

Evaluation of the predictive tools for short term forecasting of Knife Crime (used causing injury) and Serious Violence

Ethics Committee (08 February 2023)

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1 Executive Summary

In 2020, the Data Analytics Lab (DAL) introduced two related projects to the Ethics Committee. The purpose was to provide forecasts of the likely volume and locations of Knife Crime (where the knife was used, causing injury) and of Serious Violent Crime in the next 4-week period. The results of the forecasts are visualised in Business Insight (Qlik) dashboards for use by the Project Guardian Intelligence Team.

The Guardian Intelligence Team use the predictive tools to prioritise the focus of their analysis and intelligence development in order to make recommendations for the deployment of the Guardian Taskforce to senior decision makers. This is a unit of 26 officers¹ funded by the Home Office with the remit to reduce Serious Youth Violence. The Intelligence Team provide monthly briefings to those Neighbourhood Policing Units (NPU) where Knife Crime and Serious Violent Crime are predicted to be highest and where the Taskforce will be deployed.

The intention of this report is to provide the Committee with a detailed update about the performance of the forecasts whilst they have been in the beta testing phase, how the tools have been embedded into the Force's decision-making processes and the types of policing activity that have been undertaken as a result. Although developed as separate projects, this is a combined evaluation, since the tools serve a similar purpose and are used by the same team.

Beta testing has been in operation since April 2022 for Knife Crime and since May 2022 for Serious Violence. The dashboards are available to a limited number of users, based within the Guardian Intelligence Team for the specific purpose of making recommendations about the deployment of the Taskforce. This ensures that the output is used by intelligence professionals who have been trained in the use of the tools and that recommendations are developed in conjunction with other intelligence assessments.

Senior leaders who make deployment decisions and NPU commanders have also received inputs about how the tools work and there is now an expectation that any resourcing recommendations consider the forecasts in conjunction with other sources of intelligence.

The predictive tools have supported evidence-based decision making both in terms of choosing where to deploy the Taskforce, but also giving confidence to redeploy away from traditional violence hotspots.

During the beta testing phase the weighted average prediction error (WAPE) for knife crime has averaged 18% lower than the traditional hotspot approach. The model places greater emphasis on reducing the probability of deployment to areas where a crime is less likely.

¹ The Taskforce comprises of 22 police constables, three sergeants and one inspector.

2 Introduction

The purpose of these two projects was to develop statistical models to predict the likely levels of Knife Crime (used causing injury) and Serious Violence over time and space within the West Midlands Police (WMP) area for the next four weeks. The results of the forecasts are visualised in Business Insight (Qlik) dashboards (see *Figure 1*) for use by the Project Guardian Intelligence Team and were operationalised in April and May 2022 respectively.

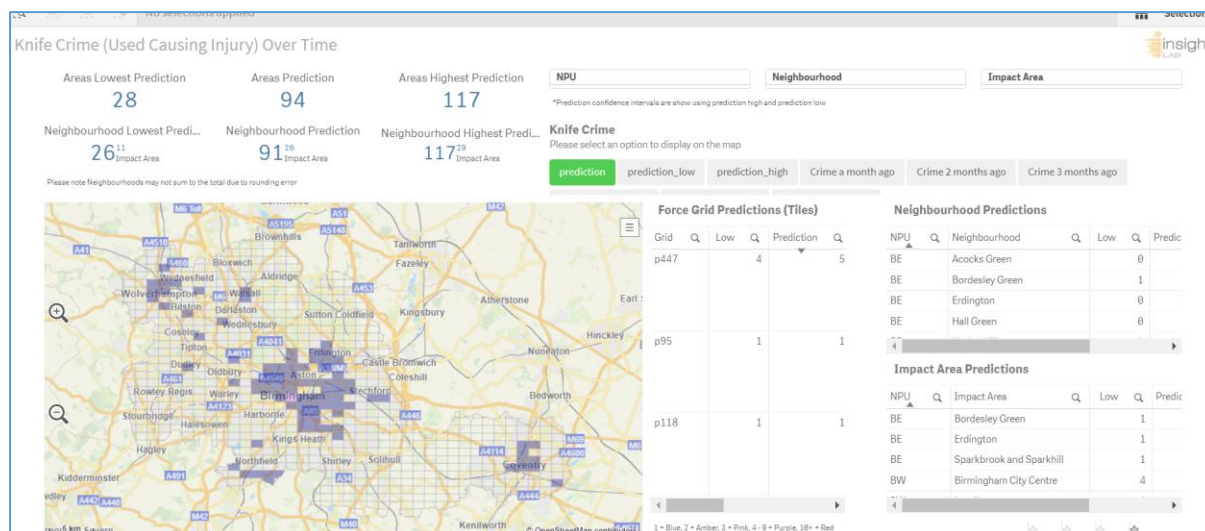


Figure 1: Knife Crime (used causing injury) Business Insight dashboard

Project Guardian is a Home Office funded project which focuses on reducing violence, in particular Serious Youth Violence (SYV). It comprises of an intelligence team and an operational taskforce whose deployment provides additional support to local neighbourhood teams (NHTs). The deployment of the Taskforce is decided via the monthly Force Tasking and Delivery Board (FTDB), chaired by an Assistant Chief Constable (ACC). These decisions are based on recommendations made by the intelligence team who use the predictive tools to inform their analysis.

As shown in *Figure 1* the dashboard divides the force area into 1km² grids for Knife Crime and 0.5km² for Serious Violence and provides a prediction for each grid square for the next four-week period. The prediction is based on two years of data, as well as considering the trend for the last 20 years. The predictions are updated on a weekly basis to ensure the analysts are always provided with the most recent data.

2.1 Ethics Committee Advice

Both projects have been presented to the Committee at various stages of their development:

Ethics Committee Meeting	March 2020	July 2020	December 2020	July 2021	November 2021
Knife Crime (used causing injury)	In principle Further information required	Interim report Further information required	Interim report Approved with major amendments	Final report Proceed with minor amendments	
Serious Violence		In principle Further information required	Interim report Approved with major amendments		Final report Proceed with minor amendments

The methodology and development of each project can be found in the [technical papers](#) presented at these meetings.

Knife Crime project

The final advice from the Committee in July 2021 was:

The Committee commends the Lab for its development of the project and addressing the points made previously by the committee and in the data science assessment.

The Committee requests that evaluation process during beta testing and the incorporation into the wider decision-making processes pursuant to Project Guardian be discussed with the Committee as these are developed, and in particular how the model will be used to inform the actions open to the police under Project Guardian, and how this model will be tested/validated for predictive accuracy in the operational environment (and thus how its accuracy or otherwise may affect the actions under Project Guardian).

The DAL reported on progress in the Three-Year Review meeting in May 2022 and further updates are provided in the remainder of this report.

Serious Violence project

The final advice from the Committee in November 2021 was:

This project should be triangulated in particular through a focus on obtaining qualitative analysis, i.e. an understanding of the factors leading to particular spatial patterns for crime, to inform a sophisticated and preventative policing response.

The Ethics Committee can offer support in relation to approaching qualitative data and the PCCs office.

The Committee has raised the need for out of time modelling to help ensure data is representative.

The Serious Violence predictive tool is no longer in regular use. It has been superseded by the Force priority to specifically focus on 'Serious Youth Violence (knife related)'. In addition, Project Guardian is using the Targeted Guardian Patrols randomised control trial to evaluate the effectiveness of high visibility patrols in reducing violence within identified hotspots.²

However, in terms of responding to the Committee's points above, it is the role of the Guardian Intelligence Team to provide additional qualitative analysis using additional intelligence to inform the policing response. This will be discussed in relation to the Knife Crime project throughout this report.

Finally, the model was developed in part by predicting over future time periods (i.e. out of training data time periods).

The remainder of this report focuses primarily on the Knife Crime project, since this is in current usage.

² This project was presented to the Committee in July 2022 (Agenda Item 4.1) [Ethics Committee Reports and Minutes - West Midlands Police & Crime Commissioner \(westmidlands-pcc.gov.uk\)](#)

3 Embedding predictions in the decision-making process

3.1 Force priority – ‘to reduce the numbers of young people being stabbed’

The chart in *Figure 2* illustrates the extent of stabbings where young people are involved (serious assaults where the victim is aged under 25 and where a knife has been used to cause injury). Between April 2021 and December 2022 there were 706 such offences recorded across the West Midlands area. This equates to an average of 34 stabbings each month. In addition, there were 18 homicides where the victim was under the age of 25 and killed by a knife.

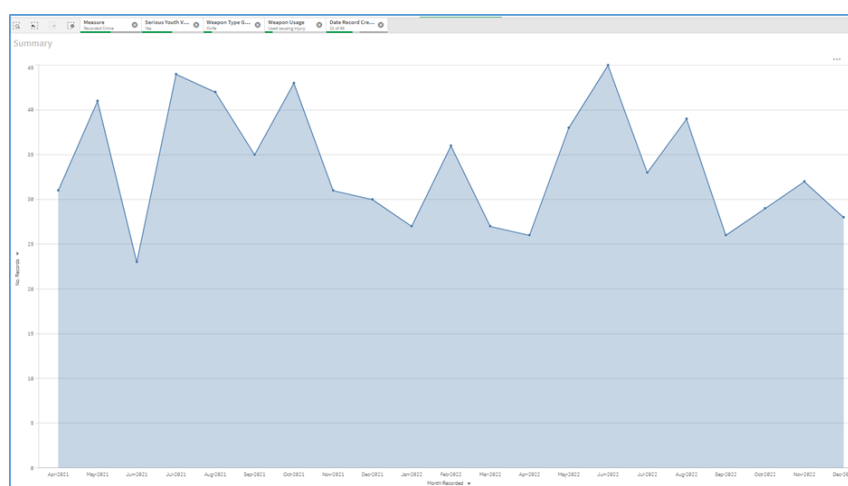


Figure 2: Serious Youth Violence Offences where a knife was used causing injury (Apr 2021 - Dec 2022)

For this reason, a key priority for the force is to reduce this specific form of violence and why the knife crime prediction dashboard is fully embedded in tasking processes, whereas the general serious violence dashboard has become less relevant.

3.2 Access to the predictive dashboard

Access to the predictive dashboards is limited to the developers in the DAL and the Guardian Intelligence Team. This means that resourcing decisions are never made solely on the basis of the prediction, but always based on a recommendation which takes account of a range of intelligence in conjunction with the prediction. The inspector in the Guardian Intelligence Team acts as a gatekeeper when there are requests for access to the dashboard.

Currently, there are 13 people with access. Three are members of the DAL and the remainder are senior officers responsible for Project Guardian or members of the Guardian Intelligence Team. The dashboards are used regularly throughout the month to review the weekly updates of the forecasts and to support tasking processes.

3.3 Educating end-users and decision makers

Since the knife crime dashboard was published to the Guardian Intelligence Team in August 2021 a close working relationship has developed with the DAL to ensure team members receive training and have a good understanding of the methodology underpinning the output.

This has been ongoing as there has been turnover of staff within the team, with the most recent training session occurring in November for the Higher Analyst and three Intelligence Analysts all attending. These are the primary end users of the dashboard.

Discussion between the DAL and the Intelligence Team also occurs whenever there are issues identified with the dashboard (for example if the data has not loaded as expected) or when the model has been adjusted to improve its performance. For example, in January the outcome of a review of the model was

discussed with the Guardian Intelligence Team to explain the reasons for a change in the level of predicted crimes, the likely implications for recommendations and to consider how this should be communicated to the wider Force.

The Guardian Intelligence Team has spent time educating senior officers responsible for tackling violence across the Force about the predictive tool. Initially, the Knife Crime predictions were socialised with the Assistant Chief Constable (ACC) chairing Force Tactical Delivery Board (FTDB) and presented at this senior level forum. It was agreed that the predictive tool should be used to support the Force priority of reducing SYV, rather than relying on a retrospective view of the previous month. The ACCs who chair the monthly FTDB and the Local Policing Board now expect to see analysis which includes reference to the predictions before making deployment decisions.

Similar work has been undertaken with the chairs of Local Tasking and Delivery Boards (LTDB) and the Intelligence Liaison Officers (ILOs) in the areas where deployments usually occur.

These boards form the governance structure for the deployment of the Guardian Taskforce and the policing response to knife crime.

3.4 Tasking process

The prediction dashboards are automatically updated on a weekly basis and provide a forecast of the likely volume and location of knife offences in the next four-week period. This weekly update provides more timely analysis and fits the requirements of the tasking processes for the Intelligence Analysts.

The analysts use the dashboard to determine which neighbourhoods have two or more knife crime events predicted for the next four weeks (see *Figure 1*) in order to focus their analysis on the most relevant areas. This threshold remains under review depending on the number of grids identified and the analytical resource available. The analysts also review offending levels from the same time last year and in the recent past to provide some context. This is combined with information from current intelligence reports and local knowledge provided by the ILOs and by the Serious, Organised Crime and Exploitation (SOCEX) Intelligence Team if there is evidence of gang tensions.

This combination of information from the predictive tool and other sources is used to make recommendations to the chair of FTDB as to where the Guardian Taskforce should be deployed for the next four weeks. Additional analysis is provided to the NPUs receiving the support from the Taskforce via their LTDB meeting and supported by the ILO. In addition, the Guardian Intelligence Team contribute to the Serious Youth Violence Operational Board which is attended by the superintendents from each NPU.

Each month, the Guardian Intelligence Team reviews resource and tactics that were deployed to the identified areas along with the predicted and actual levels of offending to assess the effectiveness of the deployment. Their findings are fed back into the relevant governance meetings.

4 Deploying the Guardian Taskforce

The Taskforce is deployed to tightly defined geographical areas where it is assessed that SYV involving the use of knives is more likely to occur in the next four weeks. Whilst the Taskforce may remain deployed to the same location for a longer period, this is reviewed and justified by the monthly analytical and tasking processes described above. Birmingham West (BW) NPU is consistently predicted as likely to have a higher volume of knife offences and as a result the Guardian Intelligence Team now provide all the analysis relating to SYV for this NPU.

The geo-fenced areas for deployment are smaller than a neighbourhood (ward). *Figure 3* shows the deployment area within BW for the period 21 November to 13 December 2022:

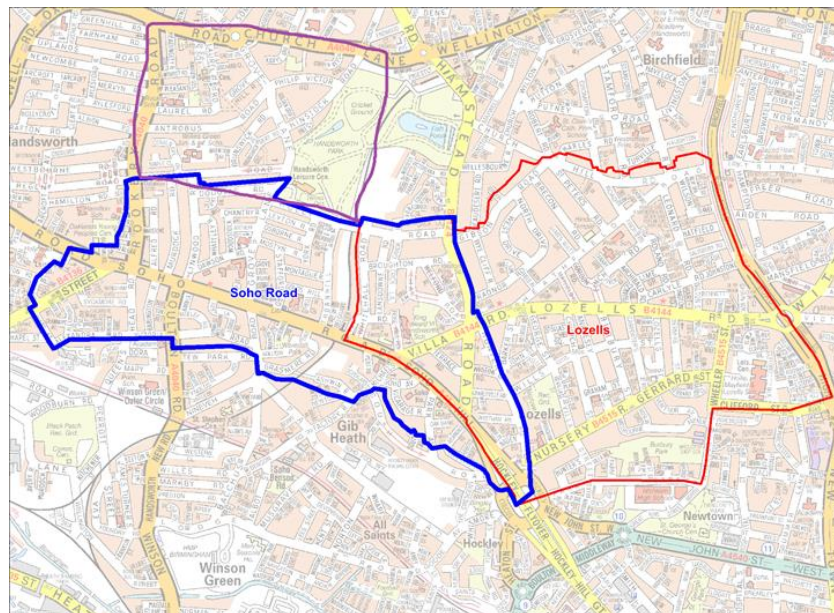


Figure 3: Guardian Taskforce deployment area 21/11/2022 - 13/12/2022

The policing activity undertaken by the Taskforce during the deployment is directed by the local constituency inspector. A planning meeting takes place prior to the deployment so that the Taskforce officers understand the local context and to ensure that they complement the local NHT delivery. Plans to deploy the Taskforce are shared with local communities via the Independent Advisory Group (IAG) so that the reasons for additional policing activity are understood. Depending on the local context different tactics will be agreed for the deployment period and the Taskforce are held to account for their activity when the period of deployment is subsequently reviewed.

The Taskforce activity is monitored on a daily basis via their daily duty note by the officers embedded in the Intelligence Team who work closely with the analysts. The types of activity include:

- High visibility patrols
- Knife arches at locations specifically identified as a risk such as a night club or an alleyway
- Plain clothes patrols
- Appropriate use of warranted powers (Stop and Search) at the discretion of the individual officer
- Weapons sweeps, for example in parks, alleyways and drains
- Arrest attempts
- Supporting warrants
- Ride outs with Youth Commissioners from OPCC office to enable youth scrutiny of operational activity
- Bespoke joint operations with NHT, Drones, Dogs, community groups
- Identifying young people who are vulnerable and making referrals to divert them towards commissioned support services.

In the period 07 November to 04 December the activity of the Taskforce resulted in:

- 27 Arrests
- 72 Stop and Searches
- 15 Weapons recovered
- 34 Intelligence Reports
- 12 Referrals

Officers from the Taskforce co-partner local officers when they are on duty. This has particularly benefited student officers who have essentially received 'on the job' tuition from Taskforce officers who have developed their skills to confidently engage with young people and who have expertise in the proportionate use of warranted powers to stop and search as well as identifying opportunities to make referrals to support services. The Taskforce Inspector is also the Bronze Lead for monitoring the use of stop and search across the Force and therefore the Taskforce officers are accustomed to intrusive supervision and engage in weekly reflective reviews of their body worn video (BWV) footage.

When the Taskforce are due to be redeployed to another area, de-escalation principles are in place to ensure local NHTs and communities benefit from the additional resource in the longer term.

5 Update on model performance

Both models have been monitored on a weekly basis in terms of both the numeric error and when treated as a yes / no whether something happened or not comparison. This monitoring has been undertaken comparing the model outputs to the outputs of a traditional hotspot approach as this would essentially be the alternative should the model(s) not be available.

The weighted average prediction error (WAPE) for knife crime has, over the beta testing period averaged 18% lower than the hotspot approach. In terms of the binary yes / no approach, the sensitivity has averaged 17%, however the specificity has averaged 97%. This results in the model placing greater emphasis on reducing the probability of deployment to areas where a crime is less likely. This is in line with the original model build which was developed in order to reduce the potential for wasting resources. Whilst the sensitivity is low, because of the emphasis on specificity, the precision has averaged reasonably well (in this circumstance) at 36%. This precision has averaged circa 47% better than the hotspot approach (which has far higher sensitivity but comes at the cost of a far lower specificity and lower precision which would have the effect of wasting resources via deployments to areas unlikely to see crimes).

6 Case Study: Deploying the Taskforce to Walsall

This case study illustrates how the predictive dashboard supports evidence-based decision making to redeploy the Taskforce.

As discussed above, the Taskforce is regularly deployed in BW NPU. However, in December the recommendation was made to deploy the whole team away from Birmingham for the first time in 12 months.

Over the previous few months, the focused deployment of the Taskforce on BW had contributed to a reduction in SYV in the relevant patrol areas (see *Figure 3*). At the end of November, Walsall (WS) NPU had experienced an increase in SYV with six offences involving knives in a fortnight. Based on the evidence that offending within the BW patrol areas was better controlled and predicted to remain so, the FTDB chair agreed with the recommendation that the Taskforce should be deployed away from BW and provide support to WS. A briefing document was provided to the Taskforce and the NHT based on current intelligence about relevant gang nominals of interest and defining the specific patrol area. Thus, the NPU receive support from both the Guardian Intelligence Team and the Taskforce when receiving a deployment.

The decision to re-deploy was made mid tactical period because of the level of threat posed by events in WS. The weekly update of the predictive tool allowed the team to assess the current threat in the BW deployment area versus the threat in WS, alongside other intelligence sources and have confidence to recommend the move away from BW.

During the WS deployment, events in BW were monitored closely. A Section 60 Order was imposed in BW for two days following a murder and six knife related events. The Taskforce temporarily returned to BW for two days to support this activity.

As a result of the WS deployment, weapons were recovered, arrests were made, cash relating to County Lines exploitation was recovered, 30 stop and searches were conducted and nominals wanted for firearms offences on BW NPU were arrested.

7 Appendix: Glossary of Terms

WMP / Law Enforcement Terminology	
ACC	Assistant Chief Constable
BW	Birmingham West
DAL	Data Analytics Lab
FET	Force Executive Team
FTDB	Force Tactical Delivery Board
IAG	Independent Advisory Group
ILO	Intelligence Liaison Officer
LTDB	Local Tactical Delivery Board
NHT	Neighbourhood Team
NPU	Neighbourhood Policing Unit
OPCC	Office of the Police and Crime Commissioner
PCC	Police and Crime Commissioner
PMP	Proactive Management Plan
SME	Subject Matter Expert
SYV	Serious Youth Violence
SOCEX	Serious, Organised Crime and Exploitation
WMP	West Midlands Police