

## Project Reference: National Data Analytics Solution – Violent Crime

### Purpose of data analysis:

The Policing Vision 2025<sup>1</sup> outlines the need for technology to be central to how law enforcement operates, calling on forces to embrace innovation so that policing can adapt to new threats and opportunities posed by the 21st century.

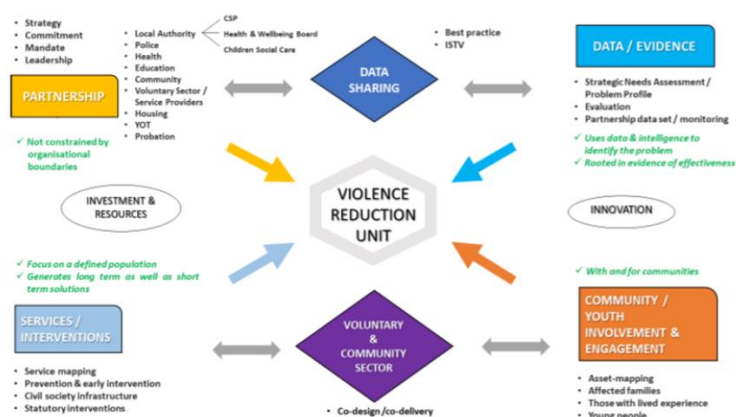
The National Data Analytics Solution<sup>2</sup> (NDAS) aims to become a centralised advanced analytics capability for UK policing. UK police forces have access to a vast amount of data, but arguably lack the technological capability to use it effectively.<sup>3</sup> By proving that advanced analytical methods can be applied to existing law enforcement datasets, it is hoped that actionable insights grounded in data could be used to guide local intervention efforts and support the cross-cutting outcomes that evolved from the reform strands within the Policing Vision 2025. Putting information at the heart of decision-making in policing by connecting existing datasets for new insights should inform risk assessment and resource prioritisation.

NDAS demonstrated the capability to use advanced data analytics to provide actionable insights during its Foundation Phase, which ran from September 2018 to April 2019. Three high-priority use cases were run as a proof of concept: Most Serious Violence, Workforce Wellbeing and Modern Slavery. Since, Modern Slavery has been discussed with the Ethics Committee on multiple occasions, receiving support for operationalising, with Most Serious Violence and Workforce Wellbeing paused due to the inclusion of predictive analytics. Further proof of concepts have been formed, including Organised Exploitation, Firearms, Domestic Abuse and the focus of this paper, Violent Crime.

The development of advanced data analytics for policing implies the need not only to prove the concept of individual use cases and bring them to operationalisation where appropriate, but also to prove the concept of a constant process to develop new use cases aimed to deliver insights to help solve different problems.

In March 2019, the Home Secretary launched a £100 million Serious Violence Fund, with the vast majority of that money being allocated to Violence Reduction Units and Surge funding for operational policing activity in the 18 worst affected force areas. The *Violence Reduction Unit Interim Guidance*<sup>4</sup> makes it clear that data is key to tackling problems of serious violence:

Diagram 1: an example VRU model



<sup>1</sup> Policing Vision 2025 Report: <https://www.npcc.police.uk/documents/Policing%20Vision.pdf>

<sup>2</sup> Founding partners are: West Midlands Police; Warwickshire Police; West Mercia Police; West Yorkshire Police; Greater Manchester Police; Merseyside Police, the Metropolitan Police Service; Staffordshire Police, and the National Crime Agency

<sup>3</sup> A Babuta, *Big Data & Policing* [URL: [https://rusi.org/sites/default/files/201709\\_rusi\\_big\\_data\\_and\\_policing\\_babuta\\_web.pdf](https://rusi.org/sites/default/files/201709_rusi_big_data_and_policing_babuta_web.pdf)]

<sup>4</sup> Home Office (2020), *Violence Reduction Unit Interim Guidance* [URL: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/876380/12VRU\\_Interim\\_Guidance\\_FINAL\\_003\\_2732020.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/876380/12VRU_Interim_Guidance_FINAL_003_2732020.pdf)]

This submission to the WMP Ethics Committee concerns the Violent Crime use case, which seeks to support a number of different stakeholders to tackle issues around violent crime. Whilst the Most Serious Violence use case previously presented sought to identify individuals most likely to commit violent offences in the future, the Violent Crime use case is entirely separate, informing end users based on current information and unlike Most Serious Violence does not include any element of predictive modelling.

The Violent Crime Use Case seeks to support the efforts of the VRU, and other departments involved in policing violent crime, by gaining relevant insights from police data. It also seeks to support the work of the Serious Violence Policy Unit in the Home Office by helping to answer key policy questions.

**Source of analytical question / hypotheses to be examined:**

During the development of this use case, NDAS engaged with a range of subject matter experts (SMEs) involved in serious violence including academics, Home Office policy leads, police and partners from VRUs and police officers involved in Surge activity. The themes identified through this activity are:

- Themes and topics: exploring the effect of themes such as knife crime, youth crime and organised crime have on the issue of violent crime.
- Hotspots: this is another key theme in *Violence Reduction Unit Interim Guidance* and hotspots of violence are a focus of police and partnership activity. This is wider than simply identifying where crime is occurring, also encompassing questions such as where the offenders responsible for that harm are travelling from and whether there are factors in those areas, e.g. deprivation, organised crime which might be contributing to violence, rather than just the hotspots themselves.
- Quantifying harm: not just through a count of offences but through identifying harm caused using a metric such as the Office of National Statistics' Crime Severity Score, to ensure that resources are focussed best where the harm is likely to have most effect on communities. In identifying cohorts, this will also explore the use of a metric which helps users understand recency and frequency of harm, as well as understanding the total harm committed.
- Networks: forming an understanding of how well connected people are and the visual representation of nominal networks, within and outside hotspot areas
- Definition of violent crime: ensure the relevance of insights by basing our definition of violent crime on the World Health Organisation definition, which aligns to the strategy of the VRUs (albeit excluding exploitation which other use cases are more geared towards tackling). When assessing knife and gun crime, applying nationally agreed definitions of these offences to ensure true comparisons can be made between different areas or across different time spans.
- Vulnerabilities and other contributing factors: an assessment of factors such as alcohol and substance abuse, mental health, adverse childhood experiences (ACEs), where victims and offenders went to school, to support both a strategic understanding of violence and help direct police and partners as to what steps need to be taken to decide on interventions to put in place.

The above themes have contributed to the problem statement, documented in the 'Methodology' section, which has continually been revised with SMEs engaged in policing Violent Crime and will continue through an iterative process of review and refinement.

It is expected that this joint effort between the SMEs and the NDAS team will result in the development of the Violent Crime capability, with the intention of operationalising during the financial year 21/22.

**Data to be used:**

- Intelligence logs – to understand links between individuals to build networks, to gather information about the use of weapons
- Crime reports – to give information about types and severity of crime, location, who was involved, what weapons were involved. Also to identify vulnerability, for example to understand the presence of crime reports indicating ACEs in a person’s past
- People information across Crimes & Intelligence
- Information relating to the involvement of individuals in organised crime groups (OCGs)
- Custody information – for example to determine vulnerabilities, and where individuals attended school
- Publicly available school’s location data used to plot schools’ locations via grid references for contextual awareness within the dashboard<sup>5</sup>.

**Level of analysis**

This will be an analysis of the problem from a force perspective, aggregated from the data relating to individuals linked to violent crime events. The capability will then allow analysis at a geospatial, network and an individual level.

**Reliability of data:**

The data is sourced from core systems used daily by police forces. The data used for this use case is: crimes, intelligence, custody, organised crime group and publicly available school location data. Systems that support the analysis are used by the forces on a day-to-day basis. All data is manually inputted by police officers in the course of their duties.

**Sample or entirety:**

Entirety

**If sample:**

N/A

**Method of sampling:**

N/A

**Method of choosing sample size:**

N/A

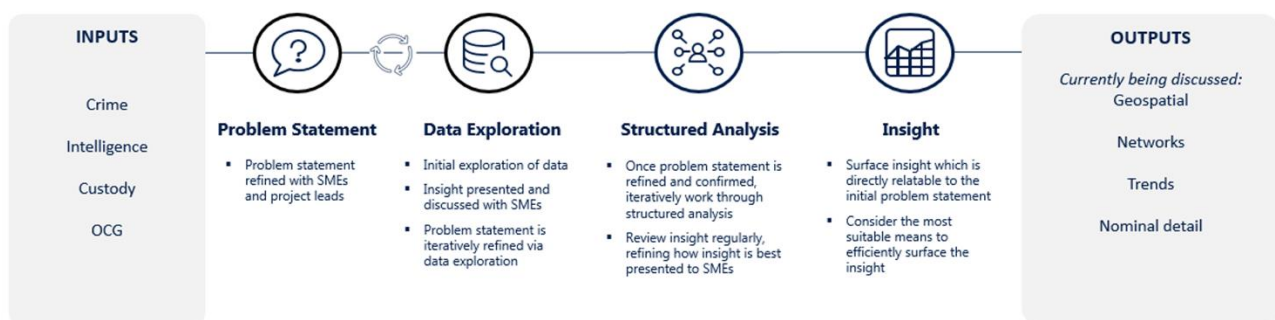
**Sample size:**

N/A

**Type of analysis: Exploratory**

**Methodology:**

There are four components to the NDAS methodology: problem statement; data exploration; structured analysis, and insight.



**1. Problem Statement**

<sup>5</sup> <https://www.get-information-schools.service.gov.uk/Downloads> edubasealldata extract downloaded 03-12-2020.

The first stage of this process is defining the problem statement. The problem statement takes the initial guidance from the Partner Forces engaged with NDAS to assess how advanced analytics could develop actionable insights into violent crime, progressing onto engaging with wider SMEs as described above.

Using a combination of the in-depth knowledge and experience from the SMEs, with the NDAS team's understanding of possible analytical approaches to assisting with current challenges, the most appropriate problem statement has been defined. This is an iterative process, so the problem statement will evolve as we move towards an operational use case, but the problem statement for the current PoC is currently as follows:

***Explore the typologies and nominal involvement within violent crime hotspots to assist a strategic understanding of the factors that contribute to violent crime, and insight to guide operational users on key factors, nominals and networks contributing to harm in these hotspots.***

- Violent crime: defined by Offence Titles and NDQIS guidance regarding offences involving knives or sharp instruments – focusing on Physical Violence
- Typologies: spanning across Knife, Gun, Youth Crime, OCG, Domestic Violence, Violence Against Women & Robbery (personal property)
- Hotspots: informed by the VRU and Force Data Analytics Labs, down to a district postcode level (potentially lower), also assessing the relevance of home address data
- High harm: segmenting nominals into cohorts suitable for interventions aligned to the VRU success factors based on their proximity to violence and their violent crime harm - supported by the ONS metrics available for each crime offence, whilst assessing the relevance of RFG
- Networks: forming insight associated to networks, not only characteristics of the nominals/events within
- Nominal factors: understanding impact of factors that contribute to Violent Crime e.g. mental health, substance abuse, ACEs, educational establishments & organised crime

## **2. Data Exploration**

Data exploration happens iteratively along with defining the problem statement. This involves investigating tables across the key data sources to find data fields that help to turn the problem statement from a business problem into a technical solution.

For this use case, this process is driven by initially understanding what defines violent crime and what key information is important to SMEs working in the area of violent crime and violent crime interventions, both operationally and strategically, and then identifying the data sources for this information and building the logic to create them. In some instances, these could be taken directly from source tables and in other cases some derivation is required to transform the raw data. The NDAS team also investigates all tables across the key data sources to find other information that could be useful for the use case. Once data exploration is complete, the raw data is transformed to create analytical tables in preparation for structured analysis (e.g. geospatial and network analytics). The process of data exploration assisted in identifying the initial source systems that would deliver the most value at the stage of operationalisation.

## **3. Structured Analysis**

The Violent Crime problem statement aims to provide a wide view of violent crime to assist both a strategic understanding and support operational users with lower level detail and event information.

The violent crime proof of concept is focussed around 6 pillars:

1. Violent crime events
2. Typologies
3. Hotspots
4. Harm

5. Networks
6. Contributing factors

These pillars support the problem statement goals and have been influenced through discussions with SMEs. The below outlines the current direction for each of the pillars.

### 1. Violent Crime events

Violent crime is defined at the offence title & HOCR (Home Office Counting Rule) level, this definition was informed through previous NDAS work in most serious violence, VRU guidance and via a workshop with the NDAS WMP team.

### 2. Typologies

Typologies will allow the user to focus on areas of operational or strategic interest and interrogate the differences in violent crime typologies. These typologies have been developed through SME discussions. The current typologies are:

- Knife crime (this has been aligned with NDQIS guidance on weapon types)
- Gun crime (with links to NDAS's Firearms PoC definition)
- Youth crime (offences where the nominal was 25 or under)
- OCG crime
- Domestic Violence
- Violence against women
- Robbery (personal property)

Knife and gun crimes are identified by the weapons involved in the events while information about OCG involvement and nominal age are available primarily at nominal level. The approach to identify domestic violence utilises known intelligence headers and relevant markers the police utilise within crime incidents to record domestic violence risk. Violence against women was included following release of the 10 year femicide census<sup>6</sup>, a study of the killings of women by men . The report highlighted the importance of understanding the differentiation of violence against women, and how this violence can be separate from domestic violence against women.

### 3. Hotspots

Hotspots of violent crime or of particular violent crime typologies are identified at an NPU and neighbourhood level – this can then either be used to focus on areas of known activity or explore hotspots highlighted within the tool for different time scales or violent crime typologies.

### 4. High harm

The VRU Interim Guidance Report<sup>7</sup> by the Home Office sets out how whole system violence reduction, or 'public health' strategies aim at reducing involvement in serious violence through three layers of prevention:

- a) primary services provided for a whole population (in violence reduction these refer to preventing violence from happening in the first place),
- b) secondary services for those 'at risk' (in violence reduction the focus is on preventing violence from escalating to serious criminality) and
- c) tertiary services for those who have experienced or caused injury (in violence reduction these relate to preventing violent offenders from reoffending)

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<sup>6</sup> <https://www.femicidecensus.org/reports/>

<sup>7</sup>

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/876380/12VRU\\_Interim\\_Guidance\\_FINAL\\_\\_003\\_2732020.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/876380/12VRU_Interim_Guidance_FINAL__003_2732020.pdf)

These three layers of prevention have been absorbed into the WMP VRU through success factors<sup>8</sup>, which have directly informed how harm is viewed within the Violent Crime dashboard. The WMP VRU relevant success factors include:

- Primary Prevention – we will seek to prevent the onset of violence, or to change behaviour, so that violence is prevented from developing.
- Secondary Prevention – we will halt the progression of violence once it has occurred – this is achieved by early detection or early diagnosis followed by prompt, effective treatment.
- Tertiary Prevention – we will rehabilitate people with established violent behaviour or affected as a victim.

The success factors influenced the data definition for three NDAS VC Categories: *Connected to VC*, *Involved in VC and High Harm VC*. These categories enable end users to understand how involved nominals are with violent crime activity based on available information within police systems.

For individuals within the *Connected to VC* category, the definition focuses on nominals who have not been a suspect or offender of violent crime but who have direct connection to someone who has had a recent violent crime event (as an offender or suspect). There is an additional requirement that the nominal must also have been the offender or suspect of a non-VC crime, this is added to ensure victim-only individuals are not placed in a VC category.

The *Involved in VC* and *High Harm VC* categories include individuals who have had at least one violent crime event in the time frame considered. To differentiate between Involved and High Harm the cohort was split based on their recency scaled violent crime harm. In this context we defined violent crime harm as the ONS severity associated to their violent crime events - this was recency scaled such that recent violent crime offences received a larger weighting. *High Harm* population then consists of the top 10% of individuals by this metric.

## 5. Networks

One of the biggest factors in effectively identifying, understanding and investigating criminal activity is understanding the connections between people. This can facilitate a more contextual understanding of an individual, their known connections and their proximity to violent crime. When establishing connections between nominals, only crime connections established between victims offenders and suspects were utilised. When connecting nominals based on shared intelligence, the reliability of the intelligence is taken into consideration when forming links between individuals.

## 6. Contributing Factors

Contributing factors surrounding violent crime have been discussed with SMEs. These include vulnerabilities such as ACEs (adverse childhood experiences), mental health issues and substance abuse. While it is appreciated that only a limited view of these vulnerabilities or contributing factors can be gained from police data alone it is considered an important element of the problem statement to help build a contextual understanding of the individuals involved.

## 4. Dashboard & Insights

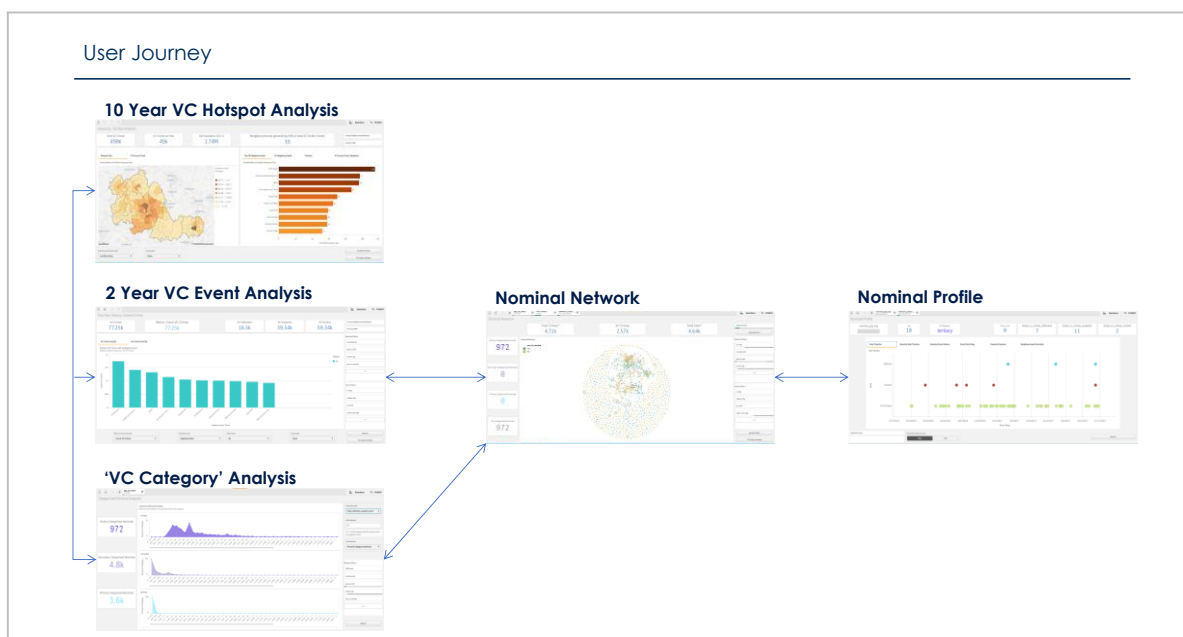
The final stage of the analytics process is to present the data in a way that informs and assists the end user in both strategic oversight and operational activities. Since the last meeting where the violent crime use case was presented, considerable amounts of thought and effort has gone into the VC dashboard, coupled by multiple SME sessions to showcase progress and collect observations from potential end users.

Below provides the user journey of the violent crime use case. The '10 year VC hotspot analysis' screen is focused on aggregated data, providing a strategic understanding on how and where violent crime is changing over time. The remainder of the screens provide a lower granularity of insight, providing improved awareness of the events and people connected to violent crime, which can then inform operational activity.

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<sup>8</sup> WMP provided document: Violence, Vulnerability And Exploitation Prevention & Reduction Strategy V2.4

All insight presented within the dashboard will align with source systems used by the police on a daily basis, with the dashboard available to augment decision making and not replace existing processes and decision making.



A further detailed explanation of the dashboard functionality and supported insight will be presented during the meeting via demonstration.

As NDAS progresses and has more data from different forces, it is anticipated that this approach will provide data to support national policy decision making. Any data shared in this context would not be personal data and would not lead to direct interventions involving individuals. It is anticipated, however, that a better understanding of the local picture in different forces, from the aggregation of this structured analysis, will support the work of the Home Office's Serious Violence Policy Unit and the National Crime and Justice Lab.

### Will the project eventually be automated?

Yes

No

Any next steps taken as a result of the insights will be based on professionals' understanding of the threat and the police and partner resources available to tackle that threat. Users will be reminded that the use case is designed to augment, not replace, the professionals' decision making. A disclaimer will be added to first screen of the dashboard to remind users of this.

### Means of evaluation:

Internal Technical Evaluation: the problem statement, methodology and Proof of Concept tool will be reviewed as part of an internal evaluation to provide recommendations on how to improve the validity of the use case. The reviewer has not been involved with the NDAS project, and internal evaluations such as this are conducted as part of general quality assurance activities by the NDAS' delivery partner.

Per feedback from the Ethics Committee, case studies covering each of the three VC Categories are also being formed in order to provide further context on the potential benefit of the dashboard and an improved understanding on how teams such as the VRU or Project Guardian may utilise such insight.

## **ALGO-CARE considerations:**

### **Advisory**

#### **If applicable, are the outputs from the algorithm to be used in an advisory capacity?**

The output of the violent crime use case will be used as a source of insight to assist the understanding of violent crime. The NDAS capability is not a tool that substitutes the professional judgment and discretion of law enforcement practitioners for automated decision-making. It is designed to assist human decision making, with added efficiencies through processing and visualisation of data.

#### **Does a human officer retain decision-making discretion?**

Yes. The Violent Crime dashboards will only be used to supplement existing processes designed to tackle violent crime and protect communities from this crime type.

It is anticipated that the interactive dashboard which encompasses outputs from this use case will support the overall process by identifying connections between information already held within police systems. There will in general be two audiences for this output: force intelligence and violent crime SMEs (i.e. those involved in the VRU and the violent crime Surge activity), at a local level engaged in the police and partnership work to identify potential hotspots/crime patterns, safeguarding victims of violent crime and disrupt and dismantle OCG's involved in violent crime events and strategic analysts (focused on understanding high level statistics and trends relating to the threats in the force area, and making resourcing decisions based on that assessment).

End users will be briefed and trained on a number of protocols put in place to aid users on understanding how the insight should be interpreted, and actions required as a result of using the dashboard. This will include steps such as cross-referencing insight from the VC dashboard with BAU policing systems.

### **Lawful**

#### **What is the policing purpose justifying the use of the algorithm (means and ends)?**

The purpose is to explore the typologies and nominal involvement within violent crime hotspots to assist a strategic understanding of the factors that contribute to violent crime, and insight to guide operational users on key factors, nominals and networks contributing to harm in these hotspots.

This will enable a better understanding of the scale of such networks to improve intelligence, guide investigations, and inform the delivery of interventions by the police and other statutory partners under the Crime and Disorder Act 1998 for potential victims and perpetrators. The use case demonstrates the ability to see these networks of in an innovative, interactive manner, which would provide insights of an otherwise very complex crime, where it is difficult and time-consuming to identify links between multiple nominals as well as the part the nominals play within networks.

#### **Is the potential interference with the privacy of individuals necessary and proportionate for legitimate policing purposes?**

The use case relies on personal information which is already in police systems. The use case brings relevant data to the surface and shows insights relating to the individuals and the networks involved. This is in relation to a key strategic threat which it is widely agreed is having a devastating effect on the lives of vulnerable people within society and the broader community. Any intervention that is put in place as a result of the insights from this use case will be to protect vulnerable people, and to disrupt and dismantle the networks that are involved in violent crime.

#### **In what way will the tool improve the current system and is this demonstrable?**



During the development of this use case it quickly became evident, from engagements with SMEs, that a lot of the data required to understand, identify, and tackle violent crime already existed within police source systems. However, due to the constraints of how the information currently presents itself, it is often extremely time-consuming, to gain a full understanding of the threat in order to systematically target the networks involved.

The focus of this use case is to better to understand how violent crime events could be identified from a more strategic perspective. The use case is being developed to give an understanding of the locations, people and networks which are seen as vital in terms of the tasking of resources and appropriate interventions to support stakeholders in providing resources to prevent violence and appropriate measures to prevent the escalation of an individual's involvement in violent crime. For example, the use case will assist identification of those individuals who are most likely to be having the greatest impact on the threat to young and vulnerable people, in order for resource-intensive pro-active investigations. Conversely, the dashboard could assist in identifying those most at risk, so that we can ensure the police and partner response to safeguard these individuals is as effective as possible, and efforts can be made to understand the risks to vulnerable people and put measures in place to prevent the recruitment of other vulnerable people to the network.

We are therefore expecting a qualitative improvement in a force's ability to tackle the threat of violent crime, as well as a quantitative improvement, as it is estimated that the ability of NDAS to visualise a network in seconds will save hundreds of hours of an analyst's time per network, freeing up this time for forming a better understanding the long-term issues that lead to violent crime and work with communities and partners to tackle these issues.

Engagements with the Violence Reduction Unit and Project Guardian (Surge funded) have been supportive of the use case when the dashboard has been demonstrated, articulating the anticipated benefit of being able to visualise existing information via the interactive dashboard. The dashboard is currently being formed as an intelligence product, used alongside existing processes and tools.

Case studies have been formed across each of the three categories in order to improve the understanding on the potential benefits that could come from the Violent Crime dashboard.

Further benefits will become demonstrable as they will be discussed & monitored through the project management process (such as the monthly SPOC meetings) and the evaluation of the project that is currently being organised.

**Are the data processed by the algorithm lawfully obtained, processed and retained, according to a genuine necessity with a rational connection to a policing aim?**

Data processed by the NDAS is derived from existing police systems, meaning the data was obtained and processed for criminal law enforcement purposes under Section 3 of the Data Protection Act 2018. In addition, the acquisition, processing, and retention of data by the NDAS on behalf of West Midlands Police is governed by an information sharing agreement (ISA) between partner agencies.

The ISA stipulates:

'Each national analytics assignment commissioned through NDAS governance will look to answer a specific problem (or "use case") on behalf of the Partner Forces, in line with one or more of the following policing purposes:

- Protecting life and property
- Preserving order
- Preventing the commission of offences
- Bringing offenders to justice, or
- Any duty or responsibility of the police arising from common or statute law.'

In this way, all data sources will be shared for a common, lawful and specified purpose.

In accordance with the Information Commissioner's guidelines, a full Data Protection Impact Assessment has been conducted. This has been shared with the Ethics Committee in the past and is continually updated as the project progresses.

### **Is the operation of the tool compliant with national guidance?**

The Violent Crime use case is being designed to allow a national view of the offending and law enforcement response. The National Police Chief's Council (NPCC) have a project to better co-ordinate the national response to the issue of violent crime, and as discussed above this is key to the strategy for the Home Office. These are key stakeholders in the development of this use case, to ensure data analytics is used to improve the work that they are doing by enabling forces to understand the landscape of violent crime more comprehensively. The development of this use case is also overseen by the Home Office's National Police Capabilities Unit to ensure it aligns with national policy.

The overall aim of NDAS is to fulfil the ambitions of the Intelligence Portfolio of the NPCC, which has articulated a national aim for a data analytics capability for UK law enforcement. In line with this aim, the project is working with the NPCC lead to develop guidance on the development and use of advanced analytics in policing. We will also be working with the Home Office and other colleagues on the development of the National Crime Lab.

In the absence of a framework regulating analytics in law enforcement, the NDAS has looked to ensure that its general operation remains aligned to the relevant existing national guidance that applies to law enforcement, particularly with regard to relevant data protection and administrative laws. This includes alignment with national best practice such as MOPI and governed data processes within the NDAS platform.

NDAS are also developing a proposed framework which brings some of the leading thinking around the development of data analytics together with the policing Code of Ethics and where applicable the ethical codes for each individual force, so that guidance on the use of data analytics is grounded the ethical principles that govern policing generally and have been built on the foundations of the Peel's 'founding principles on British policing'<sup>9</sup>. In the Building on our completion of a Data Protection Impact Assessment, NDAS was engaged in the Information Commissioner's Office Project DALE (Data Analytics in Law Enforcement) and is committed to continuing to ensure that all operations adhere fully with general data protection requirements for law enforcement.

### **Granularity**

#### **Does the algorithm make suggestions at a sufficient level of detail given its purpose and the nature of the data processed?**

The tool will provide detail at an individual, network level and aggregated view. This is considered sufficient to understand, identify, and support interventions based on the use case's problem statement. It should be noted, however, that the value of the tool depends on the quality of the insights which will be validated through feedback with SMEs. At the time of writing, this validation work has not been completed.

#### **Are data categorised to avoid broad-brush grouping and results and therefore issues of potential bias?**

The analysis of data within the use case is designed to be as wide as possible in line with the user's requirements. One of the issues for potential bias is the focus on youth crime that the use case will allow – under 25 knife crime is a strategic priority for the Home Office Surge finding. However this is justified as it is proven that this age group are

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<sup>9</sup> College of Policing (2014), *Code of Ethics: A Code of Practice for the for the Principles and Standards of Professional Behaviour for the Policing Profession of England and Wales* [URL: [https://www.college.police.uk/What-we-do/Ethics/Documents/Code\\_of\\_Ethics.pdf](https://www.college.police.uk/What-we-do/Ethics/Documents/Code_of_Ethics.pdf)]

the most likely to be involved in knife crime both as offender and victim, and there is a pressing social need to tackle this issue to save lives and prevent the wider social harm that this causes.

Focus on place-based violent crime could be considered to be an issue of potential bias and lead to “over-policing” in an area. The following issues should be noted. Firstly, there are clearly violence hotspots in any force area, usually in town and city centres, and this needs to be addressed to prevent harm. Secondly, the insights will be used for the partnership approach through the systematic, public health approach to violence – which means that interventions will not necessarily be police led. Finally, in seeking to provide a broader geo-spatial understanding of violence, not only focussing on hotspots but also locations where other violent offences are committed by the same people, the use case seeks to take the focus away from the hotspot to form a wider understanding of the problem.

**Do the potential benefits outweigh any data quality uncertainties or gaps?**

Yes. Firstly, no significant data quality issues or gaps were identified. Moreover, there is the social benefit of being able to identify networks of organised crime groups and the risk of individuals being drawn into violent crime. Existing data sources are expected to lead to more efficient safeguarding of victims and targeting of those who subject them to violent crime events.

**Is the provenance and quality of the data sufficiently sound?**

The data comes from core source systems used on a day to day basis by forces and do not show evidence of significant data quality issues.

**If applicable, how often are the data to be refreshed?**

Data will be refreshed weekly, but the frequency of dashboard refresh will be confirmed in due course, in partnership with the forces’ needs.

**If the tool takes a precautionary approach in setting trade-offs, what are the justifications for the approach taken?**

Not applicable.

**Ownership**

**Who owns the algorithm and the data analysed?**

WMP owns all tools developed as part of the National Data Analytics Solution, on behalf of the Home Office. Each partner force owns their own data being analysed and the insights derived.

**Does WMP need rights to access, use and amend the source code and data?**

No.

**Are there any contractual or other restrictions which might limit accountability or evaluation?**

No.

**How is the operation of the algorithm kept secure?**

Partner Forces’ data will be transferred to the secure NDAS AWS cloud platform via Secure File Transfer protocol (SFTP). All data will be held and processed throughout the delivery of the use cases. More detail on the security specifications can be found in the Data Protection Impact Assessment. The AWS platform has passed a penetration test and confirms to standards as set by National Police Risk Information Management Team (NPRIMT).

**Challengeable**

**What are the post-implementation oversight and audit mechanisms, e.g. to identify any bias?**

A range of governance mechanisms are in place to monitor the progress of the NDAS project as it moves toward, and beyond, its first operationalisation phase:

- National oversight is provided by the Home Office’s National Police Capabilities Unit (NPCU)
- Strategic oversight is provided by the NDAS Chief Officer and Stakeholder Governance Group, which includes the Chair of the West Midlands Ethics Committee
- Funding for the project is overseen by the NPCU and the West Midlands Office of the Police and Crime Commissioner
- The NDAS is engaged with the development of an ethical framework for the use of algorithmic systems in law enforcement
- The NDAS is engaged with the Office for the Information Commissioner

In addition, tools deployed in this context will be closely supervised using ongoing human monitoring and auditing of performance against metrics such as accountability, bias, and security. As part of ongoing use case maintenance and monitoring, the NDAS team will conduct regular reviews of the use case to monitor against bias, including being alive to feedback on the dashboard by end users. The NDAS will work with the end users — operational investigators and strategic analysts—to support the development of a decision-making oversight and audit mechanism.

**If the algorithm is to inform criminal justice disposals, how are individuals notified of its use?**

The insights generated by the violent crime use case will not be used to inform criminal justice disposals, including decisions on charge or bail; or decisions as to whether to continue an investigation into allegations concerning a subject. There will, however, be a process for notification, challenge and complaint within existing police systems.

In addition to notification, external observers and data subjects shall be able to challenge the process by which an outcome was reached, to ‘ensure that such tools are being used in accordance with the requirements of the relevant data protection legislation and principles of accessibility and natural justice under the Human Rights Act 1998’.<sup>10</sup> In line with this aim, NDAS governance forums should work with partner forces to embed standards for fairness, accountability, and transparency not just in the analytical models developed but also in the overall decision-making process that uses the outputs generated. For example, if a data subject wishes to challenge a decision that has been made with NDAS output (providing supplementary information to the decision-maker), a process will be established to allow the subject to scrutinise the use case outputs.

**Accuracy**

**Does the specification of the algorithm match the policing aim and decision policy?**

Yes. The use case will be developed directly as a response to the problem statement which was defined in collaboration with partner forces.

**Can the accuracy of the algorithm be validated periodically?**

As the product in question is a discovery tool to support the analysis of violent crime threat, accuracy scores are not calculated.

Regular consultations with end users will take place in order to ensure that the insight presented through the dashboard continues to align with end user expectations of the tool.

**Can the percentage of false positives/negatives be justified?**

Not applicable (see previous response).

**How was the method chosen as opposed to other available methods?**

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<sup>10</sup> Alexander Babuta, Marion Oswald and Christine Rinik, ‘Machine Learning Algorithms and Police Decision-Making: Legal, Ethical and Regulatory Challenges’ (2018) [https://rusi.org/sites/default/files/201809\\_whr\\_3-18\\_machine\\_learning\\_algorithms.pdf.pdf](https://rusi.org/sites/default/files/201809_whr_3-18_machine_learning_algorithms.pdf.pdf)

Previous attempts to bring tools around serious violence have not been successful, due to the predictive modelling aspect of the analytics. Significant engagement with SMEs has identified a need not only to identify cohorts of individuals involved in violent offences, but also the typologies of violence and the factors that contribute to the violence, both at a strategic level (to aid decision making on the allocation of resources by police and partners) and at an operational level (to help identify appropriate interventions). The use of the analytical capacity that NDAS brings to this problem is important, as the granular analysis of a number of different data sets, in a number of different ways, will help to address these requirements.

### **What are the (potential) consequences of inaccurate forecasts?**

We are not looking to build a use case that makes forecasts, but one that responds to the questions that users have to assist in their analysis of violent crime. Users will also be reminded that the use case is designed to augment, not replace decision making, and will have access to other information, e.g. the VRU will have access to A&E data to help understand violent crime hotspots (currently separate to NDAS's dashboard).

As part of the use case moving from a PoC through to operationalised, a comprehensive training program is delivered to each end user ensuring that users are aware and understand the limitations and caveats associated to the tool.

### **Does this represent an acceptable risk?**

Yes. A plain-language explanation of how the output was generated and the factors that influenced the output will be produced alongside the output itself. In addition, it is intended that police end users review and interpret the use case results—to complement other sources of information in order to develop a targeted, well-informed interventions approach.

### **How are the results checked for accuracy and how is historic accuracy fed back into the algorithm for the future?**

Not applicable as accuracy scores are not calculated.

### **How would inaccurate or out-of-date data affect the result?**

Not applicable as accuracy scores are not calculated.

## **Responsible**

### **Would the operation of the algorithm be considered fair?**

This use case highlights information that is already recorded within police systems, in-line with normal policing activity. The use case does not include an algorithm that can be evaluated for fairness.

### **Is the use of the algorithm transparent (taking account of the context of its use), accountable and placed under review?**

As part of our continuous engagement with SMEs, including operational and strategic decision-makers, we will support accountability in the decision-making process by helping decision-makers fully understand the output generated. We will continue to work with SMEs to define what this process and associated standards will look like, whilst learning from other projects within government utilising advanced analytics<sup>11</sup>.

### Public engagement for transparency and accountability

Ensuring there is public trust in policing is paramount. The risks of damaging public confidence and trust in law enforcement are manifold, and the consequences well-documented. The application of advanced analytics adds complexity to this: although such technologies have been broadly applied in the private sector, it is still relatively new within policing—however, in both cases the level of public discourse is nascent. Compounding this, the opacity

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<sup>11</sup> 'Ensuring statistical models command public confidence' <https://osr.statisticsauthority.gov.uk/publication/ensuring-statistical-models-command-public-confidence/>

of how personal data is collected and used has understandably raised surveillance and privacy concerns—in addition, the pursuit of new technological initiatives without public consultation has arguably led to diminishing public trust in technology.

Despite these challenges, there is an opportunity for the NDAS to engage citizens to influence its operation and build local accountability in developing ethical approaches to the use of analytics in law enforcement. A plan for meaningful public engagement should play a role in this. The Royal Society of the Arts (RSA)<sup>12</sup> suggests the application of ‘a process of citizen deliberation’ in the deployment of analytics across three phases:

1. Public scrutiny through consultation when such systems are being introduced
2. Technical oversight through testing output for value or expert-led auditing; and
3. Monitoring how the system is used by humans and evaluating its impact

We suggest that point 1, public scrutiny through consultation, be delivered through the Office of the Police and Crime Commissioner (at this stage, by the West Midlands OPCC). It is recognised that it takes real resource and commitment to deliver a plan for public engagement on this topic, and that consideration must be made towards being as representative of local citizens as far as possible to build local-level democratic accountability.

2 and 3 will be done through the process of the project, overseen by the stakeholders including the Home Office to ensure we are accountable to the public.

#### **Would it be considered to be used in the public interest and to be ethical?**

Yes. If it is demonstrable that the use case has the potential to rapidly identify information (that already exists, but would take longer to analyse manually) to support interventions to prevent violent crime, it is arguably within the public interest for it to be operationalised, in a way that is proportionate to any potential impact on individual rights.

The overall aim of this use case is to support police and partners to take a more systematic approach and achieve sustained public protection through the disruption and dismantling of networks involved in organised crime groups/violent crime.

#### **Explainable**

##### **Is information available about the algorithm / decision-making rules and the impact of each feature?**

Within the dashboard, and supporting documentation, end users will be made aware on how the insight is formed and associated caveats for the end user to proactively consider.

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<sup>12</sup> RSA, ‘Artificial Intelligence: Real Public Engagement’ [https://www.thersa.org/globalassets/pdfs/reports/rsa\\_artificial-intelligence---real-public-engagement.pdf](https://www.thersa.org/globalassets/pdfs/reports/rsa_artificial-intelligence---real-public-engagement.pdf)

## Appendix:

### Supporting Technical Information: Approach & Methodology

This section outlines the key decision points and approaches in creating the core components of the Violent Crime Proof of Concept, these align closely to the problem statement, outcomes from data exploration will be highlighted where appropriate throughout.

#### Definition of Harm

##### Introduction

This section outlines the method used to define harm. To understand harm, instead of risk, the nominal's criminal history is evaluated to create a metric that differentiates the weight of their impact from others in the data.

Creating a metric that defines harm provides this holistic viewpoint. It takes into account not only whether a nominal has committed offences in the past, but also the nature of those offences. The result of this is a metric that shows the wider impact of a nominal's crimes.

##### Approach

In total, four overarching methods were explored for measuring harm. These were further extended to create six metrics for harm. The definitions of these methods are as follows:

Metric	Description	Timeframe
ONS	Aggregated ONS severity score for all crimes where the nominal was an offender.	2 year and 10 year
CHI	Aggregated Cambridge Harm Index (CHI) score for all crimes where the nominal was an offender.	10 year
RFG	Recreation of RFG score using all elements: <ul style="list-style-type: none"><li>• Recency</li><li>• Frequency</li><li>• Gravity (two metrics were created, using each of Northumbria and ONS scores)</li><li>• Serial Victim</li></ul>	2 year
IOM	Based on the RFSDi score, created as an indicator of harm to be the target feature of the IOM model. Metric created using the following elements: <ul style="list-style-type: none"><li>• Recency</li><li>• Frequency</li><li>• Logarithmic, time-decaying harm (based on CHI)</li></ul>	10 year

#### Findings

Following SME discussions, the ONS and RFG metrics were chosen to be used in the final data model. This was due to a variety of considerations including interpretability. Given the wide scope of this use case, this harm metric is going to be used directly by the end user in a variety of contexts. Because of this, it was deemed important that the metric used was flexible and interpretable. Additionally, NDAS has used the ONS severity score before, as part of this considerable work has been undertaken to ensure wide coverage of mappings between the severity score and the HOCC codes available in the data. Using this metric would allow us to leverage this asset.

## Violent Crime Typologies

### Introduction

This section outlines the violent crime typologies defined and explored as part of this use case. These typologies were created with guidance from SMEs in the area to allow for impactful filtering and narrowing of scope when using the solution.

### Knife Crime

This theme captures crime events that can be categorised as involving a knife. It is worth noting the distinction between blade/sharp point offences (such as 'HAVE ARTICLE BLADE/SHARP POINT PUBLIC PLACE') and crimes involving a knife. The latter is any crime event in which the 'weapons used' field indicates that a knife was involved and is the definition taken here.

### Approach

The Home Office's (NDQIS) definition of knife crime was used to categorise crime events into this theme. This alignment allows for a centralised approach and ease in later comparisons of volumes or trends. According to the definition, if the weapon used in the event was amongst the weapons in the below table, it should be categorised as knife crime.

Axe	Bayonet	Bow & arrow	Chisel
Chopper	Crossbow / bolts	Dagger	Dart
Flick-knife	Fork (cutlery)	Kitchen Knife	Knife
Machete	Pen knife	Razor / razorblade	Saw
Scalpel	Scissors	Screwdriver	Sharpened object (to make weapon)
Sharp tools	Stanley knife / blade	Syringe needle	Sword

The highlighted weapons were used to categorise events where knife was used/present. The weapons that are not highlighted such as 'scalpel' were not included in our definition of knife crime as information about those weapons was not available within the WMP crime data source extract that NDAS used.

### Findings

The following table shows the volumes and the descriptive characteristics of this theme from the EDA.

Field	Description	Number of events	Number of VC events	Number of nominals	Number of VC nominals
Knife Crime	knife_crime_flag = 1	53,590	41,736	73,629	60,164

As mentioned above, not all of the events were knife\_crime\_flag =1 are VC events however 78% are noted as violent crime (are associated to crimes with as violent crime HOOCR code and offence title).

### Gun Crime

This theme captures crime events that can be categorised as involving a gun. As with knife crime this relates in particular to crime events in which the weapon codes mention a firearm and is not based on the crime type/HOOCR code.

### Approach

To categorise crime events into the gun crime theme, there were 37 weapon codes that were used to identify a firearm within WMP data, any event involving a firearm was then deemed a gun crime.

### Findings

The following table shows the volumes and the descriptive characteristics of this theme from the EDA.



Field	Description	Number of events	Number of VC events	Number of nominals	Number of VC nominals
Gun Crime	gun_crime_flag = 1	11,097	9,381	15,751	13,831

## Youth Crime

This theme captures crime and intel events where the individual involved in the event was at that time aged below 25 years old. This was highlighted as an age threshold of interest as it aligns with the approach taken by WMP's Op Guardian team.

### Approach

To identify events that can be categorised into this theme, we filter events based on the nominal's age at the time of the event. This would allow for a deep dive into youth crime events across time rather than focusing only on nominals who are currently under 25.

### Findings

The following table shows the volumes and the descriptive characteristics of this theme from the EDA.

Field	Description	Number of events	Number of VC events	Number of nominals	Number of VC nominals
Youth Crime	age_at_event < 25	1,458,180	294,577	674,098	274,420

## Organised Criminal Groups

This theme captures crime and intel events where the individuals involved in the event were connected to an organised criminal group (OCG) through use of the OCG tracker. It is noted that the extract NDAS has is from a manually maintained source, it is now understood that this data is stored within PND and so in future iterations information from this source will be sought.

### Approach

To identify OCG nominals, the OCG tracker was used which records an event in the case of a change in rank or standing of an OCG nominal. Based on this information, 1671 nominals were tagged as belonging to an OCG.

In order to categorise OCG events, SME feedback was requested and a more complex approach was taken since all events involving an OCG nominal may not be OCG events; for example if the nominal was last connected to an OCG 10 years ago, we do not deem it appropriate to connect that activity last week to the OCG. With feedback from the SME's it was decided that events that an OCG nominal was involved in from one year before their first association with an OCG (first time they were recorded in the OCG standing source table) and up to 2 years from their most recent association with the OCG (latest time of event recorded) would be categorised as OCG events. The idea behind this approach was that often information about the OCG nominals would be available after they have committed crimes and so this subset of events could then be captured to an extent using the above approach. This will be reviewed in light of the new data source being utilised.

### Findings

The following table shows the volumes and the descriptive characteristics of this theme from the EDA.

Field	Description	Number of events	Number of VC events	Number of nominals	Number of VC nominals
OCG Activity	Where event occurred up to 1 year prior to their first association and up to 2 years after their latest	53,730	1,232	31,684	2,108

Note here that the number of nominals highlights all nominals connected to an OCG event and not nominals known to be involved in OCG activity through the tracker. This distinction is made clear through a nominal flag stored in the nominal table.

## Domestic Abuse

This theme captures crime and intel events where the nominal was involved in some form of domestic abuse activity. While the focus for this use case is crimes, intelligence is also considered to bring additional context to the nominal’s involvement.

### Approach

To identify events into this theme, we used a different approach for the crime and intel data sources respectively. For the crime data source, we categorised an event as domestic abuse if it had a DV risk flag of H, M or S or if it was associated with any of the HOCTs selected in the DA use case ('008/67', '305/00', '331/00', '330/00'). The dv\_risk flag is populated with the outcome of a DASH or DARA risk assessment where the HOCT codes related to crimes linked to domestic abuse as part of the NDAS Domestic Abuse use case (documentation here). For the intel data source, an event was categorised as DV if it had a heading PROTECT and a subheading like DOM. This approach was used to create a da\_event flag which assigned a label 1 to an event if it met the above criteria and 0 otherwise. This logic was identified during the Domestic Abuse PoC however should be verified with users prior to implementation.

Nominals were tagged to the domestic abuse theme when they were linked to an event for which the value of the da\_event was 1 and where the individual was over 16 at the time of the event. This is in line with the definition of domestic abuse<sup>13</sup>.

### Findings

The following table shows the volumes and the descriptive characteristics of this theme from the EDA.

Field	Description	Number of events	Number of VC events	Number of nominals	Number of VC nominals
Domestic Abuse	DV_risk in (H, M, S) or by HOCTs as selected in DA use case	393,230	88,070	498,579	181,520

While DA events can be intelligence or crimes, VC events can only be crimes which should be noted when comparing the volume of events in the above table.

## Robbery (personal property)

This theme captures crime events where the nominal was involved in a robbery offence. This theme was highlighted in a SME discussion with the WMP Op Guardian team specifically to consider personal property.

### Approach

To identify events into this theme, NDAS tag events which have an offence title that includes the word rob/robbery and personal property (robbery\_flag =1). This relates to the following three HOCT /offence title combination:

hocr_code	offence_title
034/03	ATTEMPTED ROBBERY-PERSONAL PROPERTY
034/03	ROBBERY-PERSONAL PROPERTY
034/03	CONSPIRE TO ROB-PERSONAL PROPERTY

Nominals are accordingly tagged to this theme if they were linked to an event for the which the value of the robbery\_flag was 1.

### Findings

The following table shows the volumes of this theme from the EDA.

<sup>13</sup> <https://www.gov.uk/government/publications/domestic-abuse-bill-2020-factsheets/statutory-definition-of-domestic-abuse-factsheet>

Field	Description	# of events	# of VC events	# of nominals	# of VC nominals
Robbery	By offence_title containing 'Robbery'	63,301	63,301	81,828	81,828

In the above table it is worth noting that since all robbery personal property events are considered a violent offence there is no difference in the volume of VC events and events of this typology.

### Violence against women

This typology captures crime events where the crime has one female victim and one male offender or suspect. This area was of interest due to the work undertaken in the UK Femicide census<sup>14</sup> and reported in a Guardian article in November 2020<sup>15</sup>. Here, given that the violence focussed on in this report was targeted at events involving one female victim and one male perpetrator NDAS has used the same interpretation. It is worth noting that from this information alone we cannot assume these events were committed due to gender however it does allow the scale of this gender *directed* violence to be explored.

### Approach

To identify events that involve violence against women NDAS created a VAW (Violence Against Women) flag to tag events which have one female victim and one male offender or suspect. Note this only considers suspects if there is no offender against the crime. For instance, a crime with two offenders and one single male suspect were not included because offenders are checked for first.

Nominals are tagged to this theme if they were linked to an event for which the value of the `vaw_flag` was 1.

### Findings

The following table shows the volumes and the descriptive characteristics of this theme from the EDA.

Field	Description	Number of events	Number of VC events	Number of nominals	Number of VC nominals
Violence against women	vc_flag = 1 and one female victim and only 1 male offender/suspect	140,389	140,389	259,569	259,569

Note here that since VAW is defined by violence all VAW events are a subset of violent crime.

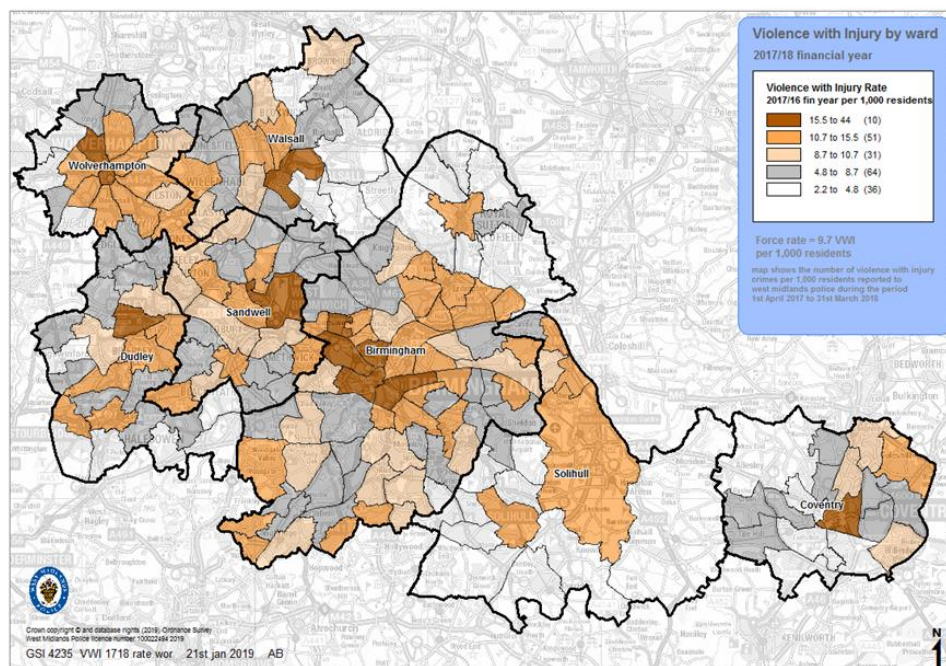
<sup>14</sup> <https://www.femicidecensus.org/wp-content/uploads/2020/11/Femicide-Census-10-year-report.pdf>

<sup>15</sup> <https://www.theguardian.com/society/2020/nov/22/if-im-not-in-on-friday-i-might-be-dead-chilling-facts-about-uk-femicide>

## Hotspots and Location Data

### Introduction

Previous work by the VRU has shown that there are geospatial hotspots of violent crime. The below figure, taken from the draft report documenting WMP's Violence Vulnerability and Exploitation Prevention and Reduction strategy outlines the 'localised hotspots within the West Midlands where the highest rates of violence are seen'.



This work can be expanded using the typologies and insight generated from all the analysis mentioned in this document.

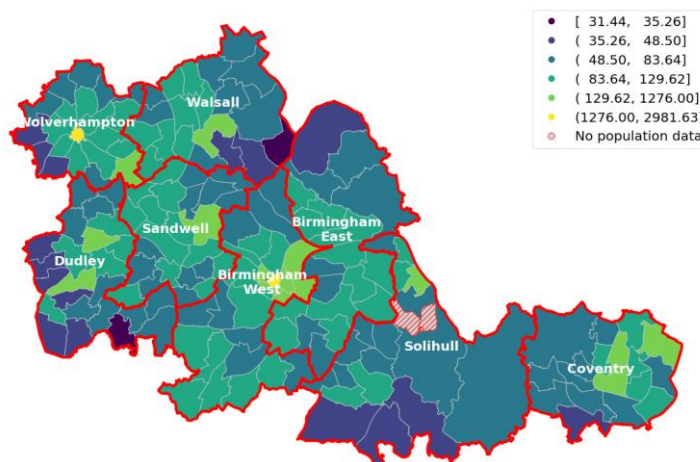
As well as this, the location data for crimes can be extended by identifying other location elements, such as the home address or school of a given nominal.

### Approach

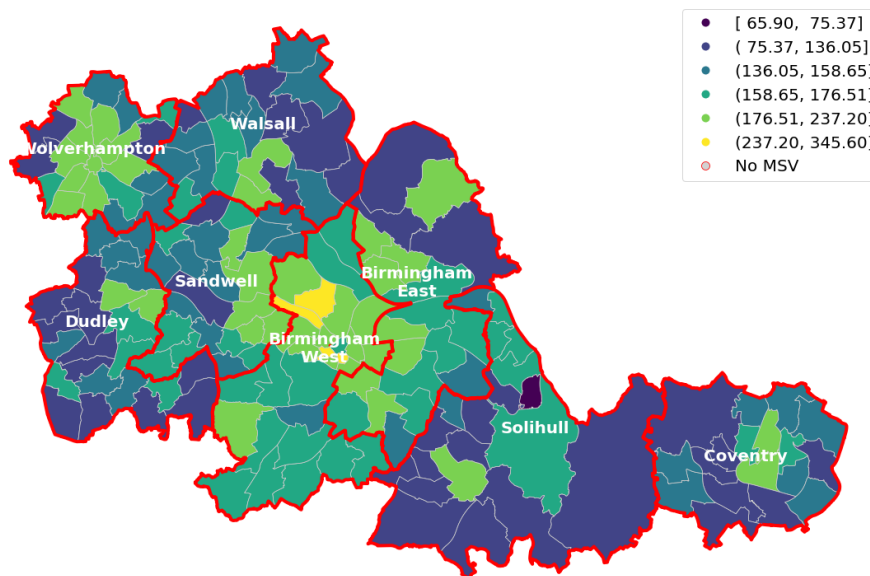
Event coordinates (null in less than 1% of crimes), were considered too granular in isolation but ideal for point-map usage where events can be viewed within a local area. For analysis at NPU level, a shapefile provided by the WMP data lab was utilised, mapping coordinates of a crime event to the corresponding NPU. This assisted in providing the location at a police relevant level.

### Findings

Crimes could be aggregated at the neighbourhood level and scaled by population to see where crime hotspots were. For example, the map below shows that Wolverhampton and Birmingham city centres are hotspots for crime.



As well as looking at overall crime, particular themes of crime can also be analysed to understand whether particular areas are hotspots for certain crime types. For example, the below map shows the hotspots for violent crimes, which are different to crime overall.



## Networks

### Introduction

Networks of linked individuals can provide powerful tools to investigate a nominal or a crime type, viewing individuals' influence, connections and proximity to others. Networks of known connections established through crime and intelligence reports have been utilised in many NDAS use cases, the key consideration in each use case is to consider both the time frame of interest (such that only recently relevant connections are considered) and what constitutes a relationship.

Once created, these connections (edges) between nominals (nodes) can be used to extract information at a nominal level about their network. The network supplies additional capability for the end user to filter and prioritise nominals to best understand their impact and harm.

### Approach

In keeping with the definition timeframe of the nominal segmentation, a 2 year window was considered within which to define a connection. This means that if a nominal was connected to another **only** by events that occurred more than 2 years ago, they will not be directly connected within the network. This filter was included in order to prune and focus the network at recent activity pertaining to violent crime and those involved.

To define a connection within this time frame both crimes and intelligence source systems were considered. Utilising learnings from the Modern Slavery production use case, crime events were only used to connect nominals where they were either a victim, offender or suspect of the crime. This means that any witnesses or other role types would not be deemed connected to the other individuals involved through this event. From Modern Slavery, this was found to remove edges pertaining to professional witnesses as well as interpreters and other individuals from whom it is less appropriate to establish a connection.

For the intelligence records, after SME discussions it was decided that it would not be appropriate to link nominals based on explicitly untrusted information. In conjunction with an intelligence analyst who is part of the WMP NDAS team the following criteria was created:

Source Grading	Information Grading	Network Edge Inclusion
1: Reliable	A: Known directly	Included
1: Reliable	B: Known indirectly but corroborated	Included
1: Reliable	C: Known indirectly	Included
1: Reliable	D: Not known	Included
1: Reliable	E: Suspected to be false	Not Included
2: Untested	A: Known directly	Included
2: Untested	B: Known indirectly but corroborated	Included
2: Untested	C: Known indirectly	Included <b>IF</b> the nominals linked by this information are linked through an additional piece of intelligence
2: Untested	D: Not Known	Included <b>IF</b> the nominals linked by this information are linked through an additional piece of intelligence
2: Untested	E: Suspected to be false	Not Included
3: Not Reliable	A: Known directly	Not Included
3: Not Reliable	B: Known indirectly but corroborated	Not Included
3: Not Reliable	C: Known indirectly	Not Included
3: Not Reliable	D: Not known	Not Included
3: Not Reliable	E: Suspected to be false	Not Included

The 'Untested' source grading was given additional consideration as SMEs raised this grading can be used for new sources of information and so has the potential to provide meaningful connections. In order to increase the reliability of connections from this source where the intelligence is not known, or known indirectly, the VC use case requires that there exists at least one other intelligence log that links the nominals.

Once created, these edges establish the known relationships in the source data between nominals, this can be further summarised through an edge weight. For this use case, the edge table is stored at 'relationship level' that means there exists only one entry per nominal pair, regardless of the number of connections between them. To provide that additional information an edge weight is assigned, this is equal to the number of shared connections between the pairing. For example, if nominal A and B are connected by 6 crime events and 4 intelligence records they would have a single entry in the edge table with a connected\_weight of 10. This provides the foundation for the creation of network metrics, the following nominal level metrics were created:

Metric	Definition
Degree Centrality	A count of the nominal's total connections in the network
Weight Degree	A sum of the edge weights directly connected to the nominal
Distance to primary nominal	Number of hops between an individual and the closest primary nominal
Distance to secondary nominal	Number of hops between an individual and the closest primary nominal
Distance to tertiary nominal	Number of hops between an individual and the closest primary nominal

## Findings

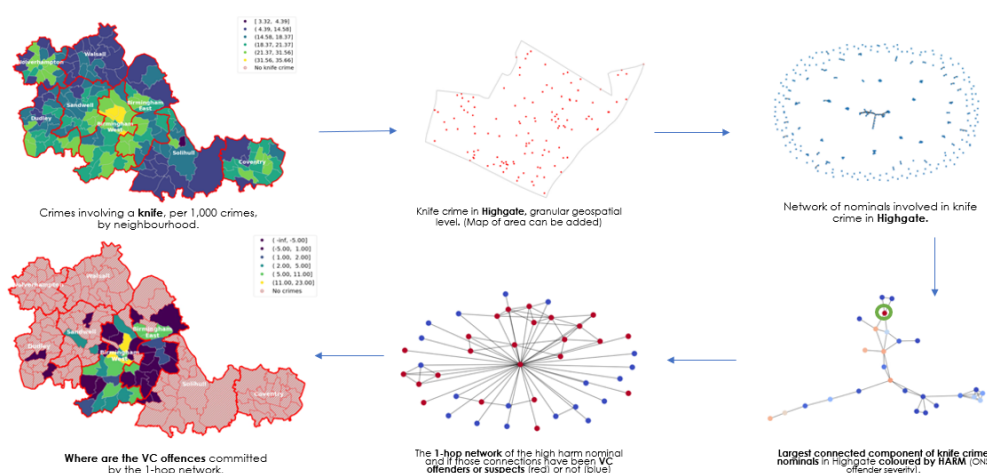
### Network

The below table shows the average centrality for the full network population, those in the Primary, Secondary and Tertiary nominal segment populations respectively.

Population	Average Centrality
All network nominals	3.7
Primary VRU nominals	2.5
Secondary VRU nominals	4.2
Tertiary VRU nominals	9.0

As can be seen, those with VC history in the last two years (secondary and tertiary nominals) have a higher average number of connections than the full population. This metric can be used to further subset the populations into those with many connections and potentially influence in their network.

Creating the networks and associated metrics allows us to link different components of the use case outlined thus far. Consider the below flow:



The above shows the cross over in typologies and tools that can be used to investigate high harm nominals involved in knife crime in Highgate. By starting from a highlighted hotspot and viewing the network of involved nominals the largest connected component can be isolated. After colouring by harm the highest harm, strongly connected nominal involved in knife crime in this area can then be expanded and the criminal activity of their connections viewed geographically.