden natural death

Supervisors: Professor Lelia Watamaniuk, University of Toronto Mississauga

The correlation between anemia and respiratory-related sudden natural death in decedents aged 21-100

ABSTRACT

Purpose: This research aims is to determine whether there is a substantial number of individuals for whom anemia potentially acts jointly with respiratory illnesses to cause Sudden Natural Death among individuals aged 21-100. This research will provide evidence to support funding applications that seek to contribute to forensic and medical understandings of the obscure and often unknown causes behind sudden natural death. **Background:** Previous literature has confirmed that respiratory illnesses and anemia can worsen the condition of one another due to their combined effects on hemoglobin and oxygen transfer throughout the body. Studies also show that a respiratory illness can cause sudden natural death. However, no studies focus directly on anemia and respiratory illnesses and their ability to cause a sudden and fatal pathophysiology in adults. **Methodology:** The New Mexico Decedent Image Database was used to obtain death records of individuals aged 21-100 who died of natural death between 2010-2017. These individuals were then further split into groups of individuals with an anemia diagnosis, individuals with a respiratory illness, and individuals with both an anemia and respiratory diagnosis. **Results:** Data has been obtained and recorded; however, full statistical analyses are still in progress. **Conclusion:** I expect this research to contribute evidence that will support an application for funding further large-scale research regarding anemia and respiratory-related sudden natural death, improve diagnoses at autopsy, contribute to public health, and aid medical awareness.

Keywords: forensic science, forensic pathology, anemia, clinical anemia, respiratory illness, subclinical anemia, sudden natural death

Supervisor: Lilliana Watamaniuk, Forensic Anthropologist for Positive Identification of Human Remains, Ontario Forensic Pathology Service, Forensic Science Program Instructor, University of Toronto Mississauga

Optimization of non-sperm cell lysis in sexual assault cases

ABSTRACT

Purpose: The purpose of this research is to optimize the non-sperm lysis of the differential extraction technique by examining the extraction efficiency using various lysis buffer concentrations and incubation times. This research is significant as the optimization of the protocol can be adapted to an automated fieldable platform for point-of-care testing to reduce processing time. **Background:** Differential extraction is a time-consuming method that separates non-sperm cells from sperm cells in sexual assault samples. However, the inefficiency in testing these samples results in a lack of confidence in the criminal justice system. Optimization of the protocol could help to reduce backlog in testing sexual assault samples in forensic laboratories. **Methodology:** Mock sexual assault samples were prepared by spiking buccal swabs with 1:10 dilutions of semen (n=27). Differential extraction optimization was carried out with varying concentrations of the lysis buffer and incubation times. Extracted male DNA was purified using QIAamp DNA Investigator Kit and quantified using Plexor HY kit and CFX96 Bio-Rad real time PCR system. **Results:** Samples processed using a 5% lysis buffer and incubated at 20 minutes yielded a higher amount of DNA compared to conventional parameters. **Conclusion:** The results suggest that the non-sperm lysis protocol can be optimized to increase efficiency in obtaining results. Accuracy of results may be improved with a larger sample size.

Keywords: forensic science, forensic biology, cell lysis, differential extraction, DNA extraction, optimization, sexual assault cases

Supervisors: Vivienne Luk, Ph.D., Assistant Professor, University of Toronto Mississauga

A 5-year retrospective study: How forensic evidence is used in Ontario criminal trials and voir dires

ABSTRACT

Purpose: The purpose of this research is to better comprehend how forensic science is used in the Ontario criminal justice system. This study is significant because it can assist in identifying trends in the use of forensic science, establish a guide for future research, and highlight frequently used disciplines for practitioners. **Background:** Forensic science is the application of science to the legal system. It can assist in providing evidence to examine elements of a crime such as identification of the suspect. The National Academy of Science (NAS) published a report calling and emphasizing the need for more research in how forensic science is used in the court since it is an important tool used in the legal system. **Methodology:** A quantitative database will be developed, and the cases are collected from Lexis Advance Quicklaw. Eight filters (Non-Appeal Courts, Non-Appeal Courts (ON), Ontario, Ontario Judgements, Non-Jurisdiction, 01/01/2018 - 01/01/2023, Criminal Trials, Trial Decisions) are incorporated on Lexis Advance Quicklaw for exclusionary purposes. This resulted in 231 cases. A set of fields coordinated by the researchers will be tracked using Google Sheets for each case (year of decision, court level, type of proceeding, expert qualification at issue and results for crown & defense, number of experts, discipline of forensic experts, overarching legal issue, nature of inference, verdict). **Results:** The collection of data is in progress. **Conclusion:** The key findings of the research, the next steps and improvements will be discussed.

Keywords: forensic science, forensic evidence, criminal justice system, criminal trials, retrospective study, voir dires, Ontario

Supervisors: Caitlin Pakosh, Assistant Crown Attorney

POSTER SESSION PRESENTERS LIST

FSC485H5:

EXPERIENTIAL OPPORTUNITY IN FORENSIC SCIENCE



SARAH BONE

Digging in the dirt: A FSC485 capstone

ABSTRACT

Purpose: The purpose of FSC485: Professional Opportunities in Forensic Science is to develop skills and abilities through an already established professional experience such as workshops, certifications, field schools, co-ops, work-study positions, internships, or jobs. FSC485 can provide students with an alternative route to the Forensic Science internship programs at the University of Toronto Mississauga. FSC485 is directed toward students seeking practical experience in a desired field not offered by the forensic internships. My poster explores how a placement in an archaeology firm was advantageous for my career goals. The poster also compares the advantages and disadvantages of FSC485 to FSC481: Internship in Forensic Science and FSC483: Collaborative Research Internship for my desired life goals. I detail how I located the opportunity by investigating many different archaeology positions available in Ontario. In addition, I discuss which aspects of an Ontario archaeological survey I contributed to, including stage twos: property assessments; stage threes: site-specific assessments, and laboratory analyses for the company Ground Truth Archaeology. I assessed many sites across the Quinte West Region, ranging from historic settlement dwellings from the mid-1700s to the late 1800s. Through the FSC485 professional opportunity, my take aways included how to apply for archaeology jobs, what employers in archaeology look for in employees, how to effectively communicate with co-workers, how this opportunity benefited in my graduate school applications and my ability to obtain similar jobs.

Keywords: archaeology, artefact, artifact, excavation, field walking, soil, test pitting

Company: Ground Truth Archaeology

TRISTAN DE COTIIS

Forensic mental health and corrections: bridging the gap

ABSTRACT

Purpose: The purpose of this research is to analyze patient data from women who have been discharged from the Women's Acute Stabilization Unit (WASU). The goals are to determine what kinds of women end up there, how much the unit has been helping them, and to identify any subgroups that resist treatment and may require special attention. The WASU is a multi-million-dollar government project upon which dozens of women have depended for mental health support, so the results of this project will be very important to mental health in Ontario. **Background:** The WASU is housed at the Ontario Shores Centre for Mental Health Sciences, a large psychiatric hospital in Whitby. It is a secure 5-bed inpatient unit used to treat incarcerated women who are suffering from acute psychotic symptoms. 40+ women have completed treatment at the WASU since its inception, but their data has never been formally analyzed. **Methodology:** Using Microsoft Excel and RStudio, patient data is being statistically analyzed to see if patients are experiencing clinically significant improvement, and whether any subgroups (e.g., ethnicities) tend to experience more, or less improvement. Statistics in the final report will primarily be paired samples t-tests (with scores on psychiatric scales as the outcome variables) and correlations (with days spent in the WASU as the outcome variable). Results will be published in a scientific journal. **Results:** In progress. **Conclusion:** In progress.

Keywords: forensic science, forensic psychology, correctional psychiatry, mental health, psychosis

Supervisor: Dr. Elizabeth Coleman, forensic psychiatrist and medical director of psychiatry, Ontario Shores Centre for Mental Health Sciences

Research abroad: skill development and student growth through international exchanges

ABSTRACT

Purpose: Foreign exchange programs provide opportunities for students to widen their horizons through education in a different country and culture. Participating in outbound exchanges also improves prospects for future employment or post-graduate studies.

Background: The Undergraduate Research Opportunities Programme in Science (UROPS) by the National University of Singapore (NUS) is a way for undergraduates to perform independent research while under supervision by a professor. Students from abroad will gain course credit at their home institution by participating in UROPS on a research subject of their choice.

Methodology: A three-month UROPS project focused on forensic entomology was conducted and culminated in a final report and oral presentation to NUS examiners. Blowfly feeding behaviors with diluted blood were examined for the influence of factors such as blood concentration and environmental conditions.

Results: Performing UROPS helps undergraduate students gain first-hand research experience within their current academic discipline. Written and verbal communication skills are practiced regularly through frequent supervisor meetings and final report submissions. Students will also engage in networking by forming lasting connections with faculty and peers in the same lab department.

Conclusion: International exchanges such as the UROPS program allows undergraduates to gain practical experience in their preferred field of study with guidance from professionals. Researching abroad allows students to develop their skills in personal, academic, and professional matters while also making progress towards their degree.

Keywords: forensic science, forensic entomology, blowflies, international exchange, study abroad

Supervisors: Dr. Shawn Yang Ming Lee, Lecturer, National University of Singapore; Stella Tan Wei Ling, Associate Professor, National University of Singapore

Improving clinician services by evaluating patient care and quality

ABSTRACT

Purpose: The purpose of this poster is to discuss my internship experience in research on improving clinician support and patient care to improve services and experience in the mental health care system in the new capstone course, FSC485: Professional Opportunity in Forensic Science. **Background:** At Ontario Shores, Minjoung's role as a student intern supported research evaluating and improving the quality of clinician services. As well as the Centre for Addiction and Mental Health (CAMH) as a research student with the Toronto Adolescent & Youth (TAY) Cohort Study, tackling mental health challenges for youth. **The Experience:** At Ontario Shores, my central role consists of supporting the research of evaluating and improving current treatment models and teaching modules for clinical staff. At TAY, my roles consist of directly working with youth from outreach, recruitment, and consent to conducting participant visits. **Takeaways:** My two research experiences were the opposite regarding research aims; at Ontario Shores, the projects were mainly clinician focused, while at TAY, it was youth-patient-focused. Focusing on both sides provided a holistic picture of the provider and patient's experience with mental health care. I have also had the opportunity to work with different populations & gain interest in unexpected areas of research. **Conclusion:** FSC485 allowed for more flexibility in what I could make of the experiences with an adjustable timeline not focused solely on research. I developed transferable skills and valuable research experience that will supplement future academic or career applications.

Keywords: forensic science, forensic psychology, evaluation research, mental health, youth psychology

Supervisors: Dr. Lynn Zhu, Researcher, Ontario Shores Centre for Mental Health Sciences; Aristotle Voineskos, Principal Investigator, Toronto Adolescent and Youth (TAY) Cohort Study, Centre for Addiction and Mental Health

LEMISHA MCLEAN

When mental illness meets the law- best practices for working with offenders with mental illness

ABSTRACT

Purpose: The purpose of the FSC485 capstone course is to gain professional experience to aid me along my journey to achieving my career goals. This experience was significant in providing me with exposure to the field and gave me insight on working with Offenders with Mental Illness (OMI). **Background:** I am a 4th year Hons BSc Forensic Psychology candidate, with a passion and keen interest in Psychology and the Law. One of my main areas of interest is treatment of Offenders with Mental Illness. My career goals entail me working hands on with such marginalized communities as they navigate the judicial system and everyday life. As a result, I completed experiences that would teach me the best practices I will need to employ while doing such work. **Methodology:** I completed an online course with the Canadian Psychological Association called- Evidence Based Correctional Practices for Working with Offenders with Mental Illness. This course introduced me to a treatment model that has proven effective in promoting better outcomes for OMI. I also completed Psychological First Aid training with Red Cross Canada and gained certifications in providing aid to myself and others. **Conclusion:** After completion of my experiences, I gained 6 Continuing Education credits from the Canadian and American Psychological Associations, as well as Psychological First Aid certifications. Overall, I was awarded with knowledge and skills on the best practices for working in with Offenders with Mental Illness in the field of Forensic Science.

Keywords: forensic science, forensic psychology, first aid, law, mental health, mental illness, offenders, psychology, psychological, treatment.

Supervisors: Dr. Tracy Rogers and Dr. Karen Woodall, FSC482/485 Professional Opportunity in Forensic Science

MICHELLE MELVIN

Healthy child development at S.E.D.I. lab

ABSTRACT

Purpose: The purpose for selecting the FSC 485 capstone experience was to have more opportunities for placements that aligned with my future career as a child developmental psychologist. I hoped to build connections with experts in the field and secure a job after I graduate.

Background: Before I enrolled in the FSC internship course, I had little prior experience in a psychology lab. I wanted to join a lab related to my career goals like the Social Emotional Development and Intervention (SEDI) lab. The SEDI lab focuses on social-emotional development research which then informs the interventions they create to nurture healthy child development and negate effects of early adversities. **Methodology:** I got accepted into the SEDI lab by inquiring about open positions and discussing my interests in child rearing methods with Dr. Tina Malti, the founding director of the lab.

Results: The application process along with the tasks during my time at the lab taught me many valuable lessons. For example, persistence, teamwork, networking, and challenging myself to try new positions outside my expertise. Through my continued efforts I was able to secure a job and assist in the policy making at the lab. **Conclusion:** Having this experience of working for a psychology lab is beneficial for future masters and career applications. Being part of the SEDI lab helped me gain exposure to the current research being published, build connections to fellow psychologists, as well as grow my credentials.

Keywords: forensic science, forensic psychology, child development, child rearing methods, developmental psychology, early adversities, intervention, social-emotional development

Supervisors: Dr. Tina Malti, Ph.D., C.Psych., Founding Director; Dr. Ruth Speidel, Ph.D., Acting Director; Chanel Tsang, HBA., Manager, Operations and Community Partnerships

Gaining valuable skills through workshops: A FSC485 capstone experience

ABSTRACT

Purpose: The purpose of this poster is to share my experience in the new capstone course, FSC485: Professional Opportunity in Forensic Science, which includes participating in psychology-related workshops. This poster will show students that FSC485 allows them to build extra skills through other educational sectors. **Background:** As someone who is not interested in research (FSC481), FSC485 accommodated my academic and career goals more because it allowed me to gain hands-on experience related to my current studies. The first workshop I participated in was titled "Working with violent, suicidal, and self-destructive adolescents", and the second workshop was titled "Effective Expert Testimony for Forensic Evaluation". **The Experience:** The first workshop taught me how to interact with vulnerable youth through collaborative work with other workshop participants, along with networking with these participants. The second workshop taught me attributes of being an effective expert witness related to professionalism. **What I Gained:** From the first workshop, I obtained a certificate of participation with 12 Continuing Education (CE) hours which can show employers my interest and knowledge related to troubled youth. From the second workshop, I obtained another certificate with 10 CE hours and techniques that I can utilize to testify as an expert witness. **Conclusion:** FSC485 allowed me to gain valuable skills and knowledge which I can utilize when working in the field of psychology. Having these experiences can also show future employers my engagement in further training for specific topics.

Keywords: forensic science, forensic psychology, certificate, expert testimony, troubled youth, workshops

Supervisors: Dr. Karen Woodall, Assistant Professor, University of Toronto Mississauga

POSTER SESSION PRESENTERS LIST

FSC407H5:

ADVANCED IDENTIFICATION FIELD SCHOOL



GABRIELLE EYER

My experience in the Forensic Identification Field School (FSC407)

ABSTRACT

Purpose: I chose to enroll in the Forensic Identification Field School (FSC407) as my capstone experience to further my interest and knowledge in the field of forensic identification and to explore forensic identification as a potential career path. **Background:** Forensic identification is defined as the application of forensic science and scientific principles to a crime scene investigation to answer questions pertaining to the identification of an individual. Work in the field of forensic identification include tasks such as photography and documentation, latent fingerprint development and enhancement, and evidence collection. **Summer component:** I completed the Forensic Identification Field School over a 2-week period in July 2022. I learned and applied techniques for advanced fingerprint enhancement and development, as well as footwear impression collection. My colleagues and I were also tasked with processing a mock crime scene (documentation, photography, evidence collection) as it would be expected of a forensic identification officer. **Fall component:** In the 2022 fall semester, evidence processing and analyses from the crime scene were ongoing. Students completed a full crime scene report. The report was then presented in a moot court setting, whereby students provided expert testimony and were cross-examined. **Conclusion:** The FSC407 Forensic Identification Field School is a great opportunity for students with an interest in forensic identification to further their knowledge and skills in the field. The course aims to prepare students who wish to pursue a career in forensic identification or policing.

Keywords: forensic science, forensic identification, crime scene investigation, photography, fingerprinting, footwear analysis

Teaching staff: Professor Wade Knapp; Agata Gapinska-Serwin; Ernest Prack; Grace Gregory Alcock

ARI KATCHEN

FSC407: Advanced Forensic Identification Field School

ABSTRACT

A 2-week course that takes place during the summer, the advanced forensic identification field school, provides a wide variety of opportunities for students to network with others in the field, develop different methods and techniques for forensic identification, and partake in a real-life mock crime scene. Lectures are given by guest speakers of different professions related to forensic identification such as fire investigations, bomb squad, and disaster victim identification. The lab activities provide hands-on experience in learning advanced techniques in forensic identification such as lifting fingerprints from the skin, using a fire extinguisher to locate fingerprints, and collecting a footwear impression in blood. Finally, students are able to use these newly acquired skills in a mock crime scene. Here, students work in groups of four to process certain sections of the crime scene. Students test their current forensic identification skills while also learning new skills such as crime scene management, evidence processing, and crime scene documentation. Once the summer portion is completed, the course finishes off with a mock trial at the end of the fall semester where students present their findings from their mock crime scene. Overall, this course provides students with useful skills including teamwork, communication, critical thinking and problem-solving, time management, and attention to detail.

Keywords: forensic science, forensic identification, fingerprints, footwear impression, evidence processing, crime scene management, bloodstain pattern analysis, photography, documentation

Advanced identification techniques for crime scene investigation: A field school experience – FSC407

ABSTRACT

Purpose: This poster presentation highlights my experiences of taking FSC407 also known as Advanced Forensic Identification Field School, as a capstone experience for FSC482. FSC407 is a field school course that is made as an extension of FSC300/302. As a course, you practice a variety of topics such as proper documentation techniques, scene mapping, protocols for potential issues, fingerprint development, and photography techniques. During the fall term, it consisted of presenting our evidence and submitting reports coupled with oral presentations on footwear and fingerprint impressions, finally ending the term with a moot court with cross examination from a lawyer. Taking FSC407 was a way for me to gain insight to fieldwork in crime scenes, while also helping me decide whether forensic identification was a career I wanted to pursue. FSC407 provides students with practical experience in the collection, analysis, and interpretation of evidence, which is critical to a crime scene investigator. Additionally, FSC407 brings together students, professionals, and experts in the field, providing students with opportunities to build their professional networks and make valuable connections for their future careers. Regarding personal growth, Forensic field school courses can be challenging and require students to work in high-pressure situations such as mock crime scenes or mock courtrooms. This led to personal growth and development as I and the other students in my class, learn to overcome obstacles and work effectively under stress. Overall, FSC407 was an effective experience for growing my network, developing the necessary skills for future careers, the development of soft skills, and personal growth.

Keywords: forensic science, forensic identification, forensic science field school, field school, crime scene investigation, photography

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