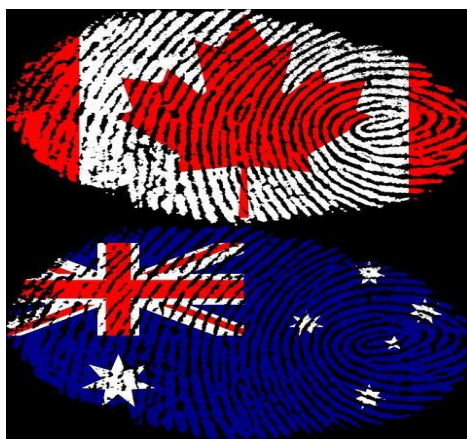


Researching International Forensic Science Responses in Australia and Canada to aid the UK Knife Crime Response



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Churchill Fellow 2018

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... so, what should we do about UK knife crime?



Image 1: 'The Knife Angel' sculpture created by the British Ironworks Museum in Shropshire from 100,000 bladed weapons recovered from knife amnesties (collection bins) from police forces throughout the UK. The Knife Angel has her hands outstretched as if to say.. 'why?' It is hoped that this sculpture will be a deterrent to further acts of violence and a memorial to everyone impacted by UK knife crime.

Please be advised that the author requests due to the sensitive and confidential nature contained within this report relating to forensic science practice within numerous Criminal Justice Systems – this report is not intended for widespread public release – however elements will be disseminated publicly, via conference presentations, media briefings, awareness campaigns etc.

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The views and opinions expressed in this report and its content are those of the author and not of the Winston Churchill Memorial Trust, which has no responsibility or liability for any part of the report.

1. ACKNOWLEDGEMENTS

This entire experience and unique opportunity would not have been possible without the support and guidance of the entire Winston Churchill Memorial Trust who awarded this Fellowship to me.

Furthermore, it is entirely justified that family members and friends are recognised here, for their consistent support: before, during and after the Fellowship, with what had been a difficult year with personal issues (my pelvis injury impacting my mobility, a sudden family bereavement during the second phase and a family member's illness).

Additionally, the involvement of my colleagues and employers at both De Montfort University and Cellmark Forensic Services throughout the application; short-listing, interviewing and pre/during/post travelling process should be recognised.

Finally, this Fellowship is dedicated to the individuals and multiple agencies of the UK Criminal Justice System - who strive to detect and prevent knife crime offences. The engagement and involvement with forensic science experts, crime scene examiners, police investigators and researchers within Canada and Australia, were crucial to this research, as they enabled observations, discussions, evaluations and recommendations.

Additionally, the valuable contribution of Sir Winston Churchill to the UK Criminal Justice System initially inspired me to apply for the 2018 Churchill Fellowships. Previously, people living within a lower socio-economic class would receive harsher penalties from courts and this bias reduced after Churchill interjected, who also improved conditions within the prisons and penal system. Sir Winston Churchill was a pioneer for the social and welfare systems of the 20th century. He was determined to enhance public policy through the labour exchange, instigate important legislation such as the National Insurance Act and Children's Act, introduce pensions for citizens aged over 70 and implement safety standards within workplaces and mines.

In my opinion, he was a role model for wanting to make a difference in so many subject areas including: literature, art and science. His forward thinking approach to look outwardly in learning from others and then in sharing this knowledge to ultimately improve the lives of those in Great Britain and elsewhere in the world, was revolutionary. Therefore, he was a truly inspirational person, who reportedly stated:

'...we make a living from what we get, but we make a life from what we give'.

For myself and others who are fortunate to work in the UK Criminal Justice System, we provide a service for everyone in our community, however challenging or difficult this may be. Ultimately, I truly hope that this research will further assist my colleagues in improving the UKCJS response to knife crime.



Image 2: The Chartered Society of Forensic Sciences annual conference in November 2018, where I met up with another Criminal Justice Churchill Fellow: Rose Mary Johnston (Churchill Fellow 2017) who collected a CSoFS award.

2. GLOSSARY

- *AFSP – Association of Forensic Science Providers*
- *ANZFSS - Australia and New Zealand Forensic Science Society*
- *APPCs – Association of Police and Crime Commissioners*
- *APPG Knife Crime- All Party Parliamentary Group Knife Crime*
- *BPA - Blood Pattern Analysis (interpretation of blood patterns, within the forensic science laboratory or at crime scenes by trained specialists)*
- *CALA – The Canadian Association of Laboratory Accreditation Inc.*
- *CPS – Crown Prosecution System*
- *CSFS – Canadian Society Forensic Sciences*
- *CSI – Crime Scene Investigation*
- *CSoFS – The Chartered Society of Forensic Sciences (UK)*
- *CT – Computed Tomography (imaging technique)*
- *Damage - clothing textile examinations – determines if a garment has been ripped, cut or punctured*
- *ERU – Evidence Recovery Unit*
- *EtO – Ethylene Oxide (consumables pre-exposed to EtO to prevent DNA contamination)*
- *FDU – Fingermark Development Unit*
- *Forensic Biology – Examinations involving bodily fluids, for e.g. blood*
- *Forensic Chemistry – Examinations involving trace evidence, for e.g. fibres, hairs, glass, paint*
- *HPM (high power microscopy, used for e.g. microscope slide searching)*
- *IABPA – International Association of Blood Pattern Analysts*
- *IAFS - International Association of Forensic Science*
- *IR - Infra Red (section of the electromagnetic spectra used in illumination)*
- *ISO17025 – International standard for laboratory testing*
- *KM – Kastle Meyer (a presumptive test for the detection of blood)*
- *LPM (low power microscopy, used for e.g. searching of exhibits)*
- *Minitape – Adhesive tape used for recovery of cellular material*
- *NATA – The National Association of Testing Authorities, Australia*
- *NCA – National Crime Agency (National Injuries Database)*
- *NKCMWGW - National Knife Crime Multi-Agency Working Group (Churchill Fellowship proposal)*
- *NKCWG - National Knife Crime Working Group*
- *NPCC – National Police Chiefs Council*
- *UKAS - United Kingdom Accreditation Service*
- *UKCJS – UK Criminal Justice System*
- *UV –Ultra Violet (section of the electromagnetic spectra used in illumination)*

3. PERSONAL BIOGRAPHY – Leisa Nichols-Drew

I have been a Forensic Scientist within the UK since 2000 and am currently employed at Cellmark Forensic Services as a team member within a forensic laboratory major crime unit, which includes investigations such as: burglary, vandalism, armed robbery, sexual offences, terrorism, assault, manslaughter, murder and cold case reviews. I actually have a blended portfolio forensic science career which also involves: undergraduate degree lecturing at De Montfort University in Leicester, as well as: undertaking research, training delivery, auditing, consultancy and public speaking for crime prevention.

I commenced my forensic science career as a Forensic Science Assistant for the world renowned UK Home Office Forensic Science Service within the ERU (Evidence Recovery Unit) of the Huntingdon laboratory. This role involved the search, examination, recovery, packaging and documentation of body fluids (including presumptive and confirmatory tests) for: blood, cellular, semen, saliva, urine, faeces and vaginal material, with the collection of: hairs, fibres and trace particulate debris, as well as conducting digital photography, shoe/tool/tyre mark analysis evidence comparisons and UV/IR imaging techniques. Additional responsibilities involved: vehicle examinations; attendance at crime scenes and other off-site working; training/coaching/mentoring colleagues; also delivering forensic awareness training sessions to: police officers, CSIs, CPS staff and judiciary. Occasional responsibilities included: visits to post-mortem examinations, case conferences, defence examinations and court when requested.

Promoted to a Senior Forensic Examiner in 2006, involved additional responsibilities for co-ordinating complex multiple item major crime investigations, and as a Technical Training Advisor in 2011 for creating, delivering, assessing and evaluating all FSS training packages. I even had the honour of demonstrating forensic science techniques to HRH Duke of Gloucester! Subsequently, appointed to a national group to facilitate best practice and validate new forensic techniques, with successful completion of UKAS Assessor and Auditor courses. Additionally, the responsibility for writing and reviewing Standard Operating Procedures, auditing and investigating quality issues led to examination processes still in use today.

In 2016, I participated in a national project which involved the transition of a novel fingermark development and visualisation method for metal surfaces (e.g. bullet casings), from researchers to practitioners in over 30 police forces across the UK, as well as the National Crime Agency, Ministry of Defence and communicated internationally. In 2017, I investigated other challenging surfaces for fingermark visualisation and have developed a unique method for leather surfaces, resulting from my MSc thesis. Recently, following my WCMT research, I have undertaken a part time PhD, to further this research, which could provide assistance for weapons in knife crime offences (leather sheaths).

A personal interest is CPD; through professional society memberships, also via attending forensic science conferences, events, workshops and training courses. Currently, my active roles within the Chartered Society of Forensic Sciences include: Assessor, Link Member Representative (to encourage new members), a Conference Committee Member and appointed a position on the Publications Committee.

Forensic science has always been a lifelong passion and it remains a privilege and honour to continue working in this field. Additional resources regarding author:

- Chartered Society of Forensic Sciences webpage: <https://www.csofs.org/Leisa-Nichols-Drew>
- Linked In networking webpage: <https://uk.linkedin.com/in/leisand>
- Consultancy Website: www.forensic-select.co.uk

4. EXECUTIVE SUMMARY

The UK is currently experiencing unprecedented levels of violent criminal offences involving the carriage and use of bladed weapons. Despite approaches designed to target knife crime, through initiatives such as Operation Sceptre (including amnesties, wands, arches); urban and rural communities continue to be detrimentally impacted.

This Churchill Fellowship investigated international forensic science responses to knife crime within Australia and Canada to assist the UK situation. These two Commonwealth countries are world leaders in forensic science and have experienced their own issues with similar offences. There were four themes for this research: the crime scene, forensic laboratory, the court system and novel research. Visits were scheduled to three different state/territory/province police forces as well as a federal/national police force within each country, as each has different legislation unlike the UK.

Similarities were observed within and between the three nations, which provides a degree of reassurance, for instance, novel research outputs, accredited facilities and standard operating procedures. However, there were a greater number of variations, such as equipment utilised, examination methodologies, court preparation, crime scene and mortuary approaches, also police force structure. Therefore, a useful opportunity to determine these new 'best practice' approaches.

There were two key responses identified: proactive and reactive, which have generated the following recommendations:

- **Reactive:**

1. Implementation of IR visualisation within the laboratory examination process for blood
2. Inclusion of Rhodamine as a successful fingerprint development method for knives
3. Practice of a tripartite working arrangement (forensic laboratory, mortuary and crime scene) to aid the investigation of knife crime

- **Proactive:**

4. Engagement of police forces, forensic practitioners and academics in research and CPD via conference attendance and regular focus group meetings and establishment of a National Knife Crime Multi Agency Working Group (NKCMAWG).
5. Suggest future knives be manufactured without pointed tips (with rounded ends instead) and pursue the potential for stab resistant textiles to be blended into clothing production (in order to minimise future injuries and fatalities)
6. Pursue UK parliament for introduction of knife manufacturing/trading safety guideline legislation as a public health issue response (within the Offensive Weapons Act, 2019).

Ultimately, if these recommendations are successfully implemented, they **will** positively impact the response to UK knife crime offences and hopefully prevent future injuries altogether.

5. INTRODUCTION

5.1 Background Context

Since 2011, the UK has been experiencing increasing levels of knife crime, impacting urban and rural communities, despite existing multi-agency initiatives. Other Commonwealth countries have had similar experiences, in Australia knives are the most used weapon, whereas in Canada, stabbings are the most frequent homicide. As a result, they have utilised many different forensic science approaches which will benefit the UK. Additionally, the Criminal Justice Systems of Australia and Canada have greater diversity, due to independent laws with both national and province/state/territory forensic service provision. Therefore, these variations could potentially identify significant improvements for the UK, even aiding historic violent case reviews.

Hence, verifying the evident rationale for my travelling to these two countries via this pioneering Churchill Fellowship. This will yield essential new learning by targeting knife offences from a scientific perspective, to focus on strategies and techniques to optimise evidence. Furthermore, it will enable vital novel research to form best practices providing assistance for UK knife crime investigations. Ultimately, it is envisioned that this Churchill Fellowship will have a dual legacy, in firstly aiding detections and convictions, whilst, in future, by also preventing crimes and reducing injuries.

5.2 Aim and Objectives

The generic aim of my Churchill Fellowship is to investigate forensic science responses to knife crime within Canada and Australia, by engaging with practitioners, investigators and researchers, to then share this new learning on the return to the UK.

The following objectives will assist in achieving my Churchill Fellowship aim:

1. Review existing literature on violent crime investigation in the UK, Canada and Australia;
2. Identify and understand variations in the investigative and crime scene approaches;
3. Compare and contrast current laboratory practices in knife crime forensic examinations;
4. Evaluate the potential for success of different practices in the context of a UK infrastructure;
5. Identify emerging research and technologies to aid UK training, reconstruction and interpretation;
6. Disseminate the findings of the project to relevant national and international organisations;
7. Initiate an international knife crime network for practitioners, investigators and researchers;
8. Produce forensic laboratory examination guidelines for knife crime.

To address the aim and objectives for my Churchill Fellowship, this report includes a critical evaluation of findings, along with resulting recommendations to be disseminated within the UK.

5.3 Forensic Science and Policing:

- UK

The UK has an approximate land size of 243,610 sq km and a 2018 population of 66.6 million people. At present there are 43 police forces in England and Wales. Whilst Scotland has a united police service and this is consistent with PSNI (Police Service Northern Ireland).

- Australia

Australia has an approximate land size of 7,741,220 sq km, with a 2018 population of 24.6 million people. Within Australia, there are multiple states and territories, each with their own legislation, police service and forensic provision. These states and territories are: Western Australia, Northern Territory, South Australia, Victoria, Tasmania, Queensland and New South Wales. There is also a federal police force that is responsible for matters of national interest within the Australian Capital Territory of Canberra as well as international matters, which is the Australian Federal Police.



Image 3: The states and territories in Australia

- Canada

Canada has an approximate land size of 9,984,670 sq km with a 2018 population of 36.7 million people. Similarly to Australia, within Canada, there are numerous territories and provinces with their specific legislation. The ten provinces are: Quebec, Ontario, British Columbia, Alberta, Nova Scotia, Manitoba, Saskatchewan, Prince Edward Island, New Brunswick, Newfoundland and Labrador. The three territories include: Nunavut, North West Territories and Yukon. Overseeing federal matters whilst additionally supporting the province and territory police provision is the Royal Canadian Mounted Police.



Image 4: The provinces and territories in Canada

5.4 Knife Crime:

- Knife Crime in the UK Overall

There were 43,516 knife crime offences in the 12 months ending March 2019 (Office for National Statistics: Crime Survey for England and Wales).

Knife related offences occur in urban and rural areas, which is apparent across the UK.

These offences are not only open space/street assaults (Serious Street based Violence) involving knife carriage often reported in the media but also domestic incidences within residential properties, as well as robberies and even sexual assaults.

The most likely 'sharp' weapon utilized is a kitchen knife. with 31 out of the 43 England and Wales police forces reporting increases in knife crime offences.

This is the highest number of offences involving sharp implements since 2011, 90% were robberies or violent assaults.

It is believed that these increased statistics are due to a reduction on police forces conducting stop and search strategies as well as increased gang activities and the phenomenon of county lines; in which individuals utilise routes from urban to rural areas for illegal activities including drugs offences.

In Northern Ireland, there were 769 recorded offences involving a sharp instrument or implement from 2017-18 and 26% of homicides were the result of using such weapons.

However, this is not a universal representation of the UK. In 2005, Scotland had one of the highest rates for knife crime offences.

The Violence Reduction Unit was formed to target Glasgow in particular. This is further confirmation that there are regional variations in knife crime.

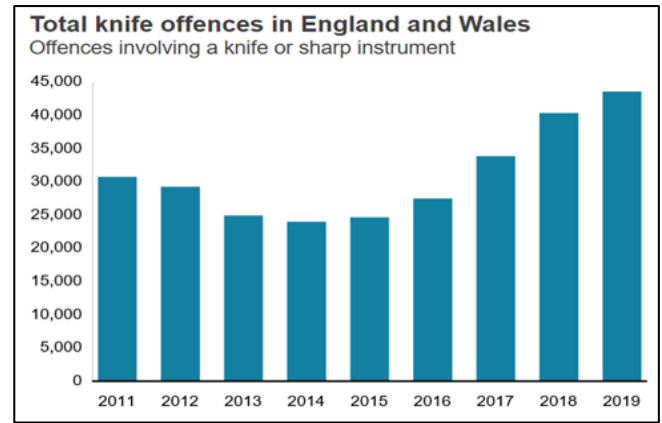


Image 5: Bar graph - numbers of knife crimes

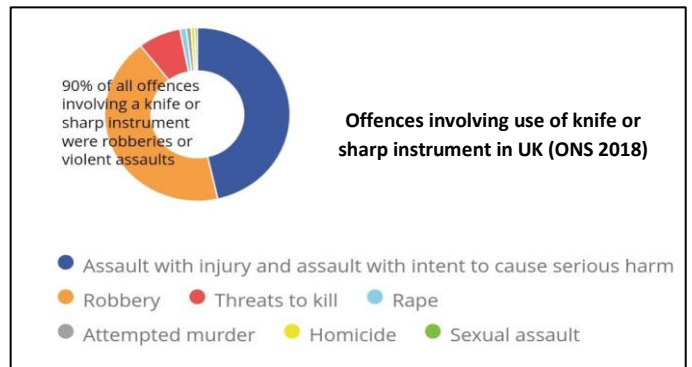


Image 6: Circle chart - Offences involving sharp instruments

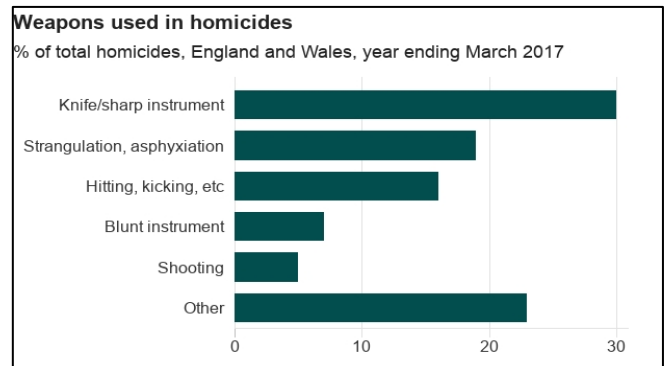


Image 7: Bar chart - Eng & Wales homicide weapon use

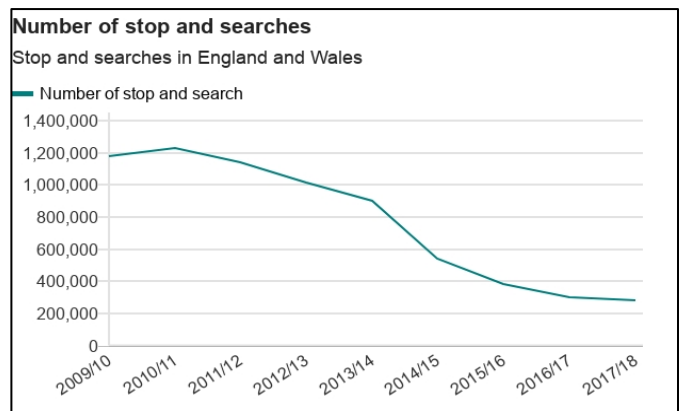


Image 8: Line graph - numbers of stop and searches

- Knife Crime in Cambridgeshire and Fenland (the home area of the Churchill Fellow)

Knife crime offences have increased by 95% in Cambridgeshire (in the East of England) since 2013 (All Party Parliamentary Group on Knife Crime). Cambridgeshire is a rural populated area. Cambridgeshire Police took action against 218 people in the 12 months ending September 2018, either for possession of a knife or for threatening someone with one. Regular knife amnesties operated by the police have successfully yielded the retrieval of weapons, e.g. November 2017, 90 bladed weapons were recovered in a seven-day period.

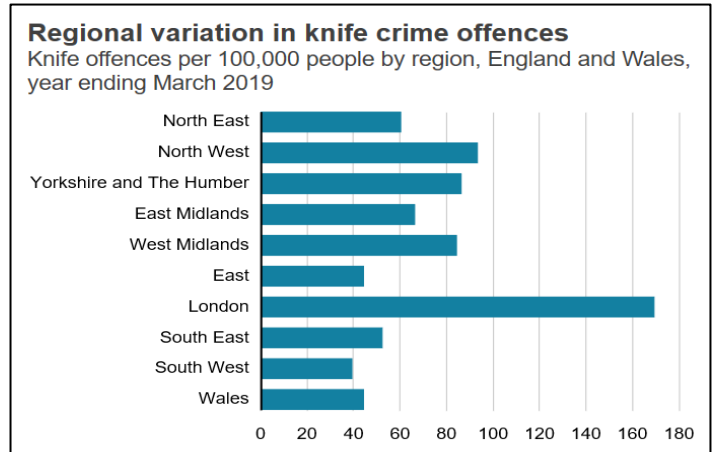


Image 9: Bar chart – Regional Variation UK Knife Crime

However, in the year ending May 2019, there were 38 recorded offences involving the possession of a weapon in the greater Wisbech area (Cambridgeshire: Fenland Region Police). This highlights the wider issue of knife carriage in Fenland. In March 2019, 6 men were convicted for stabbing related deaths in Cambridgeshire. There were 2 reported homicides by stabbing in the Wisbech area (from December 2018 – February 2019) from a Freedom of Information (FOI) request.

- Knife Crime and the Multi-Agency Response

Crucially, the UK National Health Service has reported increases in the numbers of hospital admissions related to knife related injuries and has been deemed knife crime to be a ‘public health issue’. On average, there were 12 admissions every day in the year 2016-2017, with a total of 4,434 across the entire period.

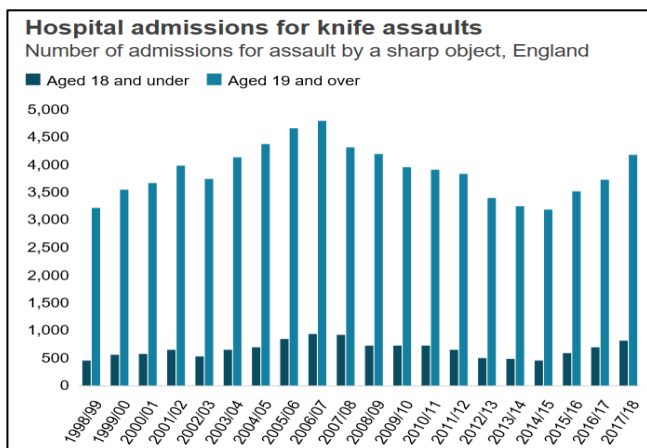


Image 10a: Bar chart - NHS admissions from sharp objects

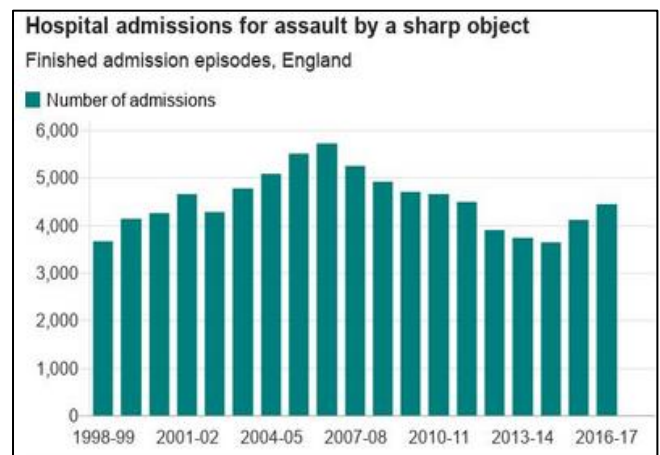


Image 10b: Bar chart - NHS admissions from sharp objects

Multi-agency partnerships have reduced the frequency of such offences by half from 137 recorded homicides to 67 in 2016-17. In an ideal world there would be no homicides at all and hopefully, this successful model could now be translated to other UK areas. Another UK anti-knife initiative is Operation Sceptre with searching wands, walk-through arches and weapon amnesty bins (knives can be anonymously deposited without fear of prosecution and then sent for secure disposal by police).



Image 11a: Weapons Amnesty Bin for knives, swords, machetes, daggers etc



Image 11b: Knife Wand



Image 11c: Knife Arch

- Knife Crime in Australia

In 2013-14, there were 238 homicides recorded in Australia and knives were responsible for 86 of these (36%) which resulted in a correlation with stab wounds being the most frequent cause of all deaths (38%) from 1989-2014.

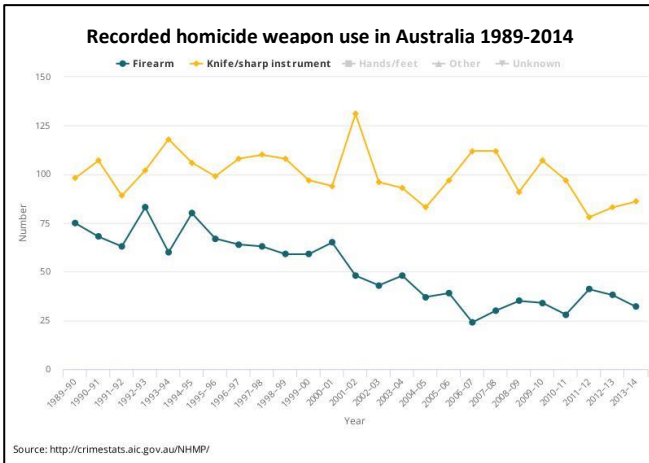


Image 12: Line graph – Australia homicide weapon use

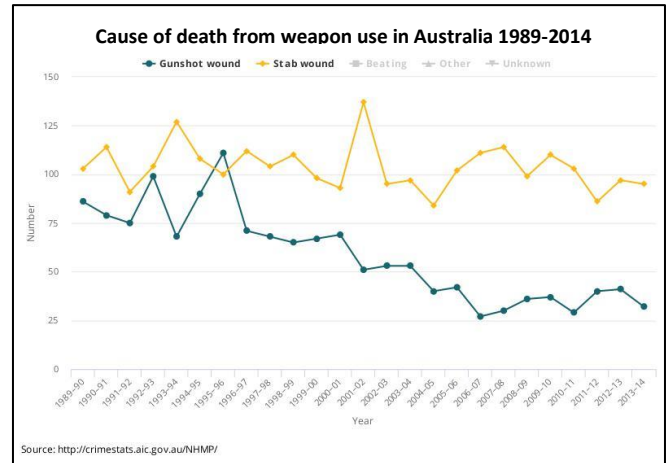
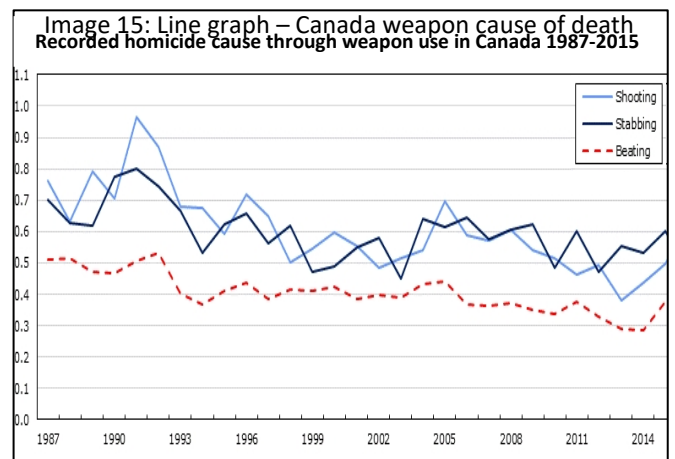
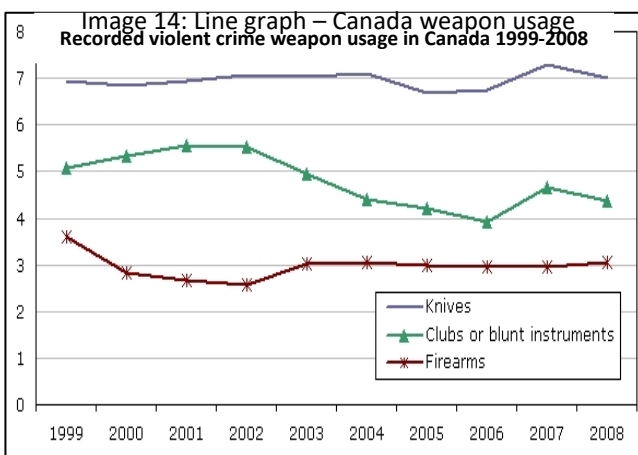


Image 13: Line graph – Australia weapon cause of death

- Knife Crime in Canada

In 2015, there were 660 homicides and stabbings comprised 216 of these (33%). However, homicides comprise only 0.2% of deaths in Canada, which reflects lower crime rates in general. In Canada, the most common homicide methods have fluctuated between stabbings and shootings in recent years, which is consistent with the frequency of recorded weapon usage. Between the years 1999 - 2008 knives were the most commonly used weapon type in violent crime offences, over wielded (clubs/blunt instruments) or firearms.



5.5 Legislative Changes

The UK, Canada and Australia have all introduced new or amended existing legislation to target knife crime related offences and particular weapons. Australia has outlawed the use of 'credit card' knives whilst Canada has targeted 'flick' knives. Meanwhile, the UK has prohibited the trade/possession/use of 'zombie' knives in the 2018 Offensive Weapons Bill. Additional UK strategies were recently issued.



Image 16: The London Knife Crime Strategy

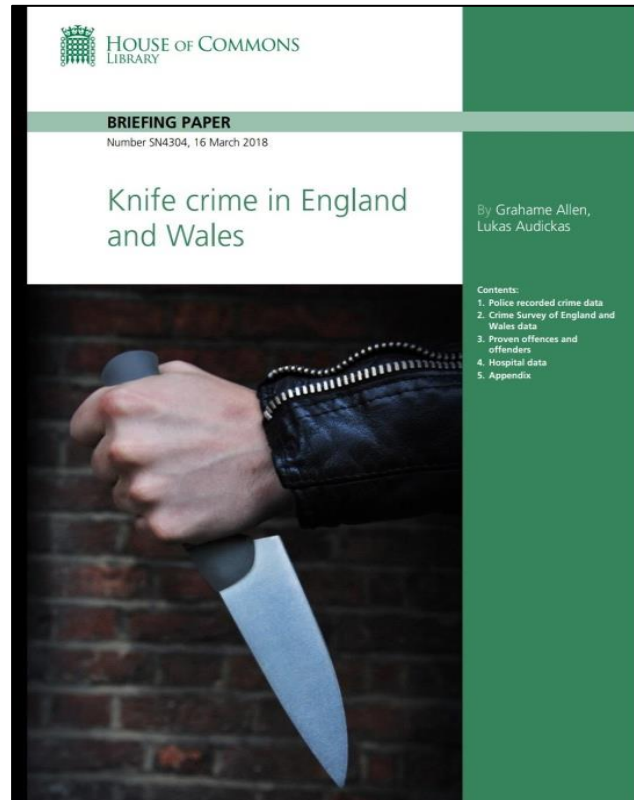


Image 17: Knife Crime in England and Wales

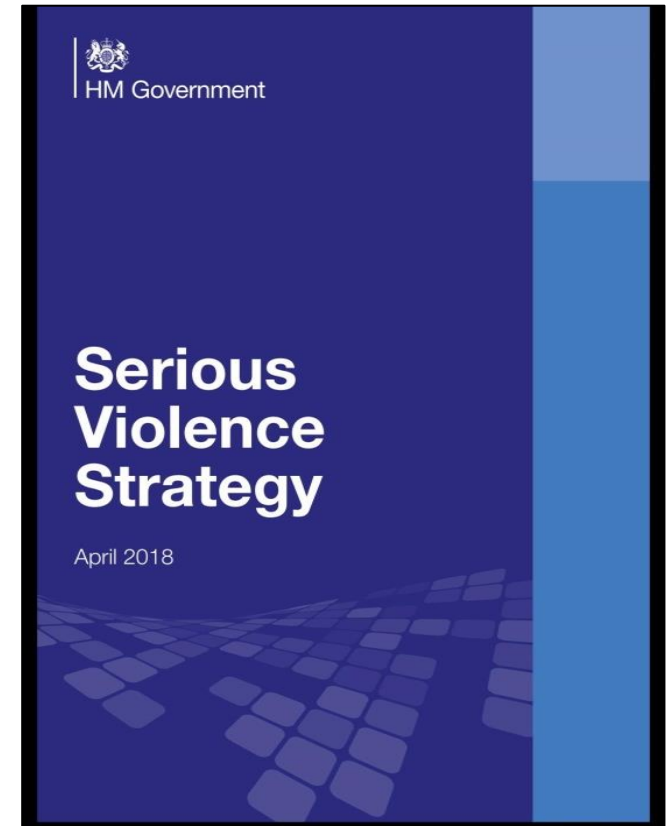


Image 18: UK HM Gov Serious Violence Strategy

5.6 Knife Terminology

Knives can vary in appearance depending upon their requirement. A typical standard kitchen knife is shown in image 16. Domestic knives are frequently encountered in criminal investigations as they are readily available. Within a forensic science laboratory examination, there is a requirement for standardised terminology to be referred to in relation to the sections of a knife, as shown in Table 1.

Numerous dimensions and measurements are also recorded during an examination, which include: Total Length of Knife, Length of Blade, Width of Blade, Thickness of Blade, Angle of Blade (this can demonstrate damage and force applied to a knife when used during an assault).

Within crime statistics, knives are routinely included within the group known as sharp instruments. These are defined as: 'a sharp instrument is any object that pierces the skin (or in the case of a threat is capable of piercing the skin), e.g. a broken bottle. Knives and sharp instruments are taken to be involved in an incident if they are used to stab or cut, or as a threat.'

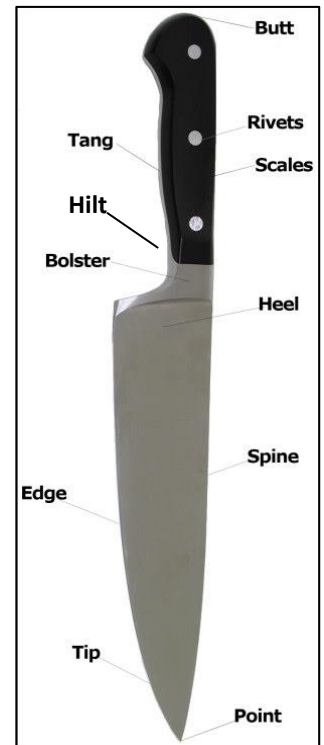


Image 19: Labelled sections of a knife

Table 1: Labelled sections and requirements of knives

Section		Requirement
Handle	Butt	Used to join handle to blade. Not present in single surface knife (where blade and handle are from same material e.g. steel)
	Tang	Surface in contact with palm of hand. Can be textured to provide extra grip. The entire handle can be de-constructed (taken apart) useful in old cases where minimal evidential traces may remain.
	Rivets	Used to join handle to blade. Not present in single surface knife (where blade and handle are from same material e.g. steel)
	Bolster	Can be referred to as finger guard – acts to prevent hand slipping to blade
Hilt		Where the blade meets handle – can be visualised in injuries as bruising
Blade	Heel	Widest dimension of blade – useful in comparison of knife to a wound
	Edge	Sharpened edge of blade – can be straight or serrated
	Spine	'Top' edge of blade – this is the thickest measurement of blade – useful in assessment of damage to clothing and wounds as can determine directionality
	Point	Can also be referred to as a tip. This is the blade area that breeches clothing and skin during a stabbing (requires force and pressure to do so)

5.7 UK Forensic Science Context and Knife Crime

- 5.7.1 Historical UK Forensic Science

Within the UK, the forensic science response to violent crime offences (including knife crime) has remained constant for the last 70 years. Within the 1930s, the Home Office established a forensic laboratory provision which would eventually become the world-renowned Forensic Science Service. This was a pioneer in forensic science technology and a source of casework examination excellence. However, in recent years, this publicly owned service has closed, which has resulted in a blended and possibly turbulent forensic laboratory situation within the UK. Privatised laboratories now conduct the laboratory examinations for police forces, and although impartial for the prosecution and defence within the UK Criminal Justice System, there are different priorities for such organisations. Primarily, as they are competitors, there is a reluctance in disclosing bespoke techniques and restrictions in sharing practices.

- 5.7.2 Current UK Sector Challenges

Due to the privatised forensic science marketplace, police forces already facilitate crime scene examinations as a component of their budgetary expenditure and can utilise other 'in-house' services; including fingermark development methodologies and certain laboratory examinations if facilities allow. Additionally, there are further disparities with regards to geographical location, contract tendering constraints and force priorities as specified by Police and Crime Commissioners. However, police forces majorly rely on the expertise provided from the privatised laboratories, resulting in additional financial burden. Smaller police forces such as Cambridgeshire have a reduced budget (due to a small population and predominantly rural farmland geography) and have collaborated with neighbouring forces (Bedfordshire and Hertfordshire) to maximise their resources. Whilst, larger police forces e.g. Metropolitan Police Service, finance their own forensic laboratory. Such disparities have resulted in the appointment of a Forensic Science Regulator to regulate quality standards and ensure consistency across the sector.

- 5.7.3 UK Forensic Science Limitations and Challenges

Bespoke forensic laboratory expertise includes the interpretation of blood patterns at crime scenes, examination of clothing for damage due to weapons, chemical testing and specialised searching methods. These are all time-consuming evidential examinations, requiring adherence to standard operating procedures (SOPs) and intensive training courses to certify scientists as proficient. Deviation from SOPs, could result in a case being ejected from the court system through loss of evidence etc. However, techniques have rarely progressed since 2000, as any new procedure must undergo extensive validation and verification before it can be utilised on actual case exhibits. Additionally, there is no specified method within the UK for developing fingermarks on steel metal (knife blades). This is therefore a challenge considering increasing numbers of violent crimes (including knife offences) within the UK.

Ultimately, forensic science is the application of science to law, and as such, we, as experts are responsible for identifying new technologies or alternative practice that may yield more evidence and aid crime detection. At present, there is a reduced forensic science research ethos within the UK due to limited funding sources. Therefore, there is a vital requirement to learn from experts in other countries to ensure that the UK maximises its capability and expertise in responding to knife crime.

5.8 My Churchill Fellowship

My Winston Churchill Fellowship was conducted over two stages within two continents: North America and Australasia; coordinated around my academic responsibilities at De Montfort University in Leicester. Therefore, I travelled during the summer recess to minimise any impact on my colleagues.

5.8.1 Visit Memento

To express my sincere appreciation to all of my hosts and organisations, I remembered to write a thank you notelet for each visit and on particular occasions I gave a Churchill Crown too. These were both received with gratitude and surprise. Therefore, I would so recommend that other Churchill Fellows write thank you cards too!



Image 20: One of my London themed thank you cards and a Churchill Crown

5.8.2 Travel Itineraries

a) Stage 1 Itinerary (July to August 2018):

18th July 2018 Travel to Canada from UK

18th – 21st July 2018 Montreal, Quebec (Phase 1)

21st – 28th July 2018 Toronto, Ontario (Phase 2)

28th – 31st July 2018 Peterborough, Ontario (Phase 3)

31st July – 4th August 2018 Ottawa, Ontario (Phase 4)

4th August – 11th August 2018 Vancouver, British Columbia (Phase 5)

12th August 2018 Arrive in UK

b) Stage 2 Itinerary (September 2018):

5th September 2018 Travel to Australia from UK

7th – 15th September 2018 Perth, Western Australia (Phase 6)

15th – 20th September 2018 Melbourne, Victoria (Phase 7)

20th – 24th September 2018 Canberra, Australia Capital Territory (Phase 8)

24th – 29th September 2018 Sydney, New South Wales (Phase 9)

30th September 2018 Arrive in UK

5.8.3 Organisations

a) Stage 1 - Canada Organisations:

- IAFS
- CSFS
- Le Laboratoire de sciences judiciaires et de médecine légale du Québec
- The Centre of Forensic Services
- Toronto Police Service
- Ontario Provincial Police
- Royal Canadian Mounted Police – Forensic Assessment Centre
- Royal Canadian Mounted Police – Forensic Investigative Services
- Ottawa Hospital Pathology Unit
- Vancouver Hospital Pathology Unit
- Trent University

b) Stage 2 – Australia Organisations:

- ESR (NZ)
- ANZFSS
- Western Australia Police
- Perth Pathology Unit
- Path West Forensic Laboratory
- RMIT University
- Victoria Police and Victoria Forensic Services
- Australian Federal Police
- New South Wales Police
- Forensic and Analytical Science Service
- University of Technology Sydney

5.9 Research Questions

I proposed the following research questions to compare the UK with Canada and Australia:

- How are examinations conducted in the forensic laboratory (testing, imaging, recording)?
- What training do experts undertake?
- What facilities, equipment, chemical tests and consumables are used?
- How are crime scenes processed?
- What novel research is being undertaken?
- What 'trends' or 'patterns' are there in knife crime?
- What court preparation is undertaken within the Criminal Justice System?
- How do experts interact with each other in knife crime investigations e.g. mortuary?

5.10 Research Methodology

To undertake my Churchill Fellowship I used numerous methodological approaches. Firstly, I informed Professional Membership Societies for potential interest and engagement, including: CSoFS, CSFS, IAFS and ANZFSS. Secondly, I obtained my Police Security Certificate to verify my Home Office clearance status, which proved useful when contacting and visiting host organisations; to access secure facilities and sensitive material. Thirdly, I purposely visited 3 different states/provinces in each country; each with distinct legislation, in addition to their national federal police forces, in order for me to obtain varied responses. Fourthly, the UK, Canada and Australia are world leaders in forensic science and have further commonality in that they are all Commonwealth nations who have jointly experienced knife crime issues. Finally, I submitted research abstracts to national and international forensic science conferences to disseminate and publicise my Churchill Fellowship, for e.g. EAFS 2018.

The following are examples of qualitative and quantitative data recovery that I utilised:

- Literature Reviews
- Conducting Interviews
- Organisational Visits and Tours
- Practical Demonstrations and Observations
- Conference Attendance
- Training Workshop
- Delivering Presentations
- Scheduled Meetings
- Telephone/Conference Call/Skype conversations
- Networking Opportunities (pre/during/post Fellowship)



Image 21: My presentation at EAFS 2018

5.11 Report Purpose

The purpose of this report is to document my Churchill Fellowship to inform, provide guidance and create best practice consensus for UK knife crime offences.

5.12 Report Audience

The intended audience for this report are primarily forensic science practitioners, police forces, researchers and academics within the UK. Additionally, the WCMT, AFSP, NCA, APCCs, NPCC, HM Government, Criminal Justice System agencies, De Montfort University (colleagues and Chancellor), charities, the NHS, legislators and the general public will find this report of interest and relevant.

5.13 Report Structure

This report will be sectioned into four themes, in alignment to the UK Criminal Justice System: crime scene, forensic laboratory, court and novel research. These are represented and defined in the table:

Table 2: Four themes of report shown as icons and key

ICON				
	Crime Scene	Laboratory	Court	Research
KEY	Magnifying Glass: Searching for evidence	Folder: forensic laboratory casefiles	People: jury, prosecution, defence, judiciary	Lightbulb: New ideas and research

Within the report, there are specific case study examples and tabulated case studies, which will illustrate key examples and learning points from my Fellowship. To assist the reader the case studies have colour coded sections as follows:

Table 3: Case study colour code system

New Concept/Idea/ Technique	Current UK Situation	Potential UK Impact/Possibilities if implemented	Advantages	Limitations	Recommendations for UK
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6. FINDINGS

6.1 Phase 1: Laboratoire de sciences judiciaires et de médecine légale, Montreal, Quebec, Canada

The forensic science laboratory in Montreal, Quebec is the Laboratoire de sciences judiciaires et de médecine légale. Maria Fiorillo is a Senior Forensic Specialist who attend crime scenes, the mortuary and conducts forensic laboratory examinations relating to violent crime offences.

I was given a tour of the following departments: Biology, Chemistry, Toxicology, Arson & Explosives, Fingerprint Chemical Development Laboratory, Fingerprint Bureau, Documents, Pathology and Ballistics.

Maria explained that the Surete du Quebec Police are also based at the laboratory location and I met police officers who actually undertake crime scene examinations, who gave me a demonstration of their impressive crime scene vehicles. Quebec is such a vast Province and regardless of the weather conditions (heat of Summer or heavy snow in Winter), the necessity to access crime scene locations is of paramount importance.



Image 23: Surete du Quebec CSI Vehicle



Image 22: Laboratoire de sciences judiciaires et de médecine légale, Montreal



Image 24: Myself and Maria

Maria and her team of colleagues were so welcoming (even though they had such high caseloads) and invited me out to lunch on the second day of my visit. Unfortunately, there had been a fatal stabbing at the time of my visit, which highlighted the truly international issue of knife crime.

I was truly privileged to have been invited to a post-mortem whilst in Montreal as this attendance is routine practice for Forensic Scientists.

I was impressed to see the quality standards in use as well as the accredited facilities, as this is consistent with the UK.

However, noticeable differences with the UK included:

- Removal of clothing from victims at the crime scene (recovered at mortuary in UK)
- Compulsory mortuary attendance at post-mortems for Forensic Scientists (*ad hoc* in UK)
- Police Officers undertake Crime Scene Examinations (not civilians as in the UK)
- o-Tolidine presumptive blood chemical test conducted (Haemastix, Kastle Meyer or Leuco Malachite Green used in UK)
- Cardboard breathable packaging to recover knife crime evidence (plastic weapons tubes UK)
- Permanent training facility and reconstruction unit (often in UK, training facilities are temporary as laboratory space is at a premium).

These are all very interesting working practices that I will communicate to the UK. However, it may take time for such alternatives to become standardised practice in the UK.

CASE STUDY: COURT TRAINING

New Concept/Idea/Technique	Current UK Situation	Potential UK Impact or Possibilities if implemented	Advantages	Limitations	Recommendations for UK
Forensic Training Provided and Visual Powerpoint Presentations provided for Courts (Judiciary and Prosecutors)	Written expert witness statements for blood pattern analysis	Maximises transparency of evidence in varied formats for courts to understand	Provides additional format to written and oral evidence	Individual courts/judges may prefer traditional formats	Promote uptake of alternative evidence formats (oral, written and visual).



6.2 Phase 2: Toronto

The Centre for Forensic Sciences, Toronto, Ontario, Canada

Regretfully, the day before I was due to visit the Centre for Forensic Sciences and Coroners Complex in Toronto, there had been a fatal shooting in the city. Despite the urgent requirement by the police for scene attendance and laboratory services, my visit did go ahead as originally planned and I expressed my appreciation upon my arrival, for the experts to give their valuable time and expertise.

The Assistant Section Head for Biology is Alex Welsh, who kindly met me at reception and escorted me around this impressive and secure facility (biometrics access). This is the most advanced and well equipped forensic laboratory I have ever visited.

The garage in particular had eight separate vehicle bays to prevent contamination between cases and isolation rooms for the examination of degraded exhibits. The Centre for Forensic Services is a laboratory designed on multiple floors with open spaces and aesthetically pleasing areas, giving a feeling of wellbeing and calm.

As per UK practice, as a visitor I gave a DNA sample, which was a swab sample from the inner mouth (known as a buccal scrape). Alex introduced me to experienced members of the laboratory Biology and Chemistry teams (John, Jen and Haidi). It was a complete honour to exchange case experiences and details of our laboratory/training/auditing roles with these experts. I was also extremely honoured as the team had pre-prepared knife exhibits within the laboratory, produced mock case notes and allowed me to witness the laboratory intranet system, where we could access SOPs (standard operating procedures) and subject guides.

The team then took me to a room where we 'gowned up', which is the process of putting on PPE (Personal Protective Equipment) such as: hair cover, face mask, gloves and a disposable labcoat. We then entered a laboratory examination area, where I witnessed the examination of knife exhibits, to represent those typically encountered in casework, for e.g. a flick knife. This involved: bench cleaning, writing of casenotes, chemical testing of suspected blood, followed by DNA recovery via swabbing.



Image 25: Centre for Forensic Sciences, Toronto



Image 26: John, Alex, Haidi and Jen

Many of these procedures are consistent with the UK forensic science approach, which provided me with reassurance that the UK is aligned to such a world leader in forensic science provision. However, noticeable differences where the UK could develop best practice include:

- Novel Leica M320 ceiling mounted microscopy and imaging equipment with in built digital camera SD card and wall monitor (typically in the UK, low power microscopes are bench mounted, which potentially could contaminate exhibits, with photography as a subsequent process).
- Separate work stream exhibit approaches for different crimes e.g. burglary and murder
- DNA samples submitted in 2D barcoded tubes consistent with case examination notes which ensures trackable continuity at all times (UK uses adhesive barcodes on DNA samples)
- Double sided tape and glass slides for fibre and hair recovery (UK uses tapelifts and acetate sheets)
- Permanent marking of blood stains on knife exhibits with pen (UK typically only marks staining on clothing exhibits)
- Novel investigative (30 days) v evaluative (60 days) case approach (UK typically has a Criminal Justice System influenced by the court process e.g. bail dates)
- Use of infra-red lighting sources for visualisation of clothing (not a routine UK process)
- Knife protocols includes the requirement for dismantling if requested (UK does not routinely have processes specifically for knives)



Image 27: Leica M320 Microscope



Image 28: Minitaping of cellular material from the inside of a balaclava

These apparent disparities could maximise potential evidence recovery from knife crime exhibits if they were to translate to UK practice. Furthermore, moving forward these will yield recommendations for this Churchill Fellowship.

Additionally, interacting with the experts in Toronto enabled exchange of laboratory practices, for instance, the recovery of cellular material via the process of minitaping. This is a routine process within UK forensic science providers, in which adhesive tape is used on fabric surfaces. I demonstrated this technique during the visit and subsequently forwarded details of research papers to Alex.

CASE STUDY: INFRA RED USAGE

New Concept/Idea/Technique	Current UK Situation	Potential UK Impact or Possibilities if implemented	Advantages	Limitations	Recommendations for UK
Infra-Red (IR) is used within the forensic laboratory to examine black/dark items for blood.	Time consuming microscopic examinations	Reduce human error rates in missing blood.	Non-destructive technique (DNA profiling can still be conducted)	Potentially high cost in equipment and lights required.	Promote uptake of IR for blood examinations.

6.3 Phase 3: Peterborough

Trent University, Peterborough, Ontario, Canada



Dr Theresa Stotesbury is a lecturer at Trent University who conducts pioneering research in Blood Pattern Analysis, a complex subject within the interpretation and reconstruction at violent crime scenes.

This research involves the generation of synthetic blood as substitute for mammalian, which assists in the training of experts. Theresa kindly gave me a tour of the campus and had arranged for me to deliver a presentation on my casework background and Churchill Fellowship to her colleagues, students and invited police.



Image 29: Theresa and me

Theresa introduced me to John Aitkenhead from Ontario Provincial Police who is an Identification Sergeant, Jaclyn Slaney and Cameron Power from the Fingermark Development Laboratory at Toronto Police and CSIs who specialise in the interpretation of blood patterns. In the UK, forensic scientists (laboratory based) undertake this specialism so it was refreshing to hear of this practice.

Subsequently, I then met John at the OPP Forensic Identification Services where he showed me the facilities and explained the differentiation between the city police, the provincial police and the federal police force. Jaclyn and Cameron were extremely interested in my fingermark research on bullet

casings and I subsequently forward them details regarding this method as used in the UK. It was so interesting meeting the police personnel and practitioners to exchange our casework experiences.

CASE STUDY: NOVEL SYNTHETIC BLOOD PRODUCT

New Concept/Idea/ Technique	Current UK Situation	Potential UK Impact or Possibilities if implemented	Advantages	Limitations	Recommendations for UK
Synthetic liquid that acts as a biochemical and physical substitute for blood.	Equine blood used to in training of BPA experts or to reconstruct scenes.	Would enable a product to be used that does not require a preservative agent (blood clots).	No health and safety concerns with this product.	As yet cost is unknown and validation would be required.	Promote usage of this product.

6.4 Phase 4: Ottawa

Royal Canadian Mounted Police, Ottawa, Ontario, Canada



Ghislain Cormier is the General Manager of the National Forensic Services Laboratory of the Royal Canadian Mounted Police in Ottawa, as well as being the President of the Canadian Society of Forensic Sciences.

This Forensic Assessment Centre is where all forensic science exhibits submissions in the federal jurisdiction are processed, which could involve exhibits being transported here from all parts of Canada.

I was given a tour of the laboratory by Ghislain and then met other scientists and RCMP staff. This enabled a discussion to learn of the national position of forensic science in Canada with regards to knife crime.



Image 30: RCMP HQ in Ottawa

I was interested to learn of alternative forensic biology tests conducted at the laboratory:

- Takayama crystal confirmatory test for blood (the UK utilises immunoglobulin test kits to confirm the presence of human haemoglobin)
- Phase Contrast microscopy for sexual offences (the UK uses cytology staining methods such as Haemotoxylin and Eosin, also Christmas Tree staining)

These are not conducted in the UK and could be introduced as alternative tests, especially for cold case reviews. However, as with all accredited institutions, new procedures require validated approval beforehand. Also, practitioners would require training and mentoring before they are implemented into live casework. Another interesting observation was the concept of the RCMP using 3 DNA databases (crime scene, missing persons, vulnerable persons). The latter could be of use in the UK too.

Prior to my travels to Canada, I discussed fingerprint development methodologies via a telephone conversation with Della Wilkinson in the Forensic Identification Unit (who was unfortunately on vacation when I was in Ottawa). Della is the eminent researcher in this subject within Canada. Della advised me of potential successful methods for knives, including Rhodamine 6G; which is a fluorescent stain used following cyanoacrylate fuming (superglue).

Another meeting that I arranged was at the Eastern Ontario Regional Forensic Pathology Unit at Ottawa General Hospital with Dr Alfredo Walker, who has extensive experience of conducting post-mortems within the UK and in Canadian Criminal Justice Systems, as a Forensic Pathologist and Coroner. I was interested to learn that CT scanning is not routinely conducted in Canada, unlike the UK. This is an important procedure as it could prevent a post mortem; which is an invasive procedure. However, there were consistencies with the UK in the examination process of knife related injuries.

6.5 Phase 5: Vancouver

RCMP E Division, Forensic Investigative Services, Surrey, Vancouver, British Columbia, Canada

S/Sgt. Dr Diane Cockle is the Coordinator for E Division Forensic Investigative Services of the Royal Canadian Mounted Police, located near to Vancouver. Despite the city of Vancouver having its own police force, the province of British Columbia is within the E Division of the RCMP, therefore during violent crime incidents requiring scene attendance, RCMP experts are requested.

In alignment with other Ontario, police officers undertake training as Blood Pattern Analysts. I was reassured to see practitioner training, coaching and mentoring that is consistent with the UK approach, along with varied examination processes (footwear, damage, physical fit, fingerprints etc).

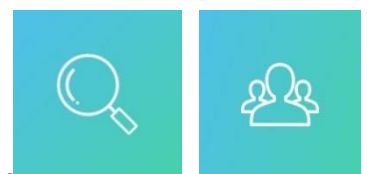


Image 31: RCMP E Division FIS, Vancouver, Canada

Diane authorised my attendance at an actual fatal stabbing scene (due to my UK security clearance certification and following RCMP verification checks) and I attended with one of the FI (Forensic Investigators). Due to the confidential nature of the ongoing investigation I could not record any photographs but I did observe passive drops and a trail outside of the property. This provided evidential support of the eyewitness account, where an injured person was transported to a vehicle.

Diane gave me a tour of the facility, which included: casefiles and examination notes, quality processes, court preparation requirements, the crime scene equipment store and laboratory examination areas, including bespoke bays for vehicles. This made me realise that the FI/CSI role is a multi-disciplinary team and complex one in Canada:

- Crime scene attendance, laboratory examinations and court attendance as expert witnesses (in the UK CSIs are witnesses not expert witnesses)
- CSIs are BPA experts so can comment on Activity Level Propositions (in UK they can assist Forensic Scientists who then determine Source Level and Activity Level Propositions)
- FI produce novel court materials jurisdiction – a powerpoint presentation to assist the jury and judiciary with technical terminology (in the UK we rely on written statements and oral evidence).

I learned so much from Diane and her team of Forensic Investigators that could revolutionise the UK crimes scene approach and intensive workloads of practitioners within our Criminal Justice System. However, we do not have a Federal police force in the UK, so to align 43 police forces; in England and Wales alone, would be problematic, especially where cross border investigations are occurring. Additionally, I was honoured to share with Diane and her team, details of my fingerprint research on leather, even after exposure to varied environmental conditions. The FIS unit do encounter leather exhibits and so this could prove useful in future. Therefore, I agreed to keep them informed. I also shared with them alternative practices that we do in the UK and learned of a vital examination and imaging technique that I think would benefit the UK forensic laboratories enormously, involving infra-red illumination. This was consistent with other forensic laboratories that I visited in Canada.

I was then honoured to meet and discuss knife crime with Dr Matthew Orde, who is a Forensic Pathologist at Vancouver General Hospital and a Professor at the University of British Columbia, who has also experienced the Australian Criminal Justice System. We had an informative and open dialogue, where we exchanged our career experiences and I concluded that there were interesting parallels with Ottawa. Additionally, this discussion provided an insight into the roles of the Coroner and the Forensic Pathologist at crime scenes and in the mortuary within Canada.

Whilst In Vancouver, I had the opportunity to visit the Vancouver Police Department, Museum and Archive facility building – which gave an interesting overview from crime scene to court. Unfortunately, there was a display of stabbing implements; actual case exhibits recovered in Canada – this highlighted that knife crime is a widespread issue impacting international Criminal Justice Systems.



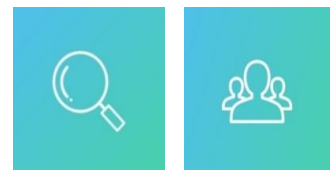
Image 32: Sharp weapons from actual cases

CASE STUDY: CRIME SCENE EXAMINERS AS BPA EXPERTS

New Concept/Idea/Technique	Current UK Situation	Potential UK Impact or Possibilities if implemented	Advantages	Limitations	Recommendations for UK
Crime Scene Examiners have dual role in being BPA experts	Separate roles in UK	Reduce waiting time for laboratory scientist to attend scene.	Training scene personnel to at least level 1 would enhance case progress.	Scene examiners would be required to attend expert witness training too.	Promote cross training/upskilling of scene examiners.

6.6 Phase 6: Perth

Forensic Pathology Unit, Path West, QE2 Medical Centre, Perth, Western Australia, Australia



The Australian and New Zealand Forensic Science Society (ANZFSS) organise a biennial symposium and in 2018, this was located in Perth. Whilst attending this exciting conference, I had the privilege of attending a two-day mortuary workshop, which was facilitated by a team of Forensic Pathologists, led by Dr Clive Cooke.



Image 33: ANZFSS mortuary workshop

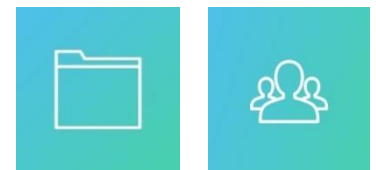
Numerous subjects were covered during the Forensic Pathology workshop, including the post-mortem process, imaging, ethical issues and determining the cause of death. Furthermore, the experts explained the information that can be obtained from stabbing (penetration) related injuries (blade length, blade width etc) and how 3D printing of bones can assist in determining potential weapons responsible. These 3D models can assist in the court process by presenting complex medical information to the jury. I thought this to be an example of exceptional practice and subsequently following my return to the UK, I have discussed this and CT scanning with Dr Jane Rutty (a fellow DMU academic) who is undertaking research into imaging of bones and injuries.

Dr Rutty has connections with the East Midlands Pathology Unit in Leicester and I hope to also engage with Professor Guy Rutty; an eminent Home Office Forensic Pathologist, as a follow up on my return.

The ANZFSS symposium included world renowned forensic experts as plenary speakers, with hundreds of presentations and posters scheduled into various subject specialisms; including crime scene investigation, digital forensics, forensic biology and education. I was honoured to have delivered two oral presentations (one on this knife crime research to enable networking and then one sharing my fingermark research on leather surfaces using Infra-Red and Ultra Violet spectra) with a poster on novel teaching methods for Blood Pattern Analysis using a virtual reality facility called The Cube at De Montfort University (where I lecture). I was pleased to see the correlation between this poster and a presentation delivered by the ESR forensic institute of New Zealand, where virtual reality and online training delivery is proving successful to practitioners around the world via a secure network. This could benefit our UK practitioners as it is often difficult to coordinate a training course requiring a full register of attendees. This alternative model allows individuals to undertake the training at their own pace.

This conference was a wonderful opportunity for networking and I managed to form connections with forensic laboratories, police forces and academic institutions. I also learned of new approaches to knife crime at the scene, for instance, Queensland Police utilise blood detection dogs to assist in reconstructing events and apprehending offenders or locating injured persons. Western Australia police are at the pinnacle of research in BPA at crime scenes and I was hoping to liaise again with Dr Mark Reynolds, as I have previously attended a BPA course facilitated by Dr Reynolds. However, regrettably there was a multiple stabbing incident in WA, which required numerous experts to attend, another example demonstrating the occurrence of knife crime in other international jurisdictions.

Cold Case Unit, Forensic Laboratory, Path West, Perth, Western Australia, Australia



My colleague at Cellmark Forensic Services, Huw Turk, had previously engaged in forensic investigations with Western Australia Police and he kindly connected me with Scott Egan from the Cold Case Unit at the Path West forensic laboratory.

I met up with Scott at the ANZFSS conference and he kindly invited me to his laboratory. Scott is the Cold Case Unit Manager at the Perth forensic laboratory and gave me a tour of the facility, where I observed laboratory areas, along with storage of casefiles and exhibits, where



Image 34: Curved ended hunting knives encountered in Australia

I also learned of different casework procedures for knives:

- One of the examiners demonstrated the electronic casenote form for knives, where I was interested to learn of the data that could be obtained from the weapons, including blade tip shape.
- In Australia, they frequently encounter an array of different hunting knives (with varied shaped tips). In the UK, it is rare to have a specific examination form for knives, but I feel we could implement this in the UK, along with the knife process route in Toronto at the CSFS facility.
- At the Perth facility, exhibits undergo minimal handling by practitioners with the use of disposable forceps to manipulate the weapon or clothing garment on the bench (routinely in the UK, latex gloves; worn over nitrile gloves, are frequently changed to prevent contamination. By combining both approaches, this would maximise UK best practice.
- Specialist imaging equipment involving infra-red spectra, for dark coloured clothing and footwear. Using this technique blood staining can be distinguished from the background colour, as with IR the garment appears white, clearly displaying any apparent blood. Surprisingly, the use of IR is not an examination procedure conducted in the UK. Instead, time intensive microscopic examinations are undertaken, which are thoroughly recorded diagrammatically. Therefore, IR is a vital UK requirement.
- Additionally, dismantling of weapons (and clothing or footwear) is routinely conducted within the Perth facility, which is a behavioural consistency with the UK; as unfortunately it is a common occurrence for offenders to attempt to remove evidence from exhibits by wiping or washing. However, the sensitivity of the presumptive and confirmatory chemicals along with the plethora of microscopy procedures available, maximise our attempts for evidence capture.



Image 35: IR visualised blood on a black garment

CASE STUDY: VIDEO LINK COURT EVIDENCE

New Concept/Idea/Technique	Current UK Situation	Potential UK Impact or Possibilities if implemented	Advantages	Limitations	Recommendations for UK
Expert evidence can be given via video link to court	Expert witnesses required to physically attend court	Reduce time taken to travel to court and waiting times at court	Provides alternative evidence format for court.	Would have to be required at highest level in UK to be accepted in court	Promote uptake of video link for expert evidence.

6.7 Phase 7: Melbourne

Textile Research Department, RMIT University, Melbourne



I had an opportunity to discuss textiles science with Tess Mercer; a PhD researcher from RMIT University in Melbourne, at the ANZFSS conference in Perth. Tess has generated exciting new findings, regarding the wear and tear of garments, in relation to damage and BPA, which furthers our knowledge base when interpreting and evaluating case findings.

The Supreme Court of Victoria, Melbourne



In Melbourne, I met one of Australia's most experienced forensic experts in damage examinations; Jane Taupin (who has experience of the UK Criminal Justice System too). While waiting for our meeting,

I toured the courts area of the city, including the Supreme Court. We had a very useful discussion where I learned of the Royal Commission into Australian forensic science, which involved an infamous investigation where damage evidence came into question. I was reassured to see that damage examinations are valued in the state of Victoria, which was consistent with the RCMP in Canada. We can learn so much from this vital evidence as it involves the interaction of a weapon with textiles (clothing).



Image 36: The Supreme Court of Victoria

Evidence Recovery Unit and Biometric Services Division, Forensic Department, Victoria Police Forensic Services Centre, Macleod, Melbourne, Victoria, Australia



My UK forensic laboratory had kindly supported me in verifying my UK status to the Director of the Victoria Police Forensic Services Centre laboratory in Macleod; Rebecca Kogios, who kindly authorised me to visit them.

On arrival, I voluntarily gave a DNA sample (which was a mouth swab sample known as a buccal scrape), before being given tours of the Fingerprint Unit by Lillie Nikitina



Image 37: Victoria Police Forensic Services Centre

and then the Evidence Recovery Unit by Ben Goodwin. The entire visit was coordinated by Steven Fowler (Biometric Services Division Manager). Lillie, and her colleague Craig, explained the working of the fingerprint unit and their involvement in research and personal development, which is an apparent common theme in Australia and Canada.

Proudly displayed within the corridors of the department were numerous research posters that had been disseminated at conferences. Further evidence that practitioner staff are encouraged to undertake research projects which could have a positive impact by improving casework protocols. We then accessed the fingerprint laboratory areas where an exhibit that had previously undergone Rhodamine 6G staining was being imaged. The clarity of the fingermark detail was truly impressive to see and could aid knife exhibits within the UK.

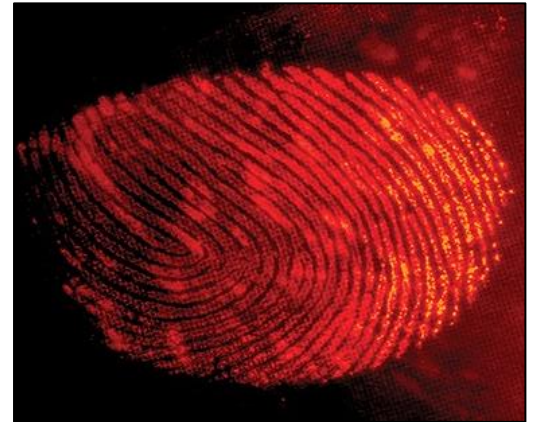


Image 38: Rhodamine 6G Fingermark

Ben then gave me a tour of the ERU and explained how cases are allocated within his team. The well-being of staff is carefully considered in case allocation as certain cases could be disturbing, especially as this laboratory undertakes the testing for bodily fluids, as well as DNA recovery from post-mortem samples.

Similarly, to the UK, acid phosphatase is used as a presumptive test for semen. However, if a positive reaction is obtained, a simple extraction is used to generate microscope slides, which is different to the typical UK extraction process involving lengthy incubation and centrifugation stages.

CASE STUDY: RHODAMINE 6G FINGERMARK DEVELOPMENT METHOD

New Concept/Idea/ Technique	Current UK Situation	Potential UK Impact or Possibilities if implemented	Advantages	Limitations	Recommendations for UK
Rhodamine 6G is an effective fluorescent fingerprint development technique for steel surfaces e.g. knife blades	Currently, UK experts are struggling to develop fingerprints on steel surfaces.	Enable more fingerprints to be developed, visualised and identified.	More crime detection.	Time required in training staff and validating this method.	Promote usage of Rhodamine 6G as a fingerprint development method on knife blades.

6.8 Phase 8: Canberra

Forensic Biology Team, Specialist Operations, Majura Complex, Canberra, Australian Capital Territory, Australia



The capital city of Australia is Canberra and it is situated in the ACT (Australian Capital Territory) which is policed by the Australian Federal Police. Additionally, the AFP responds to issues of national and international importance. Within the ACT, I had the privilege of visiting the world famous forensic laboratory complex of the Australian Federal Police – a specific built facility utilising collaboration of different forensic science disciplines (biology, chemistry, analytical, DNA, fingerprints, research).



Image 39: AFP Forensic Facility Majura Complex

Situated on the boundaries of Canberra, the Majura Complex is climate controlled and has three levels of PPE (Personal Protective Equipment) depending upon the case circumstances and requirements. It was so interesting to discuss this laboratory with Mojca Keglovic who is the Team Leader for Biology at Majura and who has worked in forensic science for almost the same amount of time, allowing us to our exchange our experiences of current and historic methodologies.

I was interested to learn that the AFP has the latest technologies including: FISH (fluorescence in situ hybridisation) which highlights variances between male and female cells on microscope slides and LMD (laser microdissection) in which a laser is used to target the highlighted cell from removal and subsequent DNA profiling. These techniques were formally readily available within the UK but are very costly to perform and require specific equipment and expertise. Also, the AFP has its very own SEM (scanning electron microscope), which is atypical of forensic laboratories and as such equipment is costly and requires expertise usually located in academic institutions. Other techniques included:

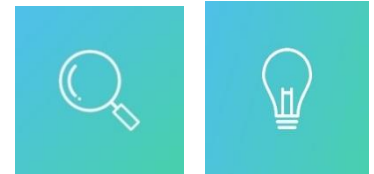
- A sensitive gel technique for presumptive testing of saliva on clothing (the UK utilises a paper-based method known as Phadebas to detect the enzyme alpha amylase).
- Haemastix indicator strips as a presumptive method for blood, in correlation to Victoria. However, the AFP do utilise OBTI confirmatory immunoglobulin test kits, consistent with the UK.
- DNA Phenotyping of casework samples (potentially determines physical appearance traits). This is not yet implemented within the UK, although previously we could detect a 'red hair' gene.
- Digital casefiles (in keeping with WA and Ontario police forces) ensure that findings can be accessed remotely from the laboratory or crime scene. The UK initially trialled complete digital transition, however, majorly relies on paper casefiles within its Forensic Service Providers.

It was apparent that the AFP has a vested interest in research, such as the 'Conan stabbing machine' developed by PhD researcher and AFP Chemist Kate Sloan, in partnership with the University of Canberra and University of Technology in Sydney. This device can recreate the penetration of fabric,

with any sharpened implement, in multiple directions and with varied degrees of pressure and force. In the UK, reconstructions are conducted using chainmail gloves and polystyrene blocks. However, the pressure and force cannot be controlled, with difficulty in creating consistent replications. I have since linked the AFP, with the Royal Canadian Mounted Police and the UK National Crime Agency, due to their similarities in jurisdiction and international workings.

6.9 Phase 9: Sydney

**Research Department, Forensic Evidence and Technical Services
Command, NSW Police, Sydney, New South Wales, Australia**



I was invited to visit the research department of New South Wales Police, by Dr Jennifer Raymond, the NSW Research Coordinator, and Lauren Atwood; Research Assistant. This, in my opinion is another indicator of forward thinking practice by having its own research infrastructure. This appears to be consistent with other police forces in Australia and in Canada.

Practitioners, investigators and researchers contribute to a research culture and as a result are encouraged to disseminate this practice at forensic science conferences. Dr Raymond has a prominent role within the Australian and New Zealand Forensic Science Society (ANZFSS). Additionally, by financially supporting employees and colleagues to attend such key events, contributes to an active CPD system.

We discussed current casework issues, which included vinyl coverings/surfaces in vehicles, which are proving problematic in the recovery of fingerprints. Jennifer and Lauren were interested in my current leather research; similar surface to the vinyl substrates and they kindly gave me samples to bring back to the UK. This will be taken forward as an example of a new UK-Australia research collaboration.

I then toured the NSW crime scene triage unit, where fingerprint development laboratory methodologies are conducted in addition to exhibit examinations.

I witnessed a knife being examined and photographed, whilst other exhibits were placed into a fuming cabinet for cyanoacrylate (superglue) treatment.

I was also interested to learn that NSW CSIs recover knife exhibits in cardboard packaging (cylindrical weapon tubes), which is another consistency with Canada (Surete du Quebec).

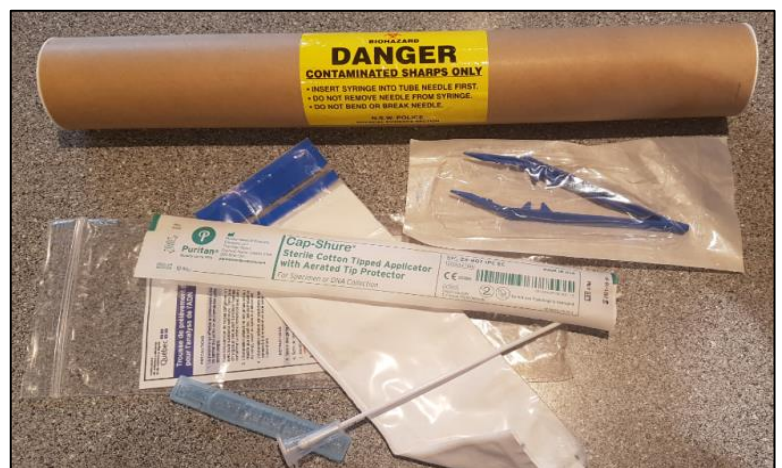
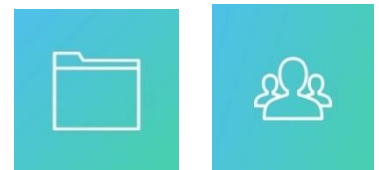


Image 40: Cardboard (used in NSW), breathable swab evidence packaging (used in Quebec) and blue plastic forceps similar to WA

CASE STUDY: ALTERNATIVE EXHIBIT PACKAGING (NON-PLASTIC)

New Concept/Idea/Technique	Current UK Situation	Potential UK Impact or Possibilities if implemented	Advantages	Limitations	Recommendations for UK
Novel exhibit packaging at crime scenes	Currently, UK experts are encouraged to utilise plastic packaging.	Align packaging within UK to Australia and Canada.	Reduce contamination static for trace evidence and enhance DNA recovery.	Validation studies would need to be undertaken before use in casework.	Promote usage of cardboard packaging for all exhibits.

Forensic and Analytical Science Service, NSW Health Pathology, Lidcombe, Sydney, New South Wales, Australia



I visited the laboratory of the NSW Forensic and Analytical Science Service in Lidcombe (on the outskirts of Sydney). It appears to be a familiar provision that forensic services are a provision within a state or territory health provider in Australia. Again, another similarity with Canada, in that such provision is publicly funded, unlike the privatised marketplace of the UK. The laboratory manager; Clint Cochrane, hosted my tour of the Biology and Chemical Criminalistics departments.



Image 41: FASS Laboratory, Lidcombe

The Biology department includes: examination areas where presumptive tests and microscopic procedures are conducted. Similarly to Quebec, FASS utilise o-tolidine for blood testing and Clint helpfully demonstrated this technique using the two reagents: o-tolidine and H_2O_2 (hydrogen peroxide) which undergo an oxidation-reduction reaction in the presence of haemoglobin (the protein within red blood cells; known as erythrocytes). However, one novel casework approach that could assist sexual offence investigations is an automated slide searching machine: Sperm Tracker. Typically, searching a microscope slide could take an Examiner within the UK, up to an hour of their time, which is then peer

reviewed by a colleague. The automated machine records coordinates of all potential spermatozoa for the Scientists to review and an entire slide rack can be searched in only a couple of hours, therefore, a highly useful process for the UK.

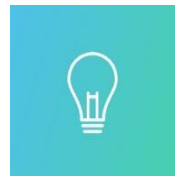
Another novel casework approach involves the use of RSID kits for confirming the presence of saliva, which are not in routine use within UK laboratories. This could assist the UK response to knife crime where a verbal argument and altercation has occurred, resulting in potential saliva transfer.

Clint also gave me a tour of the DNA unit – where I witnessed DNA extraction processes from the viewing screens of the corridor. However, certain rooms had restricted access due to the requirements for degraded samples and amplification of DNA, which is consistent practice with the UK. At the ANZFSS conference, I actually discussed DNA methodologies with Australian Churchill Fellow Dr Jodie Ward, who leads the specialist DNA laboratory.

Within the Chemical Criminalistics department, I discussed typical examinations conducted within this unit, including that of physical fits and damage assessments. Physical fits involve separate pieces/sections of an exhibit being assessed and realigned. This is highly relevant for knife crime offences, where for instance, a blade tip has snapped from the knife. Another similarity observed was the Leica microscope as used in Toronto.

Forensic Science Department, University of Technology, Sydney

Whilst in Sydney, I met with PhD researcher Natasha Benson from the University of Technology in Sydney (UTS) on the main forensic science campus.



This visit was approved and coordinated by Professor Claude Roux; who coincidentally is the new President for the International Association of Forensic Sciences.

UTS is a leading institution in forensic science research and teaching and Natasha explained the workings of the 'Conan' device as well as giving me a demonstration. Such a device would be useful for the UK and it is hoped that the partnership between the AFP and the NCA National Injuries Database can continue.



Image 42: The Conan stabbing machine developed between AFP, U of Canberra and UTS

CASE STUDY: DEVICE TO REPLICATE TEXTILE DAMAGE

New Concept/Idea/Technique	Current UK Situation	Potential UK Impact or Possibilities if implemented	Advantages	Limitations	Recommendations for UK
Novel device can be used with numerous weapons at varied angles and forces to replicate motion/direction/pressure during stabbing incident.	Currently, UK experts are encouraged to chainmail gauntlets with weapons for textiles on a polystyrene block.	Produce accurate simulations for stabbing scenarios.	Enhance knowledge for casework situations (interpretation and evaluation).	Such a device is bespoke and currently only available in Australia.	Promote international partnership working to acquire similar device.

New South Wales Criminal Justice System

I had the privilege of being shown the sights of Sydney by Michael and Janis Drury, who had lengthy careers in the NSW Criminal Justice System (policing and Crown Prosecution Service) and I hope to visit them again in 2020 (for the next IAFS conference, which will be occurring in Sydney!).

I also visited the Crime and Justice Museum, where I observed a cabinet of bladed implements. A proportion of these had curved ended blades (for use in hunting) as I had seen in Perth, in addition to novel concealable knives (credit card style) frequently encountered and seized by the Australian Border Force.

UK RESEARCH CULTURE

This report would not be complete without considering and including novel research being undertaken within the UK. Recent conference attendance in the UK, has led me to learn of novel knife crime techniques and current research being undertaken. The University of Portsmouth is conducting a PhD into the recovery of fingermarks from submerged knives in sea water. Whilst the forensic science company Foster+Freeman have marketed a device for developing fingermarks on knife blades. Hampshire Police have trialled a method called Multi Metal Deposition on to cling film surfaces that had been wrapped around knife handles. Also, researchers at Loughborough University are developing technologies for detecting concealed blades on a person. Additionally, Professor Sarah Hainsworth (Aston University) and Professor Guy Ratty (University of Leicester) have widely published their extensive research into sharpness of weapons and stab related injuries.

LEARNING POINTS

Between Australia and Canada there were evident correlations between their practice, such as police force organisational structure, facilities, equipment, working practices, court preparation, research avenues, education/CPD and legislation, that are inconsistent with the UK. However, the UK should be reassured as there are consistencies with training provision, professional societies, quality standards, auditing and accreditation.

SUMMARY TABLES - CASE STUDIES:

Please find a summary table with case studies from Canada and Australia related to each key area of my Churchill Fellowship:

- Table 4: Crime Scene
- Table 5: Forensic Laboratory
- Table 6: Court Process
- Table 7: Novel Research

IMPROVING UK FORENSIC SCIENCE RESPONSE TO KNIFE CRIME

Having evaluated the case studies, I have created documentation and a Standard Operating Procedure (SOP) for UK police investigators, scene examiners and forensic laboratory practitioners. These have taken the format of investigative and evaluative work-flow processes and a forensic laboratory knife examination form. These can be located after the case study tables.

Table 4: Crime Scene Case Studies - Summary

	New Concept/Idea/ Technique	Current UK Situation	Potential UK Impact or Possibilities if implemented	Advantages	Limitations	Recommendation for UK
Le Laboratoire de SJDML, Montreal, Quebec, Canada	Tri-Working for Forensic Scientists (crime scene, mortuary and laboratory)	Requested scene attendance for forensic scientists – not all scenes	Alignment of UK experts with other countries in improving knife crime response	Improve understanding and sharing of expertise regarding knife offences	Varied approaches across UK (police forces and forensic laboratories)	Promote such multi- agency involvement and communication to CSIs
RCMP, Vancouver, BC, Canada	Forensic Investigators BPA trained	In the UK, CSIs are not BPA trained.	Increase knowledge and expertise of UK CSIs	Training awareness sessions would assist in case interpretation	Training, resource and facility requirement	Aligning practice to professional organisations (IABPA)
Path West Mortuary, Perth, WA, Australia	3D Printing of bone damage/injury and CT Scanning	Not currently routine practice in UK mortuaries	3D models used to illustrate findings and CT scans could reduce PM need	Enable examinations without further damage to bone	Cost of purchasing a 3D printer and support network	Communicate this practice to pathology experts
Crime Scene Unit, Sydney, NSW Police, NSW, Australia	New style of exhibit packaging (cardboard tubes and boxes) preferred by CSIs for knives.	Plastic exhibit packaging used at UK crime scenes for evidence collection and preservation.	Align with other countries to avoid environmental factors e.g. humidity can impact DNA recovery.	Cardboard items can be treated with EtO and would reduce static for trace evidence e.g. fibres.	Cost of each cardboard item for UK police budgets and supply chain.	Promote such consumables to UK police forces and suppliers.

Table 5: Forensic Laboratory Case Studies - Summary

	New Concept/Idea/ Technique	Current UK Situation	Potential UK Impact/Possibilities if implemented	Advantages	Limitations	Recommendation for UK
RCMP, E Division, FIS, Vancouver, BC, Canada	The use of Infra-red lighting in clothing examinations	Time consuming LPM examinations	The improved imaging of evidence - assist detections	Reduce the time consuming examinations	Cost of supplying IR imaging and viewing equipment	Promote the use of IR in forensic laboratories
Centre for Forensic Science, Toronto, Ontario, Canada	New ceiling mounted digital microscope equipment: Leica M320 Microscope.	Bench mounted stereo microscopes - problematic in capturing evidence images.	Align examination process with other countries – important for quality and consistency.	Reduce bench equipment (contamination risk). Examine and image at once.	Cost of each microscope and supporting equipment (digital screen, fibre optics etc).	Promote the use of these microscopes to UK Forensic Service Providers.
Victoria Police and Forensic Services, Melbourne, Victoria, Australia	Rhodamine 6G use for fingermarks on knives as a fluorescent staining method	Numerous methods available within the UK. However, steel surfaces of blades are problematic.	Increased visualisation of fingermarks could yield further identifications of individuals	Improve fingermark visualisation rates on steel surfaces (blades)	Validation and verification would be required before implementation	Promote use of Rhodamine 6G to Fingermark practitioners within the UK
AFP, Majura Complex, Canberra, ACT, Australia	Varied PPE graded rooms in laboratory with viewing aspects	Typically one set of PPE used in all labs	Viewing areas assist communication with police	Signage and colour coding would assist	Redesigning laboratory areas for viewing aspects would be difficult	Share laboratory designs with the expert network

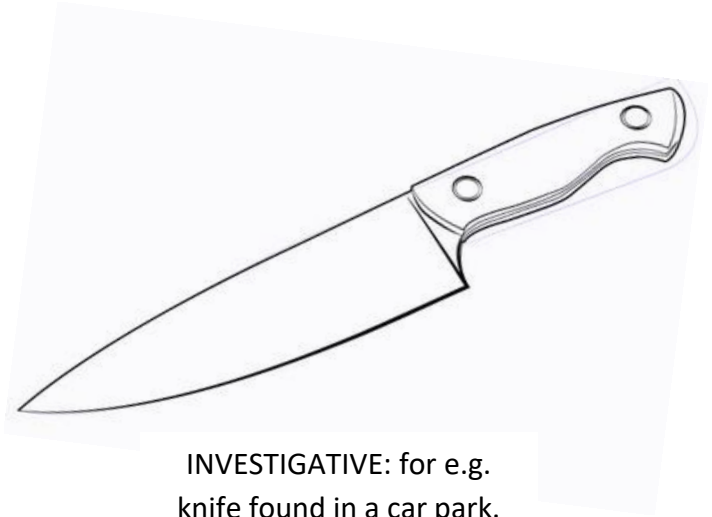
Table 6: Court Case Studies - Summary

	New Concept/Idea/ Technique	Current UK Situation	Potential UK Impact/Possibilities if implemented	Advantages	Limitations	Recommendation for UK
Le Laboratoire de SJDML, Montreal, Quebec, Canada	Training sessions for police officers and judiciary	Judiciary and CPS receive guidelines by Forensic Regulator	Increase dialogue and understanding	Training material aids understanding of forensic science issues	Cost of training judiciary could be high	Promote these novel approaches to the UK Criminal Justice System Via Forensic Science Regulator, AFSP, CPS etc
RCMP, Vancouver, British Columbia, Canada	Produce visual presentation material to support court evidence	Written statements submitted for files or oral evidence presented in court	New approach to communicating complex technical information to juries and judiciary	Aid the communication of scientific material in a controlled unbiased manner	Time constraints for preparing material in urgent court dates	
Path West Forensic Laboratory, Perth, WA, Aus	Video link appearances at court for witnesses	Verbal evidence or written witness statements	Alleviates transport issues and time waiting in courts	Requires a secure video connection link	Would require amendments to the Criminal Justice rules	
Forensic and Analytical Scientific Service, NSW, Aus	Source level propositions ONLY	Propositions can be taken to activity level (one level higher than source)	Reduce witness disagreements over evidence interpretation	Cases requiring source ONLY could be fast tracked	Certain cases may need to know 'how did it get there?'	

Table 7: Novel Research Case Studies - Summary

	New Concept/Idea/ Technique	Current UK Situation	Potential UK Impact/Possibilities if implemented	Advantages	Limitations	Recommendation for UK
Trent University, Peterborough, Ontario, Canada	The use of synthetic blood in Blood Pattern Analysis training and reconstruction	Equine blood or human blood with preservatives used in UK scenarios	This new approach would aid UK BPA training case reconstructions	Avoids any potential biohazard and short shelf life of conventional blood sources	Validation and verification required before UK use – in accordance with ISO17025	Highlight these novel products to UK BPA experts to increase uptake and use
RMIT, Melbourne, Victoria, Australia	Novel textile analysis research	Current knowledge relates to casework experience only	Research theory would support any case work findings	Useful when considering washed garments and resulting evidence	Training workshops would be required to educate/update all UK experts	Promote such research to UK damage and BPA experts
NSW Police, Sydney, Australia	Research unit embedded in police force	Research routinely conducted by UK universities	Promote investigator, practitioner and academic partnerships	Increase research outputs on topical issues	Difficult for every UK police force to have own research unit	Highlight such a model to UK police forces
University of Technology Sydney, Sydney, New South Wales, Australia	The importance of damage evidence reconstruction via the Conan device	Microscopic examinations and hand-held reconstruction activities	Increased knowledge base that can be shared with international experts	Controlled experiments (pressure, direction etc) which could aid case interpretation	Forensic Scientists may lose expertise if not encouraged to maintain their competencies and expertise	Promote this vital evidence type to researchers and practitioners

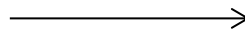
UK KNIFE CRIME WORK PROCESS



1. Knife recovered from scene of crime



2. Is this an investigative or evaluative case?



INVESTIGATIVE: for e.g. knife found in a car park.
Who has handled this?



- Record all physical details (measurements)
- Speculative DNA swabbing of grooved areas
- Presumptive testing of any red stains
- Visual search with light source
- Cyanoacrylate fuming of textured handle.
- Rhodamine 6G staining.



- DNA swab to National DNA Database.
- Fingermarks loaded to IDENT1 Database
- Weapon details uploaded to NCA NID
- Weapon sent for amnesty bin disposal.

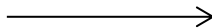
EVALUATIVE: for e.g. knife located in violent crime scene, such as an assault.
Does it have blood on it?



Determine case assessments and propositions – for the defence and prosecution



- *Fingerprint Precautions *
- Knife examined using LPM
- Measurements and photographs recorded
- Observe for hairs and fibres
- Presumptive test for blood
- Swabbing for DNA
- Fingerprint Development Methodology



Compare scene samples with control samples (DNA and fingerprints)

Interpretation and Evaluation

Peer Review

FORENSIC SCIENCE LABORATORY KNIFE EXAMINATION FORM

UK FORENSIC LABORATORY KNIFE EXAMINATION RECORD		CASE NUMBER	EXHIBIT NUMBER	
PACKAGING				
Cardboard Box ☐		Plastic Tube ☐	Other ☐	
Secure ☐		Sealed ☐	Packaging No.	
DESCRIPTION				
.....				
Total Length (mm):		Blade Angle (°):		
Blade Length (mm):		Blade Width (mm):		
Blade Thickness (mm):		Blade Edge (straight/serrated)		
Blade Shape (round, straight, pointed, other):				
Condition/Damage:				
PHOTOGRAPHIC IMAGES				
DATE	TIME	LAB AREA	BENCH	SCIENTIST

REFLECTION:

On reflection, I truly believe that my Fellowship was well organised and maximised the opportunity within both countries. Also, I consciously utilised public transport wherever possible as I wanted my Fellowship to be environmentally considerate. Therefore, I regularly used trams, buses, trains, subways and ferries. I also feel there was a healthy balance between attending arranged appointments and undertaking opportunities to explore the surroundings and culture. Embracing this experience to such vast countries as a solo traveller is the most rewarding experience of my life. At first, the notion of planning, preparing and undertaking such a wonderful opportunity was daunting. However, knowing that the WCMT was supporting me; as were my family, friends and colleagues, gave me such confidence and self-belief.

There were a few difficulties with my Churchill Fellowship, majorly relating to my employment availability. The constricting schedule of the academic year unfortunately meant that I had a narrow window for organisation of dates for the first phase of my Fellowship. This was a limitation for a few potential meetings and host organisations in Canada who take a Summer recess in July and August. However, thankfully everyone was so accommodating and I was able to discuss the Fellowship with them via telephone, Skype or email, which was beneficial as they were still involved in the research.

Another consideration with hindsight should have been the weather and climate in the two countries. I had not anticipated the varied conditions and extremes of temperature that can occur. For instance, Canada experienced unseasonably hot weather in Montreal and even in Vancouver; which typically has cooler mountain air. Whereas, Australia was so much cooler, having just entered Spring. Thankfully, I had packed coordinating clothing and had plenty of layers, just in case!

My travel experiences have resulted in other tips that may be useful for other Churchill Fellows:

1. When travelling within cities in Australia and Canada - use the public transport network systems as these are: clean, safe, environmentally friendly and inexpensive (sometimes free!)
2. When booking hotel accommodation, consider using a website that includes all taxes/local fees and breakfast - knowing this in advance will further your budget and avoid surprise costs on arrival
3. When attending conferences be proud to be a Churchill Fellow - it gave me such confidence to go up to people I did not previously know and introduce myself (a very useful icebreaker!)
4. Ask your host organisations for recommendations of places to stay/eat - very useful information especially if there is a Public Holiday while you are visiting!
5. Consider doing guided city tours if you have limited time (these are an excellent way to see places of interest and may include discounted entrance fees to museums etc)

This entire Churchill Fellowship experience has been enlightening for me, both professionally and personally. Professionally, this unique opportunity has enabled me to meet with forensic science experts within two different countries and to visit them in their facilities, therefore broadening and strengthening my knowledge base. Additionally, I was able to exchange UK practice with my hosts in Australia and Canada, evidencing mutual professional respect. Also, by representing UK forensic science overseas, I feel that this has demonstrated me being a leader in my sector, which is a complete

honour. As a result, an international professional network has been formed to continue sharing this best practice.

In recent years, UK forensic science has endured a period of uncertainty, with mergers, cost reductions and service closures. However, my Churchill Fellowship has made me more optimistic about my own future and that of the sector. It has renewed my professional fulfilment and revalidated my sense of purpose for the career that I love, which has additionally inspired colleagues to apply for their own Churchill Fellowship.

On a personal level, I feel that I have developed as an individual with increased confidence, self-belief and in broadening my horizons, especially as this year has had its challenges. Since returning from my solo travels, I have more courage to apply for opportunities as I have set myself new short/medium/long term career goals. So far, I have enrolled for a part-time PhD in forensic science, been requested to sit on the Chartered Society of Forensic Sciences Publications Committee and have been internally shortlisted by De Montfort University as a representative for a National Teacher Fellow award (which is the highest accolade in Higher Education lecturing). Hopefully, these personal ambitions will translate to ensure the Churchill Fellowship is also highly successful.

Finally, my ending comments are directed towards those potential Churchill Fellows of the future, who may be reading sections of my report and wondering 'should I apply?'. My simple answer is: 'yes!', after all, if you want to make a difference, then you are indeed a potential change-maker already. For me, this experience has been life changing and so it can, for you too!

UNEXPECTED FINDINGS:

Although the aim of this research was to investigate the forensic science approaches to knife crime, in reality, my Churchill Fellowship resulted in other interesting and unexpected findings. My research has yielded results that can assist an array of offences including sexually motivated crimes and cold case reviews. I learned of bespoke equipment including automated microscope slide searching apparatus, which is typically time intensive, in addition to alternative chemical tests and novel DNA phenotype technology. The latter could potentially provide useful information as to an individual's appearance known as genetic traits.

Within both countries, there were two standout forensic science laboratories: the Australian Federal Police in Canberra and the Forensic Science Centre and Coroners Complex in Toronto. Both had additional features within their purposeful built forensic facility to promote well-being for the staff employed there, such as aesthetic open spaces for working areas and social break times. This is a vital inclusion, as the environment gave an instant sense of calm and tranquillity, where regular time away from computer desks is encouraged. Careers in a Criminal Justice System can elevate mental health issues within individuals, due to the pressurised workload and even specific case circumstances. The UK charity MIND even has a 'blue light' campaign to highlight mental health in emergency services.

7. CONCLUSION

The UK is currently experiencing unprecedented levels of offences involving sharp implements, which is impacting urban and rural communities. This was the purpose for my Churchill Fellowship, the aim of which has been to investigate the forensic science responses to knife crime within Canada and Australia to aid the UK response, in which there were eight successfully achieved objectives.

The findings have shown similarities between and within the three countries, which provides reassurance of consistency in approach. For instance, all countries have quality standards and have undergone accreditation, with specified training development programmes for staff and novel research outputs. However, there were significant differences in laboratory equipment, crime scene investigation approaches, mortuary practice, legislation, court preparation and police force structure. The vast disparity was surprising, especially as the UK has previously been a world leader in forensic science. Therefore, the opportunity to travel and experience forensic science in Canada and Australia on a first hand basis was extremely beneficial, in order for me to determine this novel 'best practice'.

In my opinion, there are two key issues here; in that there are proactive and reactive responses to answer the frequently posed question: 'what should we do about knife crime?'. Therefore, numerous recommendations have been suggested for the UK. However, although these would generate best practice there are noticeable challenges. At present, there could be a situation where UK approaches continue to be deemed fit for purpose and will remain so until UK police forces and organisations receive further funding or investment in resources for any of the Fellowship recommendations to be achievable. Additionally, I have proposed legislative changes, which could prove problematic in implementation and is therefore an obvious limitation.

Furthermore, if the UK continues in its current situation without any action, then unfortunately, there will continue to be further injuries and deaths as a result of knives. Ultimately, this Churchill Fellowship **will** make a dramatic impact if multi-agencies (including parliament) join together to ensure that the required resources are set aside to support these recommendations, to ensure that they are successfully implemented, adhered to and achieved. Then, hopefully, in time, reported crime statistics and hospital admission data will start to reflect this societal shift for UK knife crime.

8. RECOMMENDATIONS

There were two key approaches identified from this Churchill Fellowship, which are proactive and reactive. This should be viewed as an advantageous outcome for UK knife crime, as there is an immediate requirement to respond (reactive) to existing criminal investigations within the UK Criminal Justice System, whilst also preventing (proactive) further offences. Therefore, the following recommendations are sectioned into these two perspectives. For each, there are supporting statements stating their potential benefit and the requirements to ensure they can be implemented.

- ***Reactive Recommendations:***

1. Implementation of IR visualisation within the laboratory examination process for blood

In both Canada and Australia, infra-red is a frequently used examination method in forensic laboratories, in that it can visualise blood on dark surfaces (clothing). Typically in the UK, such examinations are conducted using time intensive microscopy. Therefore, a capability for IR, will reduce examination times for violent offences, which can enhance detection times. However, forensic laboratories will need to purchase IR equipment, which is a limiting factor.

2. Inclusion in UK practice of Rhodamine 6G for successful fingermark development method on knives

Rhodamine 6G is a commonly used fingermark development method within Australian and Canadian laboratories for steel blades and surfaces of knives. This fluorescent staining follows conventional superglue (cyanoacrylate) fuming and is successful at visualising fingermark pattern details. Within the UK, this could increase fingermark yield. However, it would require practitioners to be trained in this method and for the process to be validated within the laboratory setting before use in casework.

3. Practice of tripartite working arrangements (forensic laboratory, mortuary and crime scene)

Engagement of experts from multiple CJS agencies would maximise evidential potential by enabling a consistent practice across the UK. There are numerous police forces within the UK, who are serviced from only a few forensic providers. These laboratories are mainly geographically located in the Oxfordshire area and North West, therefore, encouraging a uniform approach could prove challenging. However, an ongoing review into UK forensic science, could promote a transition to a regional approach.

- ***Proactive Recommendations:***

4. Engagement of UKCJS experts in research and Continual Professional Development

By following the example of Australia and Canada, the engagement of police forces, forensic practitioners and academics in research would maximise outputs of novel techniques. This could be achieved via conference attendance (for instance the CSoFS) and regular focus group meetings. However, it would require a UK culture shift from employers, as at present, such events are self-funded.

5. Suggest future knives be manufactured without pointed tips and pursue the potential for stab resistant textiles to be blended into clothing production

If all new knives are manufactured with rounded ends (instead of pointed tips) this would remove the opportunity for knives to breach skin (with pressure and force) and cause stab penetration wounds. Likewise, with the inclusion of stab resistant fibres in clothing production this would minimise an opportunity for future injuries. Transforming, conventional items will be problematic and economically costly to producers and consumers. However, a 'trade-in' or swap system could be a viable approach.

6. Lobby UK parliament for introduction of knife manufacturing/trading safety legislation

Lobbying my member of parliament, the APPG for knife crime and Baroness Lawrence in the House of Lords with my Churchill Fellowship findings, this will highlight the public health issue of knife crime and the requirement for a legislative change regarding knife design/trade/safety features. However, such a change will require parliamentary debate and public consultation. Ultimately, this is a UK necessity.

9. DISSEMINATION AND IMPACT

It is vital that the findings from this Churchill Fellowship are disseminated amongst forensic science experts and academics within the UK. The following includes details of implementation and impact:

- UK House of Lords Science Select Committee Forensic Science Enquiry submission response (published October 2018)
- Brief colleagues in Cellmark Forensic Services in advance of CSoFS (October 2018)
- Oral presentation at the 2018 Annual CSoFS Conference (November 2018)
- Informed colleagues at De Montfort University (School of Pharmacy, November 2018)
- Updated National Injuries Database at National Crime Agency (November 2018)
- Briefed Leicestershire Police on findings (December 2018)
- Attended a workshop at DMU Stephen Lawrence Research Centre (December 2018)
- Launch a WCMT workshop for De Montfort University Faculty of Health & Life Sciences (January 2019)
- Present research lecture at DMU Women's Network – (March 2019)
- Presentation at CSoFS Fingermark Conference (May 2019)
- Presentation at IABPA Conference (Paris) (June 2019)
- Presentation at IAI Conference (Warsaw) (June 2019)
- Presentation at National Knife Crime Conference 2019 (London) (July 2019)
- Presentation at DSTL (Home Office) Industry and Academia Event (July 2019)
- Meeting with Office of MP for NE Cambridgeshire (July 2019)
- National media articles (August 2019)
- Shortlisted for Home Office case study by Office of Forensic Science Regulator to Government Chief Scientist (science informing policy) (August 2019)
- Writing a journal article for Journal of Legal and Forensic Medicine (August 2019)
- Publicised SOPs and examination forms to forensic practitioners (August 2019)
- Meeting with office of Police and Crime Commissioner for Cambridgeshire (August 2019)

10. THE NEXT STEPS...

- Engage with the newly formed Fenland Violent Crime Museum (in the author's home area)
- Request an audience with Baroness Lawrence of Clarendon (Chancellor at De Montfort University)
- Appear before the All Party Parliamentary Group – Knife Crime
- Brief National Knife Crime Working Group
- Communicate the Knife Crime Network between organisations within UK, Canada and Australia
- Create a training manual publication for practitioners
- Pursue part time PhD related to knife crime
- Engage with fellow academics and researchers to conduct cross-disciplinary research related to knife crime offences (courtesy of the DMU Stephen Lawrence Research Centre) and injuries
- Encourage UK practitioners and researchers to undertake knife crime research via my CSoFS roles
- Write to NPCC
- Write to APCCs
- Write to Home Office, Ministry of Justice and Minister for Policing
- Write to 20+ retailers (online and high street in UK)
- Write to current Victim's Commissioner
- Write to former Victim's Commissioner
- Write to knife manufacturers
- Submit a resolution for the NFWI regarding knife crime

Additionally, prepare and publicise generic media articles (web, printed text and radio interviews) aimed for widespread public circulation (these will be a redacted version of the findings within this report).

11. REFERENCES

- AIC. (2017). Australian Institute for Criminology. Crime Statistics.
http://www.crimstats.aic.gov.au/NHMP/1_trends/#causeDeath [Accessed: 19 November 2018]
- Allen, G. & Audickas, L. (2018). Knife crime in England and Wales: Briefing Paper Number SN4304. House of Commons Library.
- Bai, R.F., Ma, S.H., Zhang, H.D., Chang, L., Zhang, Z., Liu, L., Zhang, F.Q., Guo, Z.M. and Shi, M.S., 2014. Forensic discrimination of three common brands of kitchen knives in China by ICP-AES and infrared absorption. *International journal of legal medicine*, 128(2), pp.353-360.
- Bannister, J., Pickering, J., Batchelor, S., Burman, M., Kintrea, K. and McVie, S. (2010). Troublesome Youth Groups, Gangs and Knife Carrying in Scotland
- Benson, N., Dos Santos, R.O., Griffiths, K., Cole, N., Doble, P., Roux, C. and Blanes, L., 2017. The development of a stabbing machine for forensic textile damage analysis. *Forensic science international*, 273, pp.132-139.
- Bleetman, A., Perry, C.H., Crawford, R. and Swann, I.J., (1997). Effect of Strathclyde Police Initiative "Operation Blade" on accident and emergency attendances due to assault *Journal of Emergency Medicine* 14 (3) p.153-156
- Bortels, L., (2011). Knife Crime: Recent data on carriage and use Trends and Issues in Crime and Criminal Justice Australian Institute of Criminology 417
- Brown, B., (2004). Juveniles and Weapons: Recent Research, Conceptual Considerations, and Programmatic Interventions *Youth Violence and Juvenile Justice* 2 (2) p. 161-184
- Carr, D.J., Godhania, K. and Mahoney, P.F., 2018. Edged weapons awareness. *International journal of legal medicine*, pp.1-8.
- Cheng, Y.K., 2016. CCTV Footage used to Link Suspect to Bloody Footwear Impression. *Journal of Forensic Identification*, 66(6), p.517.
- Eades, C., Grimshaw, R., Silvestri, A. & Solomon, E. (2007). 'Knife Crime' A Review of Evidence and Policy. 2nd Ed. Centre for Crime and Justice Studies. https://www.crimeandjustice.org.uk/sites/crimeandjustice.org.uk/files/ccjs_knife_report.pdf [Accessed: 12 November 2018]
- Ebner, L., Flach, P.M., Schumann, K., Gascho, D., Ruder, T., Christe, A., Thali, M. and Ampanozi, G., 2014. The tip of the tip of the knife: stab sequence reconstruction using postmortem CT in a homicide case. *Journal of Forensic Radiology and Imaging*, 2(4), pp.205-209.
- England, R. and Jackson, R., (2013). A nurse clinician's approach to knife crime prevention *British Journal of Nursing* 13 (2) p. 774-778
- Foster, R. (2013). Knife Crime Interventions: 'What Works?'. The Scottish Centre for Crime and Justice Research. Report No. 04/2013. The SCCJR. http://www.sccjr.ac.uk/wp-content/uploads/2014/01/SCCJR_Report_No_04.2013_Knife_Crime_Interventions.pdf [Accessed: 12 Nov 2018].

Golding, B. and McClory, J., (2008). Getting to the point: Reducing gun and knife crime in Britain: Lessons from abroad. Policy Exchange

Grega, M., Matiolański, A., Guzik, P. and Leszczuk, M., 2016. Automated detection of firearms and knives in a CCTV image. *Sensors*, 16(1), p.47.

Hainsworth, S.V., Delaney, R.J. and Ritty, G.N., 2008. How sharp is sharp? Towards quantification of the sharpness and penetration ability of kitchen knives used in stabbings. *International journal of legal medicine*, 122(4), pp.281-291.

HM Government, (2009). Saving Lives, Reducing Harm, Protecting the Public: An Action Plan for Tackling Violence 2008-2011 One Year On

HM Government. (2018). Serious Violence Strategy.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698009/serious-violence-strategy.pdf [Accessed: 12 November 2018]

Hofmann, M., Adamec, J., Anslinger, K., Bayer, B., Graw, M., Peschel, O. and Schulz, M.M., 2018. Detectability of bloodstains after machine washing. *International journal of legal medicine*, pp.1-14.

Karchewski, L., Armstrong, G., Nicholson, M.L. and Wilkinson, D., 2014. Assessment of the Leeds Spectral Vision system for detecting biological stains on fabrics. *Canadian Society of Forensic Science Journal*, 47(4), pp.230-243.

Kemp, S.E., 2017. Forensic analysis of sharp weapon damage to textile products. In *Forensic Textile Science*(pp. 71-97).

Kinsella, B., (2011). Tackling Knife Crime Together- A Review of Local Anti – Knife Crime Projects. London: Home Office

Kodjo, CM., Awinger, P. and Ryan, S.A. (2003). Demographic, Intrinsic and Extrinsic Factors Associated with Weapon Carrying at School Archives of Paediatric and Adolescent Medicine 157 11: 96

Lemos, G. (2004). Fear and Fashion The use of knives and other weapons by young people Bridge House Trust Lemos and Crane

Mayor of London. (2017). The London Knife Crime Strategy. The Greater London Authority. https://www.london.gov.uk/sites/default/files/mopac_knife_crime_strategy_june_2017.pdf [Accessed: 12 November 2018].

ONS. (2018). Office for National Statistics: Crime Survey for England and Wales – 2018.

<https://www.ons.gov.uk/peoplepopulationandcommunity/crimeandjustice/bulletins/crimeinenglandandwales/yearendingjune2018#main-points> [Accessed: 19 November 2018]

Palazzo, E., Amadasi, A., Boracchi, M., Gentile, G., Maciocco, F., Marchesi, M. and Zoja, R., 2018. The detection of metallic residues in skin stab wounds by SEM-EDS: A pilot study. *Science & Justice*, 58(3), pp.232-236.

PSNI. (2018). Police Recorded Crime in Northern Ireland. <https://www.psni.police.uk/globalassets/inside-the-psni/our-statistics/police-recorded-crime-statistics/2018/may/crime-bulletin-may-18.pdf> [Accessed: 19 Nov 18]

Puentes, K. and Cardoso, H.F.V., 2013. Reliability of cut mark analysis in human costal cartilage: The effects of blade penetration angle and intra-and inter-individual differences. *For Sci Int*, 231(1-3), pp.244-248.

Richards, C., 2015. Alternative light source photography. *Pathology*, 47, pp.S23-S24.

Riggs, D. and Palasinski, M. (2011). Letter Tackling knife violence: Young men view things differently British Medical Journal p. 342

Schotman, T.G., Westen, A.A., van der Weerd, J. and de Bruin, K.G., 2015. Understanding the visibility of blood on dark surfaces: A practical evaluation of visible light, NIR, and SWIR imaging. *Forensic science international*, 257, pp.214-219.

Scottish Government. Resource Doc No Knives, Better Lives
<http://www.scotland.gov.uk/Resource/Doc/254432/0096154.pdf>

Sethi, D., Hughes, K., Bellis, M., Mitis, F. and Racioppi, F. (2010). European Report on Preventing Violence and Knife Carrying Among Young People World Health Organisation (Europe)

Shepherd, J. and Brennan, I. (2008). Editorial Tackling knife violence British Medical Journal p. 337

SILVESTRI A, OLDFIELD M, SQUIRES P and GRIMSHAW R (2009) Young People, Knives and Guns Centre for Crime and Justice Studies

Sloan, K., Fergusson, M. and Robertson, J., 2018. Textile damage examinations on the cutting edge—an Australian perspective. *Australian Journal of Forensic Sciences*, pp.1-7.

Smith, R., (2008). Are Knives Ads Working? Youth crime special report: young people's views Children and Young People Now

Squires, P., (2009). The knife crime 'epidemic' and British politics British Politics 4 (1) p.127- 157

Statcan. (2017). Statistics Canada: Crime Survey
<https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3510006901>[Accessed 19 November 2018]

Sterzik, V., Panzer, S., Apfelbacher, M. and Bohnert, M., 2016. Searching for biological traces on different materials using a forensic light source and infrared photography. *Int journal of legal med*, 130(3), pp.599-605.

Stotesbury, T., Bruce, C., Illes, M. and Hanley-Dafoe, R., 2016. Design considerations for the implementation of artificial fluids as blood substitutes for educational and training use in the forensic sciences. *Forensic Science Policy & Management: An International Journal*, 7(3-4), pp.81-86.

Tan, W., Huang, P., Huang, Z., Qi, Y. and Wang, W., 2017. Three-Dimensional Microwave Imaging for Concealed Weapon Detection Using Range Stacking Technique. *International Journal of Antennas and Propagation*, 2017.

Taupin JM (1999) Comparing the alleged weapon with damage to clothing- the value of multiple layers and fabrics. *J Forensic Scie* 44:205–207

Taylor, E., (2010). Tackling Knives Action Programme: Key Findings Probation Journal 57: 187- 188

Thompson, T.J.U. and Inglis, J., 2009. Differentiation of serrated and non-serrated blades from stab marks in bone. *International journal of legal medicine*, 123(2), pp.129-135.

White, R., (2004). Police and Community Responses to Youth Gangs Australian Institute of Criminology Trends and Issues in Crime and Criminal Justice 274 p. 1-6

Zhuge, X. and Yarovoy, A., 2012, April. Automatic target recognition in ultra-wideband 3-D images for concealed weapon detection. In *Synthetic Aperture Radar, 2012. EUSAR. 9th European Conference on* (pp. 186-188).

12. APPENDICES

i. Conference Event Attendance and Presentation Dates

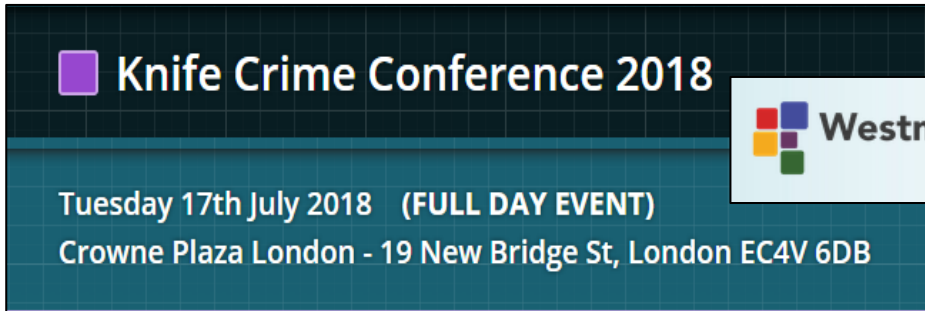


Image 43: Westminster Insight Conference, London, UK. Presentation Date: 17th July 2018



Image 44: European Academy of Forensic Sciences Triennial Conference, Lyon, France. Presentation Date: 30th August 2018



Image 45: Australian and New Zealand Forensic Science Society Biennial Symposium. Presentation Date: 11th September 2018



Image 46: The Chartered Society of Forensic Sciences Annual Conference, Northampton, UK. Presentation Date: 2nd November 2018

ii. National Auditing and Accreditation Organisations



Image 47: National Association of Testing Authorities, Australia



Image 48: Canadian Association for Laboratory Accreditation Inc



Image 49: United Kingdom Accreditation Service

iii. International Forensic Science Organisations



Image 50: CSFS - Canadian Society of Forensic Science



Image 51: IAFS - International Association of Forensic Sciences



Image 52: CSoFS – The Chartered Society of Forensic Sciences



Image 53: ANZFSS – Australian and New Zealand Forensic Science

iv. Sharp Weapon Type Example



Image 54: Flail



Image 55: Zombie Knife



Image 56: Shanks (self-made weapons)



Image 57: Sword



Image 58: Machete

v. Forensic Laboratory Organisations



Image 59: Centre for Forensic Sciences, Toronto, Ontario, Canada



Image 60: Laboratoire de sciences judiciaires et de médecine légale, Montreal, Quebec, Canada



Image 61: Path West Laboratory Medicine, WA, Australia



Image 62: Forensic and Analytical Science Service NSW Health Pathology, Australia

vi. Police Force Badge



Image 63: Surete du Quebec Police, Montreal, Quebec, Canada



Image 64: Ontario Provincial Police, Canada



Image 65: Royal Canadian Mounted Police, (Ottawa, Ontario and Vancouver, British Columbia) Canada



Image 66: Toronto Police, Canada



Image 67: Western Australian Police, Australia



Image 68: Victoria Police, Australia



Image 69: Australian Federal Police, Australia



Image 70: New South Wales Police, Australia