Home Office

Impact of Forensic Science Project

Phase 1 Report

Marie Barrett (Marie.Barrett1@homeoffice.gov.uk)

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Acknowledgment

The work set out in this report wouldn't have been possible without the collaboration and advice of many individuals and organisations. The Home Office would like to offer all of them thanks.

Impact of Forensic Science Project – Developing Metrics to Measure Forensic Science's Impact on the Criminal Justice System.

1. Executive Summary

The first phase of the Impact of Forensic Science project is described below, including the successful development of a model of measurement of forensic impact. The metrics developed by the project reflect real world forensic science impacts in a language that is important and understandable across the CJS, including to senior decision makers such as Ministers and Chief Officers

It is widely accepted that forensic science delivers an important and largely positive contribution to the criminal justice system (CJS). However, the detailed impact of forensic science is not understood in any measurable way. Successive reviews of forensic science in England and Wales have highlighted the need for a system to measure forensic value to inform policy making and strategic investment decisions. This project aims to develop a system of ongoing measurement to address that need.

There is a growing research base around the use of forensic science in policing. However, few studies have robustly and comprehensively captured the value that the forensic science adds to the CJS, or how best to reflect this in routine data collection. Improving the quality of data coverage is likely to play a pivotal role in addressing this gap.

Previous work to develop metrics in any systematic fashion is likely limited because measuring forensic impact is intrinsically difficult. This difficulty is due to several broad reasons:

1. A multitude of factors impact on the CJS and CJS outcomes, making it inherently difficult to determine what is attributable to forensic intervention.
2. Forensic Science is complex, being a diverse set of discrete, individual scientific disciplines that are also used in combination to form a collective, often interdependent, scientific approach.
3. The potential opportunities for forensic evidence to make an impact are diverse (e.g., the length of investigations, the cost of investigations, final outcomes, linked offences, guilty pleas).
4. Data capture across different part of the CJS is extremely disjointed. CJS data are not always collected in a consistent way, or in sufficient detail to identify use and application of forensic techniques. As such, there are currently few comprehensive datasets relevant to the issue of forensic impact.
5. To accurately assess forensic impact, it is necessary to test interventions in experimental settings, but there are currently few robust evaluations on the impact of forensic interventions and use of randomised control trials (RCTs) to assess forensic impact are rare. This may in part reflect the challenges around designing RCTs for crime investigation settings in a way which is proportionate and ethical.

It was important that the project should attempt to address all these difficulties. An approach was devised to model a series of "Impact Points" at which forensic science could contribute to the progression of a case through the CJS. Addressing a sequence of targeted impacts offered an opportunity to identify specific forensic contributions. Each of the impact points was then defined, and a "question" posed (QP) by the CJS to forensic science was articulated. The impact points, their definitions and the questions posed at each are documented in **Appendix 1**.

Three categories of metric were suggested:

- **Forensic Effectiveness** – A count or percentage of instances where forensic science positively contributes to answering a question posed at an impact point.
- **Forensic Timeliness** – How quickly forensic science contributes or is unable to contribute at an impact point.
- **Forensic Cost Benefit** – How much it costs to deliver the benefits of Effectiveness and/or Timeliness in proportion to how much money is saved by the contributions.

For this model, measurement of these metrics was theoretically possible at any individual impact point or collection of impact points; for any crime type or collection of crime types; and for any forensic discipline or collection of disciplines.

A series of proof-of-concept studies were designed in collaboration with police forces and in some instances, academics. These studies aimed to begin to improve the measurement of the contribution of a forensic discipline or series of disciplines on a specific crime type at one or more of the impact points. The approach was to manually gather data to generate the metrics described above and to understand where that data was found in case and crime management systems. These data sets were collected either from data automatically generated by force management information systems or bespoke coding of case file information held on record management systems.

We also gathered data relating to other "impacting factors"[1] including some case demographics and exhibit types to attempt to measure their impact on those metrics. Success was determined by the ability to generate metrics on forensic effectiveness, timeliness, and cost benefit from the captured data.

Two studies failed to complete data sets, principally due to the resource required to do so. The Covid19 pandemic meant that the Home Office project team was unable to provide the in-force resource originally intended where academic resource was not commissioned. It is important to note how time consuming the exercises were and opportunities to streamline data capture, especially by automation, are therefore now a priority.

Six studies successfully completed data capture. They attempted to measure:

- The impact of digital forensics (principally mobile phone evidence) on rape and serious sexual offences (RASSO) investigations in one force.
- The impact of DNA profiling and the use of the National DNA Database on the investigation of burglaries in one force.
- The impact of all forensic science on the investigation of homicide in four forces.
- The impact of fingerprinting on the investigation of drug crime in one force.
- The impact of digital forensics, including the use of at scene digital forensic triage, on the investigation of online child sexual exploitation (CSE) cases in one force.
- The use of DNA profiling and the Prüm data exchange for DNA, on the investigation of all crime types in one force.

Each data set was assessed for completeness and data integrity. In some studies, the data needed to be normalised or have fields recategorized. This was due mainly to the use of free text or comments on a field (which should be actively avoided in future studies and systematic applications of this approach) or where the categories of response were too broad and so sample numbers in categories were too low for meaningful analysis.

[1] These are factors that impact on forensic science and affect the ability of forensic science to deliver value. Examples might include the type of exhibit or whether it has been found indoors or outside. Collating this information adds context to our understanding of forensic value.

None of the studies returned any data relating to cost and so the generation of Cost Benefit metrics was not possible. This issue will need to be addressed in phase 2 of the project by exploring alternative approaches to measuring this thematic metric.

All six studies allowed the generation of effectiveness metrics across a range of impact points. Simple analysis utilising Excel tools such as pivot tables allowed the generation of interactive dashboards and categorised by impacting factors such as case demographics, exhibit types etc. The effectiveness metrics provided indicators that either baselined forensic impact or offered simple comparisons of effectiveness metrics in different scenarios including a comparison of two different operational approaches to investigation. Examples of these forensic effectiveness metrics are shown in Figure A below:

Figure A

Did Forensics Science Contribute Overall (Count)?

Impact Point	Yes	No
Link Crimes	15	2
Identify person of interest	74	22
Generate Intelligence	44	278
Eliminate Suspects	10	2

Did Forensics Science Contribute Overall (Percentage)?

Impact Point	Yes	No
Link Crimes	88%	12%
Identify person of interest	77%	23%
Generate Intelligence	14%	86%
Eliminate Suspects	83%	17%

Did Forensics Science Contribute Exclusively (Count)?

Impact Point	Yes	No
Link Crimes	7	10
Identify person of interest	30	66
Generate Intelligence	18	304
Eliminate Suspects	5	7

Did Forensics Science Contribute Exclusively (Percentage)?

Impact Point	Yes	No
Link Crimes	13%	59%
Identify person of interest	41%	69%
Generate Intelligence	6%	94%
Eliminate Suspects	42%	58%

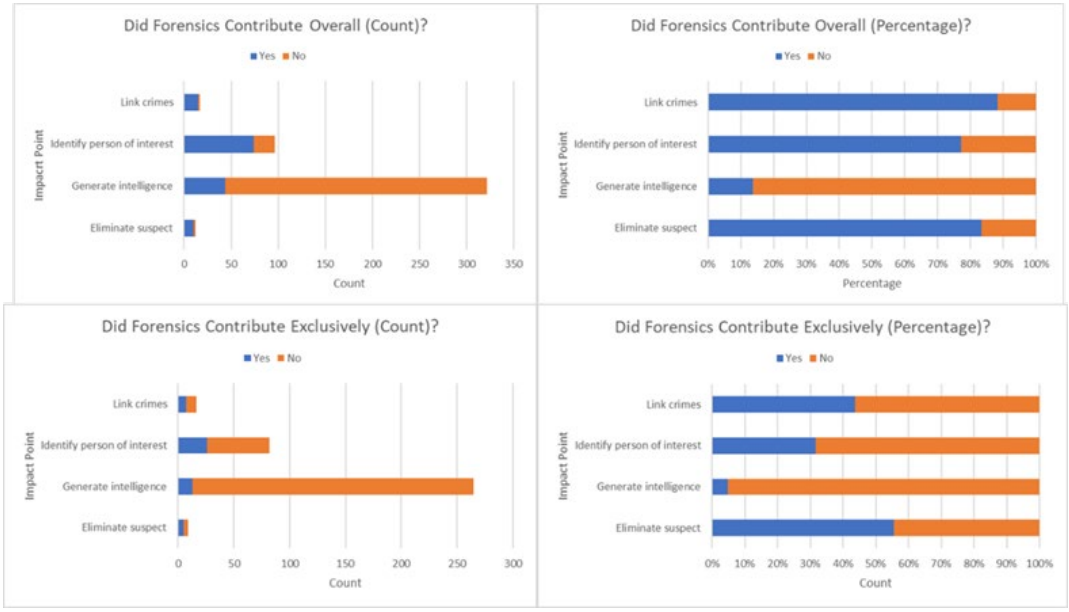

Figure A. An example of forensic effectiveness metrics (which measures instances of positive contribution at an impact point) including exclusive forensic effectiveness (where no non-forensic intervention delivered a contribution at the same impact point and forensic science alone contributed). Top charts show both the count (top left) and percentage (top right) effectiveness of forensic science impacting on the investigation of burglary cases (n=551). Bottom charts show both the count (top left) and percentage (top right) exclusive effectiveness of the same study. (Assessment of potential impact based on mix of quantitative and qualitative data dependent on Impact Point. Some assessments based on the judgement of the research team.)

All the studies allowed the generation of timeliness metrics. Simple analysis utilising Excel tools such as pivot tables allowed the generation of interactive dashboards allowing timeliness to be measured overall and categorised by “impacting factors” such as particular case demographics or exhibit types. In general, generation of this information was perceived to be less meaningful than the effectiveness metrics. Several of the studies required the use of proxy measurements such as the date of offence as the starting point and forensic reporting date as the end date/time, losing any granularity of how timeliness changed across the impact points. However, there were several examples that demonstrate the insight gained from measurement. Examples of forensic timeliness metrics are shown in Figure B below:

Figure B

Impact Point	Count (Forensics)	Minimum (Forensics)	Medium (Forensics)	Maximum (Forensics)	Mean Average (Forensics)	Standard Deviation (Forensics)
Admission of guilt (pre charge)	2	2	2.50	3	2.50	0.71
Charge	50	2	7.00	793	71.74	145.24
Eliminate suspect (post-charge)	1	28	28.00	28	28.00	0.00
Eliminate suspect (pre-charge)	24	1	41.50	318	91.13	109.80
Establish cause of death	41	1	77.00	280	87.17	78.43

Establish crime committed	45	1	2.00	245	14.60	42.97
Identify person of interest	38	1	3.50	722	37.66	119.33
Identify victim	11	1	2.00	29	5.82	8.80
Link crimes	2	2	5.00	8	5.00	4.24
Link designated scenes	27	1	5.00	148	20.78	41.07
Overall	241	1	6.00	793	50.22	100.96

Row Labels	Count (Forensics)	Minimum (Forensics)	Median (Forensics)	Maximum (Forensics)	Mean Average (Forensics)	Standard Deviation (Forensics)
Admission of guilt (pre-charge)	2	2	2.50	3	2.50	0.71
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Eliminate suspect (pre-charge)	24	1	41.50	318	91.13	109.80
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Link designated scenes	27	1	5.00	148	20.78	41.07
Overall	**241**	**1**	**6.00**	**793**	**50.22**	**100.96**

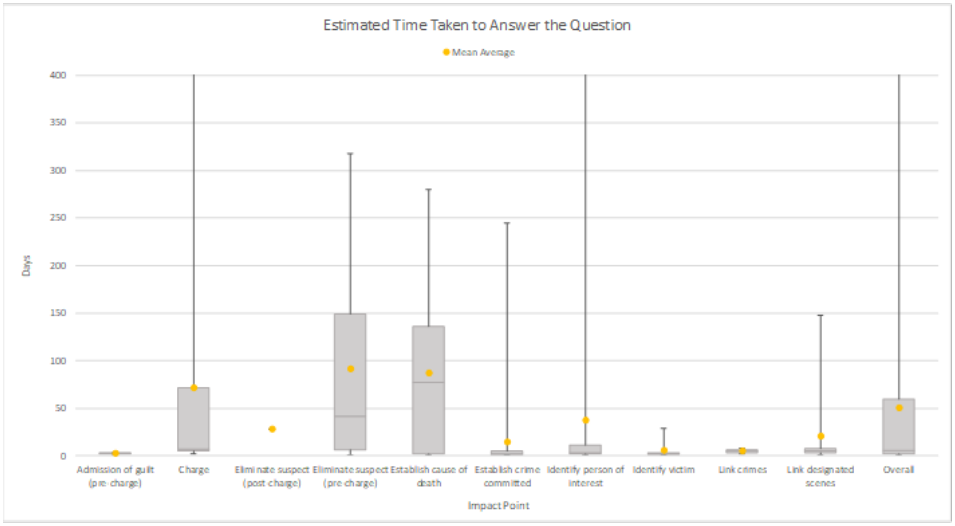

Figure B. An example of forensic timeliness metrics using the Impact Point model displayed as a box and whisker chart. showing for the given set of data: the minimum value, lower quartile, median, mean, upper quartile, maximum value (often off the scale here). This figure illustrates forensic timeliness in homicide cases (n=42) for each of the impact points measured with metrics relating to both mean and median times taken for forensic science to respond at any given impact point.

The studies were not without issues. Problems arising included:

- The diverse set of information management systems that had to be interrogated for relevant data and difficulties accessing some of them.
- For some data, the need to review scanned documents for relevant information rather than discrete fields of data and the concerns this raises for considerations of automation.
- Differing interpretations of “instances” of impact with some studies capturing impacts at exhibit or case level rather than occasions where the impact occurred.
- Difficulty capturing uniform information on the time taken to deliver forensic impact.

None of these issues were insurmountable and do not invalidate the concept of the approach although they will need to be addressed in the next phase of the project.

Following the creation of a model and metrics suitable for measuring ongoing forensic impact on the CJS, the project makes the following recommendations for next steps:

1. The Home Office will use the experience gained in the proof of concept studies to create a toolkit of documents and guidance to enable others to replicate this model of study and impact measurement.
2. The FCN expert network on Performance and Risk should refine the model to improve definition and to categorise the impact points. Policing and academic partners should prioritise utilising this approach for pilot studies and change programmes.
3. The FCN should lead work on automating the approach with support from the Home Office.
4. The Home Office will engage with cross CJS data improvement projects to highlight forensic science as a priority area for that improvement.
5. The Home Office will look at alternative approaches to generating cost benefit metrics.
6. The Home Office should prove the concept of the impact point model beyond the impact on investigations and work with CPS and HMCTS to measure the impact of forensic science on charging and the court system.
7. The Home Office will consider expanding the scope of the project to include the impact of forensic science on crime prevention and deterrence.

2. Introduction and Project Background

Forensic science is a vital tool in the investigation of crime and the efficient and effective operation of the Criminal Justice System (CJS). Anecdotal evidence is that forensic science can greatly improve the investigative and prosecution processes of the CJS. This is especially the case in high harm offences including homicide, rape and serious sexual offences (RASSO) and serious violence.

It has become increasingly clear, however, that there is a need for a more detailed evidence base on the impacts delivered by forensic science which in turn will allow robust measurement of the value it delivers, or could deliver, to the CJS on an ongoing basis.

The 2016 Home Office Forensic Science Strategy[2] noted *"Research into the contribution that forensic evidence makes to the investigation of crime is limited…. **There is a need for in-depth analyses to enhance our understanding of the specific contribution of forensic science to the CJS in England and Wales**; for example, in terms of deterrence, increased prosecutions and convictions, and maintaining legitimacy and impartiality."*

Similarly, the 2019 Joint Review of Forensic Science Provision[3] found *"The evidence base on the use and impact of forensic science is not extensive, but it does indicate that it has an important role to play in a number of areas, including the detection of 'hard to solve' cases, and in the apprehension of prolific offenders. **While assessing the impact of forensic evidence is challenging, some measures to indicate its value to criminal justice outcomes would be strongly preferable to reliance on anecdotal feedback.**"*

The Joint Review Implementation Plan[4] commits *"The Home Office and the Transforming Forensics Programme will work with the Ministry of Justice and CJS partners to **develop metrics to illustrate the impact of forensic science on police work, CJS outcomes, public confidence and costs – both to the CJS and the wider economy.** ….. A framework, such as a balanced scorecard, is needed to efficiently assess the impact of forensic science on outcomes. The needs of the Court and the defence will be given equal weighting to police investigations and prosecutions in the design. This may also need to be supplemented by continuous review of real cases by multi-disciplinary teams."*

The Forensic Strategy and Joint Review both articulate a longstanding desire by many CJS stakeholders to have a much clearer evidence base for forensic science's value. That evidence base is needed to:

- allow the creation of robust forensic policies and strategies, both by government and their CJS partners of policing and the CPS.
- inform investment and resourcing decisions.
- measure the benefits of the changes enacted by those policies and decisions.
- identify best practice along with opportunities to standardise national approaches.
- identify missed opportunities to take advantage of potential forensic value.

3. Project Scope & Definitions

In 2020 the Home Office initiated the Impact of Forensic Science project. This project sought to develop a model to allow the ongoing measurement of the impact of forensic science on the CJS.

For the purposes of this project, **"forensic Science"** is defined as:

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[2] Forensic science strategy - GOV.UK (www.gov.uk)

[3] Joint review of forensics and implementation plan (accessible) (publishing.service.gov.uk)

[4] Forensics-implementation-plan-April-2019.pdf (publishing.service.gov.uk)

- any scientific discipline as applied to the investigation, detection, and subsequent court proceedings of a crime. This includes the act of recovering the evidence to be analysed - both physical recovery of exhibits and material and digital extraction of information from a device or system. Forensic science can be defined as a set of scientifically distinct scientific disciplines such as DNA, drug, or mobile phone analysis but also as the collective use of those distinct disciplines as a combined, holistic approach.

For this project, "**the CJS**" is defined as:

- the systems of law enforcement within England and Wales to include Policing, the Crown Prosecution Service and the Crown and Magistrates Courts. Here we also include the Defence and the victims of crime.

This project uses the term "**impact**" to mean:

- the delivery of value as positive or negative contributions. Although the project seeks to address issues relating to monetary value, the term "value" here is used in a broader sense and is not constrained to cost or expenditure.

The scope of this project aimed to create an approach that could address any forensic discipline (both physical and digital) and any crime type.

This first phase of the project has not addressed wider themes of public and social impact, such as crime prevention, crime deterrence[5] (including criminal recidivism) or wider public confidence in the CJS. However, these extended themes remain important, and it is possible that forensic science has a positive influence on these too. Activity to address these wider themes remains an aspiration for a later phase of the project.

4. Project Considerations

4.1 The existing evidence base

There is a modest but growing evidence base on the impact that forensic science has on different aspects of the CJS (see for instance the review elements of Peterson et al 2013[6]). Although it is challenging to summarise briefly, the following general points can be made from the literature. Older studies have generally pointed to forensic science having some effect on criminal justice outcomes in terms of higher clearance rates, a greater impact on harder to detect offences, and longer sentences. Unfortunately, few studies that have attempted to answer questions on the impact of forensic science have been methodologically robust. As Ludwig and Fraser (2014[7]) note, *'there has been limited systematic or formal evaluation of how forensic science…has been used in practice in criminal investigations and what specific value it contributes to investigations or criminal justice more generally'.*

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[5] See, for example, Anker, Anne Sofie Tegner, Jennifer L. Doleac, and Rasmus Landersø. 2021. "The Effects of DNA Databases on the Deterrence and Detection of Offenders." *American Economic Journal: Applied Economics*, 13 (4): 194-225.

[6] Peterson, J.L., Hickman, M.J., Strom, K.J. and Johnson, D.J. (2013). Effect of Forensic Evidence on Criminal Justice Case Processing. Journal of Forensic Sciences, vol. 58, pp. 79-90

[7] Ludwig, Anika; Fraser, Jim. / Effective use of forensic science in volume crime investigations: identifying recurring themes in the literature. In: Science and Justice. 2014; Vol. 54, No. 1. pp. 81–88.

Wilson et al's (2011[8]) systematic review of the use of DNA in case clearance illustrates the situation well. Of studies included in Wilson's systematic review on the use of DNA, only five met the review criteria, and of these only one - Roman et al's (2008[9]) was a randomised control trial.

Roman et al achieved this in their study of the use of DNA in property crimes, with the control group of offences being crimes which still yielded DNA at the scene but where processing of DNA for control cases was delayed. This did allow DNA impacts to accurately captured and findings were consistently positive for forensic impact across all measures (suspect identified, arrested, and charged). Triaging or delaying access to tests in this way cannot be realistically applied to the "whole system" approach to measurement envisioned by this project.

Studies such as Roman offer important insights into forensic impact but even then, only do so for a single forensic discipline and for a relatively narrow definition of value. Forensic science has the potential to impact at several points in what has been called 'the value chain' - but defining that value in the context of a police investigation or in the criminal justice system can be very difficult and too often reflect on costs alone (Ludwig 2016[10]).

4.2 Further Considerations for modelling

Beyond the published evidence base, it was clear that any system of measurement needed to address a series of important considerations. Forensic science is fundamentally complex and (as covered in our definition) is both an enormously diverse set of scientific disciplines that cover an array of physical and digital techniques whilst also being a holistically applied collective science. The criminal justice system is, equally, a complex hybrid of diverse sets of distinct organisations, not least including 43 individual police forces commissioning forensic science both in-house and outsourced to the private sector. This makes the exam question "what is the impact of forensic science on the CJS" an extremely complex one with many moving parts.

Adding to that complexity, the list of things that impact on the criminal justice system as well as forensic science is equally large and diverse – ranging from geography, demographics, crime profiles, local priorities, and resourcing (force, CPS, courts and defence) to name just a few. This ensured that pinpointing the impact that forensic science has on the CJS, as opposed to this myriad interaction of other factors, was a prime consideration of the project.

Anecdotal evidence suggested that large data sets addressing this topic did not exist and that even individual police forces utilised multiple case and crime management systems, databases, and spreadsheets, with little harmonised nomenclature or systematic definitions between organisations. In general, the data systems used to manage forensic science commissions within police forces (or subsequently to private sector providers) were distinct from those that trace the progress of an investigation, let alone a prosecution or court case.

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[8] Use of DNA testing in police investigative work for increasing offender identification, arrest, conviction and case clearance - Wilson - 2011 - Campbell Systematic Reviews - Wiley Online Library.

[9] Roman, J.K., Reid, S.E., Chalfin, A.J. and Knight, C.R. (2009). The DNA field experiment: a randomized trial of the cost-effectiveness of using DNA to solve property crimes. Journal of Experimental Criminology, vol. 5, pp. 345-369

[10] Ludvig, A, E'value'ating Forensic Science (2016). Forensic Science Policy & Management An International Journal 7(3-4), pp 66-77

Many external influences impact on forensic science and constrain or enhance its ability to deliver impact in turn. These “impacting factors” include systemic differences such as resourcing, training, submission policies and the application of quality standards. The model devised by this project needed to address all these considerations set out in this and the previous section. It would need to allow for impacts to be categorised by forensic discipline or collective forensic sciences; by crime type; by each CJS organisation’s perspective and priorities. Such complexity means that a series of broad performance indicators rather than any attempt at definitive metrics of proof would be the most appropriate approach.

4.3 The Forensic ADR and other systems of measurement

From 2004 - 2017 forensic data were submitted quarterly by police forces to the Home Office as part of the Annual Data Return (ADR). From April 2009, this covered data on DNA and Fingerprints for the following crime types:

- All crime
- Domestic burglary
- Theft or unauthorised taking of a vehicle

Analysis was made available by the Home Office for five indicators on both DNA and Fingerprints:

- the percentage of crime scenes examined (= number of crime scenes examined / recorded crime)
- the quantity of crime scene stains (DNA and Fingerprints) recovered from crime scenes
- the identifications and matches of these crime scene stains to an individual’s fingerprints and DNA.
- the conversion of Fingerprint identifications and DNA matches into “detections”.

This approach is an attrition model, with each subsequent measurement seeing forensic contributions diminish as a case progresses through these prescribed stages.

The Forensic ADR was ceased in 2017, principally because the Home Office was not utilising the information or analysis at the time and it was considered inappropriate to continue to request forces to collate and submit the data.

As part of the project we have discussed the Forensic ADR with several police forensic stakeholder groups and considered options for returning to this approach of data collection. Despite some positive feedback, including a reference to it creating a clear system of monitoring forensic interventions within one force, the forensic ADR was more broadly seen as too simplistic a measure of value and has been described by some forensic leaders as “bean-counting” and its utilisation as “opaque”.

The extremely limited range of metrics covered by the Forensic ADR, along with a focus entirely on DNA and fingerprints has led us to conclude that there would be limited value in resuming its submission and capture in that format – certainly not to justify the resource required to gather the information - and instead there should be a focus on broader and more meaningful reflections of forensic value. In time, once a new model and system of metrics is fully developed, consideration might be given to adding those more meaningful metrics to the ADR again to allow access to the information generated across CJS capabilities.

A brief review of what has been measured more recently in police forces on forensic impact revealed some good work to link forensic work to final CJS outcome especially charging decisions, more work to linking identification and others again on eliminations. This mirrored the evidence base offered by

academic work and principally focused on these measurements for the biometric database disciplines of DNA and fingerprints.

We noted that the Niche Records Management System (RMS) had recently added a field to capture a positive contribution by CCTV to a CJS outcome, alongside the existing assessment by an SIO of any positive impact of "Forensics" (here meaning DNA, fingerprints or footwear marks) and body worn video. This version is live in one force and will be rolled out across all 25 Niche forces although completion of the field will not be mandatory. The force that has adopted this approach was able to successfully generate metrics showing counts and percentages of positive CJS outcomes attributed, at least in part, to CCTV across different offence types.

We also saw examples of forces measuring the impact forensic science had on the assurance given to victims of volume crime where a CSI had attended to recover evidence. These types of survey generated an evidence base for potentially assessing the impact forensic scene attendance has on victim assurance.

4.4 The limitations of metrics associated with CJS outcome.

The approaches described above are all positive steps to measuring forensic value, but their pitfalls are that they may miss other important types of impact that forensic science can deliver. Evidence identifying a person of interest for example may be insufficient to proceed to a charging decision but can also offer intelligence alongside other cases to give a wider picture of offending. Even for volume crime, finding intelligence to link crimes can significantly increase the understanding of the importance of a single crime as one of a pattern of crimes, and therefore of higher priority.

Here forensic science can contribute facts, themes, or hypotheses to building a knowledge base about a crime or a series of crimes but may not be directly responsible for a positive CJS outcome for the case it was originally commissioned for.

The use of outcome-based assessments of impact will also necessitate a finalised CJS outcome before any value can be captured at all. In the context of CJS timescales of months, if not years, this means measurement of the value of forensic commissions that have taken place significantly in the past. Understanding the impact of an intervention, in many instances after significant time has passed, has obvious limitations for reacting to those measurements of impact and enacting timely responses to them.

In 2016's Forensic Science and Beyond: Authenticity, Provenance and Assurance, Gallop and Squibb-Williams[11] suggest "*if the effectiveness of police investigations, and the utility of forensic evidence, are to be measured by way of appearances in the courtroom this may lead to ignoring …investigations that …fall by the wayside post-investigation and pre-trial.*" In their 2017 publication "Is Forensic Science Worth It?", Bitzer et al[12] suggest "*The usefulness of forensic science continues to be questioned by evaluative studies taking as indicator its judicial contribution, mainly resulting in disastrous conclusions. The used indicators highly underrate and limit the actual contribution of forensic science, which are dependent on the definition, object, role, and integration in the criminal justice process accorded to the discipline."*

[11] Forensic science and beyond: authenticity, provenance and assurance (publishing.service.gov.uk)

[12] Bitzer, S., Margot, P. and Delémont, O. (2017) Is Forensic Science Worth It? *Policing*, vol. 13(1), pp. 12-20

These types of observations, along with all of the other considerations highlighted above, led this project to look wider than CJS outcomes or an attrition model when developing its suggested approach.

Figure 1 shows a diagram developed by forensic leaders at the Metropolitan Police for the 2019 Home Office, NPCC and APCC Joint Review of Forensic Science Provision, to describe forensic impact in the absence of any meaningful measurements to utilise in the report:

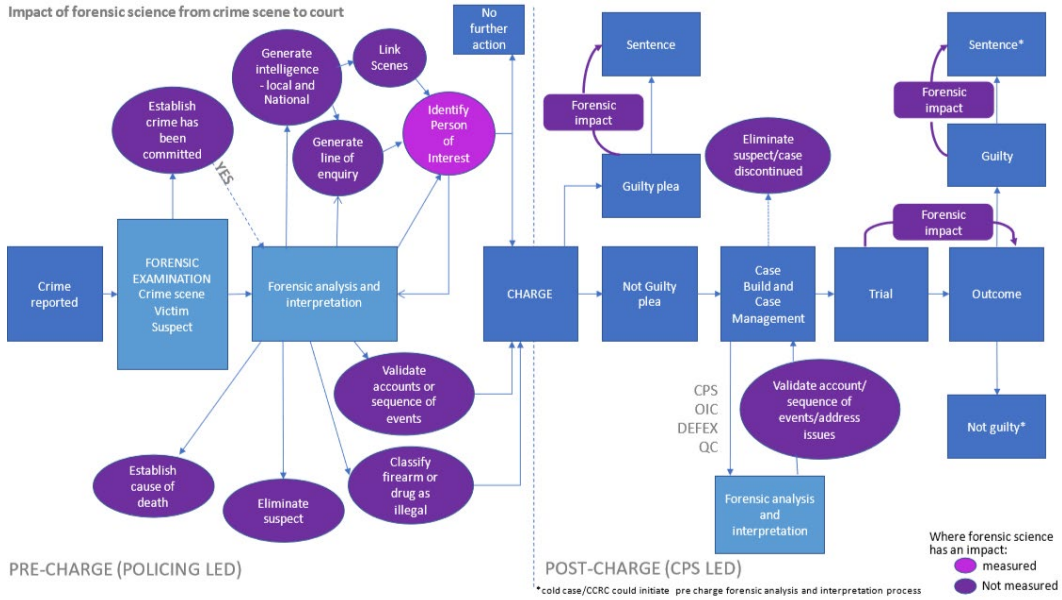


Figure 1. Impact Diagram, 2019 Joint Review of Forensic Science Provision.

The Impact Diagram shows the following stages:

Pre-charge stages:

Crime reported
Forensic examination crime scene victim suspect
Forensic analysis and interpretation
No further action

Pre-charge impact Points (measured):

Identify person of interest

Pre-charge impact Points (not measured):

Establish crime has been committed
Establish cause of death
Eliminate suspect
Generate intelligence – local and national
Generate line of enquiry
Link scenes
Classify firearm or drug as illegal
Validate accounts or sequence or events

Post-charge stages:

Charge
Sentence
Not guilty plea
Case build and case management
Forensics analysis and interpretation

Trial
Outcome
Guilty
Not guilty

Post-charge impact Points (not measured):
Forensic impact
Eliminate suspect/case discontinued
Validate account/sequence of events/address issues

This depiction of a systematic series of impacts offers an opportunity to think about forensic value in a more granular (and so, potentially, a more identifiable) way. If it is hard to tease out and measure the impact of forensic science on final CJS outcomes because of all the other factors that impact on a CJS outcome, then targeting more focused points in the CJS may offer a better chance to specifically identify what forensic science alone has been able to contribute. If it is unwise to focus only on forensic science contributions in court, then focusing on the individual steps of the entirety of an investigation and subsequent prosecution may offer a way to measure the totality of the value that forensic science can bring to the CJS. By focusing on impacts external to the forensic department but central to investigations and the court process, impact metric indicators would relate to real world benefits in a language that resonates with both government ministers and chief officers.

5. The Impact Point Model

5.1 Identifying and Defining Impact Points

Using the diagram shown in figure 1 as a starting point, we expanded on the idea of identifying where and when during an investigation, charging decisions or the court process that forensic science has the capability to impact. We used wide reaching stakeholder engagement to add to this view and as a result created an expanded version of the diagram, identifying what we have termed “Impact Points”.

It is important to note that the impact points are not independent of one another. Impact at one point may often lead to an increased chance of impact at others. Despite this, each forensic impact can exist in its own right as well as part of a cumulative impact that a forensic intervention may have at multiple points.

It is also important to note that our model needed to hold a neutral position on the guilt or innocence of individuals, with the exoneration and elimination of suspects being given equal value to admissions of guilt.

Figure 2 sets out the combined “Impact Points” identified with CJS stakeholders as being the points where forensic science could deliver value to the CJS.

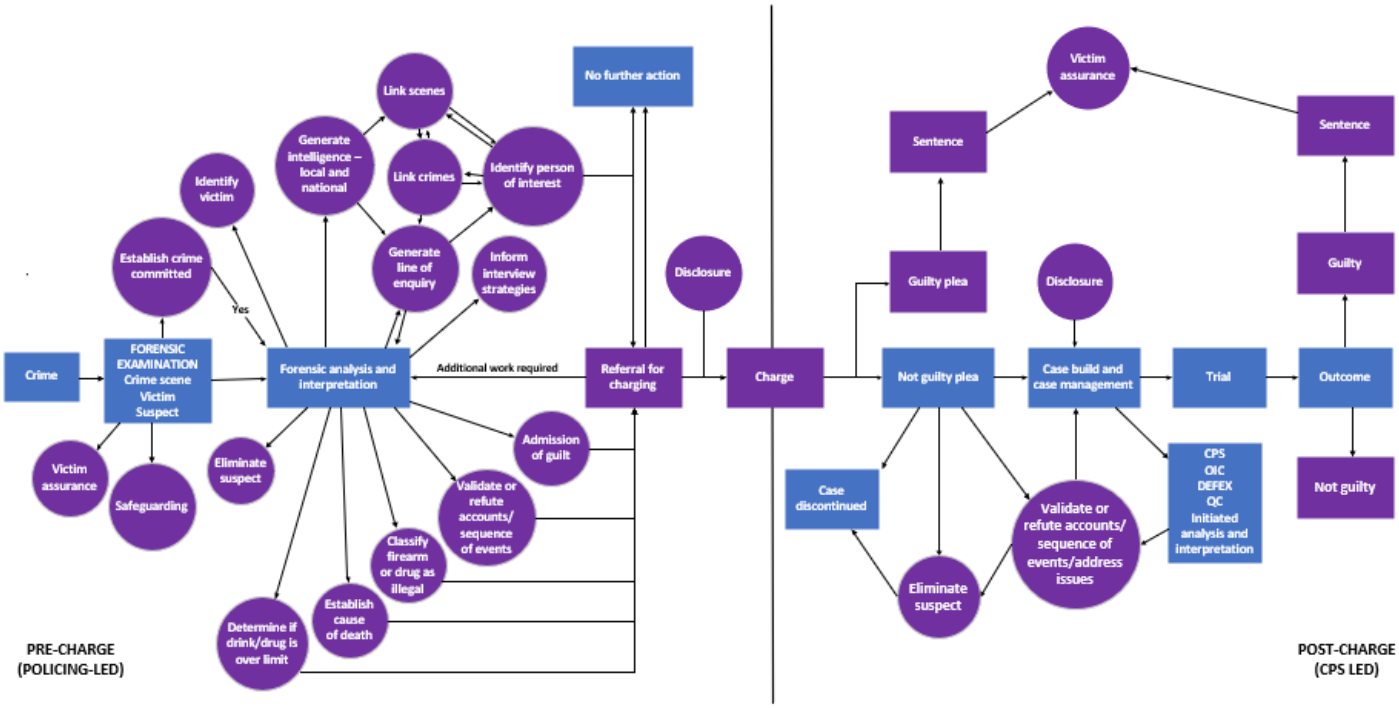


Figure 2. Impact Points where forensic science can impact on the CJS.

Pre-Charge stages:
Crime
Forensic examination crime scene victim suspect
Forensic analysis and interpretation
No further action

Pre-charge impact points:
Establish crime committed
Victim assurance
Safeguarding
Eliminate suspect
Identify victim
Generate intelligence – local and national
Generate line of enquiry
Link crimes
Link scenes
Identify person of interest
Inform interview strategies
Determine if drink/drug is over limit
Establish cause of death
Classify firearm or drug as illegal
Validate refute accounts/sequence of events
Admission of guilt
Referral for charging
Disclosure

Post-charge stages:
Case discontinued
Not guilty plea
Case build and case management
CPS, OIC, DEFEX or/and QC initiated analysis and interpretation
Trial

Outcome

Post-charge impact points:
Guilty plea
Sentence
Eliminate suspect
Victim assurances
Disclosure
Validate or refute accounts/sequence of events /address issues
Guilty
Not guilty

The approach taken here was an idealistic one of identifying all possible points in scope irrespective of whether we would find data to measure the impact there. The evidence that comprehensive data sets did not exist offered an opportunity to start from these idealistic first principles and then to adapt as the project progressed.

Once the impact points were mapped, we undertook an exercise to define each point, keeping the definitions broad enough to encompass all crime types and forensic disciplines. We noted where they were associated with specific forensic disciplines or crime types. For each impact point we also described a figurative "question posed" (QP) by the CJS to forensic science. These questions would have a binary "yes" or "no" response, with "yes" meaning that forensic science had contributed to answering the question posed and having value and "no" meaning it had failed to do so and having no value.

The Impact Point Definitions and their respective QP's can be found in **Appendix 1**.

Example of defining the impact point and posing a question:

Impact Point: Establish Crime Committed
Definition: Confirming or refuting that the reported crime has occurred.
Question Posed: "Can we determine if a crime has been committed?".

Further information: Most forensic disciplines can contribute to answering the question posed. For the purposes of these metrics it is of equal value to determine if a crime has been committed as to determine if it hasn't, with the negative impact being inability to determine either way. Disciplines used are somewhat dependant on the crime type but include Crime Scene Analysis, Pathology, Fire Investigation, Toxicology, Drug Analysis, Biology and Chemistry trace evidence, Firearms classification, CCTV, mobile phone, and computer analysis.

5.2 Developing metrics to measure impact at the Impact Points

We worked with a broad group of cross CJS stakeholders and the Home Office Analysis and Insight team (HOAI) to develop a simple set of metrics for the impact point model while acknowledging that for this phase of the project we would be creating impact indicators rather than definitive measurements of value. It was important to ensure the metrics were simple as the other dimensions needed for the model were so complex and acknowledging the desire to create a systemic approach to understanding forensic impact. Any metric would need to apply to any of one of the 27 impact points, for any crime type or collection of crime types, and for any forensic discipline or collection of disciplines. The categories of metric indicators suggested are described below:

- **Forensic Effectiveness** – how often forensic science positively contributes to answering a question posed at an Impact Point
- **Forensic Timeliness** – how quickly forensic science answers (or fails to answer) the question posed at an Impact Point
- **Forensic Cost Benefit** – how much it costs for forensic science to contribute at the Impact Point as a proportion of the money that contribution saves.

6. Proof of Principle Studies

A series of forensic impact case studies were developed to prove the concept of this impact point approach. Collaborations were created with police forces and academics to focus on individual studies in the attempt to measure the impact of a forensic discipline or disciplines on a particular crime type at chosen impact points.

In the absence of comprehensive data sets, this phase of the project had researchers manually trawl case and crime management systems and case records to recover the data needed. The intention was to determine if appropriate data could be found, and if so, where, and then to determine if it could be utilised to generate the effectiveness, timeliness and cost benefit metrics described above.

Success of this phase of the project in the context of each study was determined by:

- finding and collecting data associated with the impact points and impacting factors.
- generating the forensic impact metrics associated with the impact points.
- those forensic impact metrics being deemed useful by CJS stakeholders.

The following studies returned full data sets that went on to be analysed:

- The impact of digital forensics (principally mobile phone evidence) on rape and serious sexual offences (RASSO) investigations by Hampshire Police. This study[13] led by the University of Portsmouth covered forensic submissions for RASSO cases to the digital forensic unit in the first 6 months of 2019. This equated to data relating to 93 cases with forensic interventions of a total of 906 offences in the same period. The study captured 1115 instances of potential impact across 12 impact points.

- The impact of DNA profiling and the use of the National DNA Database on the investigation of burglaries in the Metropolitan Police. This study covered one week of offences in February 2019 and data was captured for all 551 cases irrespective of whether forensic science was utilised. The study captured 730 instances of potential impact across 4 impact points.

- The impact of forensic science (all disciplines) on the investigation of homicide cases across four forces by interrogating information collated as part of the Homicide Investigation and Forensic Science Project (HIFS)[14]. This study led by South Wales University[15], equated to a total of 44 homicide cases dating from 2005-17 and included a cold case originating from 1987. This study captured 588 instances of potential impact across 10 impact points.

- The impact of fingerprinting on the investigation of drug crime in the Metropolitan Police. This study covered 1 year of submissions to the fingerprint unit over 2019 and equated to 151 cases of approximately 48,000 offences. The study captured 210 instances across 4 impact points.

[13] Contact paul1.smith@port.ac.uk

[14] Homicide Investigation and Forensic Science Project (HIFS) | University of South Wales

[15] Measuring the Impact of Forensic Science on Homicide Investigation — University of South Wales

- The impact of digital forensics, including the use of at scene digital forensic triage, on the investigation of NCA intelligence packages relating to online child sexual exploitation (CSE) cases by Staffordshire Police. This study[16], led by Staffordshire University, covered all 239 cases investigated from July 2016 through to December 2019 and captured 1,258 instances of potential impact across 7 impact points.

- The impact of using DNA profiling and the Prüm data exchange for DNA on the investigation of all crime types in the Metropolitan Police. The Prüm data exchange involves ongoing searching of unmatched crime scene stain DNA profiles on the National DNA Database against the DNA databases of EU countries. This study covered 474 Prüm matches delivered between July 2019 to October 2020 and captured 474 instances of potential impact across 3 impact points.

Some studies represent relatively small sample sizes but still offer important insights into the application of the conceptual model. Collectively, the 6 studies explore 16 different impact points. This list shows the times each impact point was included in the collective study set:

Figure 5 shows the times each impact point was included in the collective study set.

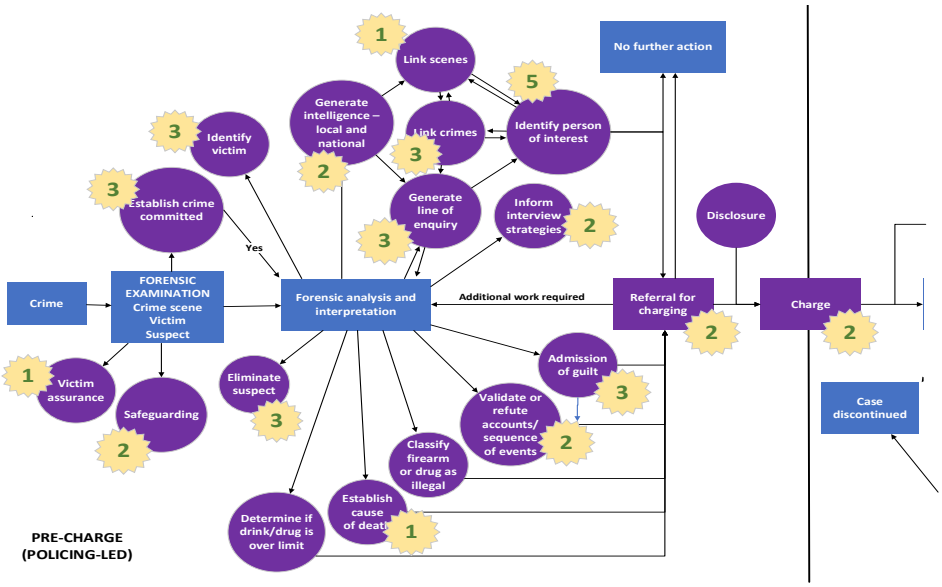


Figure 5. Number of studies that addressed each impact point.

Pre-charge impact point:
Establish crime committed (3)
Victim assurance (1)
Safeguarding (2)
Eliminate suspect (3)
Identify victim (3)
Generate intelligence – local and national (2)
Generate line of enquiry (3)
Link crimes (3)
Link scenes (1)
Identify person of interest (5)
Inform interview strategies (2)
Determine if drink/drug is over limit (0)

[16] https://blogs.staffs.ac.uk/ccjs/files/2021/09/An-Observational-Study-Using-the-Impact-Point-Approach-To-Measure-Utility-of-Digital-Forensics-in-CSE-cases.pdf

Establish cause of death (1)
Classify firearm or drug as illegal (0)
Validate refute accounts/sequence of events (2)
Admission of guilt (3)
Referral for charging (2)
Disclosure (0)

Post-charge impact point:
Charge (2)

While these six studies succeeded in collecting complete, analysable data sets, two more studies failed to capture complete data sets, principally due to the resource required to do so. We will discuss the resource intensive nature of the data capture further in section 6.4.1 below.

6.1 Study design and methodology

The studies principally focused on the investigative impact points although some of the charging and outcome decision impact points were included where possible. This focus was led by the availability of CJS colleagues, resources, and accessibility in the context of Covid19 and court recovery. The charging, court and outcome impacts should be fully addressed at a later phase of the project.

We designed all studies to be retrospective and focused on work already completed. We were keen to gather all impacts and information including cataloguing final case outcomes. Police investigations often take many months and court timescales add to the time taken until a final CJS outcome. Retrospective rather than experimental studies also had the benefit of avoiding any changes to crime patterns or to work delivered due to the pandemic and so also avoided any anomalies that might be introduced.

Each study focused on a specified crime type (with one exception). Previous research[17] into the application of forensics suggests patterns of use vary widely by crime type, as decisions on whether to proceed with forensic recovery and then subsequent analysis will differ depending on the crime type. We wanted to ensure this variable was minimised when generating metric indicators.

Each study focused on a specified forensic discipline (with one exception which we will discuss later in the report). Again, there is good, accumulated evidence[18] that forensic impact is discipline specific. Decisions on which forensic disciplines are utilised in the investigation of a crime depends principally on what evidence is recovered from a crime. Different disciplines can also deliver functionally different evidence of either identity or activity. Studies were designed to target an individual discipline but did offer opportunities to capture any observations of other disciplines too.

Each study targeted specific impact points. These were kept as broad as practical for the resource and information available for the study and the process of developing the study designs reinforced the point that some impact points are more applicable to some forensic disciplines and/or crime types. We did develop further categorisation in this phase of the project, but it would be a valuable exercise to attempt to categorise these associations to ensure targeted use of the impact point model in the future.

[17] See, for example. National DNA Database Strategy Board Biennial Report 2018 - 2020 (publishing.service.gov.uk)

[18] See, for example, The use of forensic science in volume crime investigations: a review of the research literature (publishing.service.gov.uk)

Where possible the studies were designed to capture data on all crimes of the selected crime type during the defined period for the study. It is important to note that the ultimate influence on whether forensic science can make an impact is whether a scene is attended for forensic examination but capturing information where no forensic interventions had occurred was important for two reasons. The first was to attempt to remove selection bias introduced by allowing researchers to select a subset of cases. This might have led to bias toward selecting cases where forensic science had been particularly successful. The second was to provide the context in which any findings would be presented and so to understand the relevance of the impact to the investigation of that crime type. Where it was not possible to access this data or where the volume of crimes would have been prohibitively high then information of total crime numbers was captured instead.

Studies were designed, where possible, to allow an assessment of impact by collecting equivalent data on cases where forensic techniques had not been deployed. Where possible studies were designed to assess non-forensic interventions as well as forensic work undertaken

Each study was also designed to capture information on selected “impacting factors”. These were factors that could influence the impact that forensic science had and would allow impact metrics to be categorised. Examples of impacting factors included exhibit types, victim/offender relationships and whether a crime scene was indoors or outside.

Each study design also assessed more general local information that might influence forensic impact. In the main this related to local force protocols and policies relating to when a crime would warrant a forensic scene examination, to exhibit recovery protocols and submission policies.

6.2 Data Capture

Data captured was designed around an Excel spreadsheet due to the simplicity and universal nature of the tool.

Researchers were asked to create one new line of data for each instance of potential impact (be it forensic or non-forensic) in a case for any individual impact point studied. They were instructed that an instance was defined as each occasion in the course of investigating or prosecuting a crime that the CJS posed one of the impact points questions (see appendix 2).

Each column of the spreadsheet reflected either a case identifier, the impact point chosen, the series of chosen impacting factors and information on the forensic or non-forensic activity - whether it had contributed to successfully responding to the impact point question posed, how long it took and how much it cost to do so.

Data field responses were restricted, where possible, by use of drop-down menus or restricted formats to maximise standardised responses. Where this was not possible free text was allowed but at the request that its use be minimised.

The definition of when an intervention (forensic or non-forensic) was deemed to have contributed to answering the impact point question (“yes” response) or not (“no” response) was left to each researcher’s individual assessment. It was left to researchers to define what constituted a successful contribution response to any QP in the specific context of the crime and forensic discipline studied. This represented a range of responses reflecting objective to more subjective decisions for researchers, depending on the data collected. This was deliberate at this stage of the project in order to allow the QP’s and responses to be broad enough to cover examples of all crime types and forensic disciplines but will need to be more defined and objective measures in any future iterations of the model to ensure reproducibility and help to enable potential automation.

6.3 Data Cleansing and Analysis

We assessed completed data sets to ensure they were structured as expected and free of inconsistencies that can occur during the transfer of data due to human error. This included typographical errors, missing entries and incongruous entries, for example observations where it was indicated that forensic science was not used but then said to have contributed, or date entries where the chronology of events in a case did not make sense.

Data for some studies required additional normalisation, particularly in fields where data validation had not been used and free text had been entered. In some studies comments on Excel cells had been used to input data to circumvent the data validation limitations. These comments sometimes included extra detail to complement the original entry and had to be extracted and inputted into new or existing fields where required.

We engaged with researchers to narrow down or combine categories of response in the impacting factors fields where the categories of response were too broad and so sample numbers in categories were too low for meaningful analysis. In addition, for two studies, instances where neither forensic nor non-forensic methods were used were removed as they were not relevant to the study.

For some studies, researchers had not captured data for the time taken to respond to an impact point. For those studies we worked with researchers to look at how this could be calculated from other information provided for each instance for example by using the dates of the offence and dates for forensic report delivery.

No study provided data on the cost of an instance of impact. Researchers reported that they were unable to find or infer this data. We will address the actions needed to address this issue in section 8 of this report.

It was apparent that impact instances often included both forensic and non-forensic interventions and, from narratives attached, these were often interdependent. Our advice from commissioned analytical oversight resource was that this made our plans to compare the forensic and non-forensic approaches inappropriate where the approaches were both utilised within the same instance. As such only limited further work was done to explore the counterfactual approach.

For each study we used Excel tools to create dashboards to determine if effectiveness metrics and timeliness metrics could be measured, both on an overall basis and by broken down by impact point. This was done using pivot tables complemented by charts to visualise the analysis. We used slicers to make these dashboards interactive and to visualise the effect of the impacting factors such as case demographics or exhibit type. An example of a dashboard is shown in figure 6.

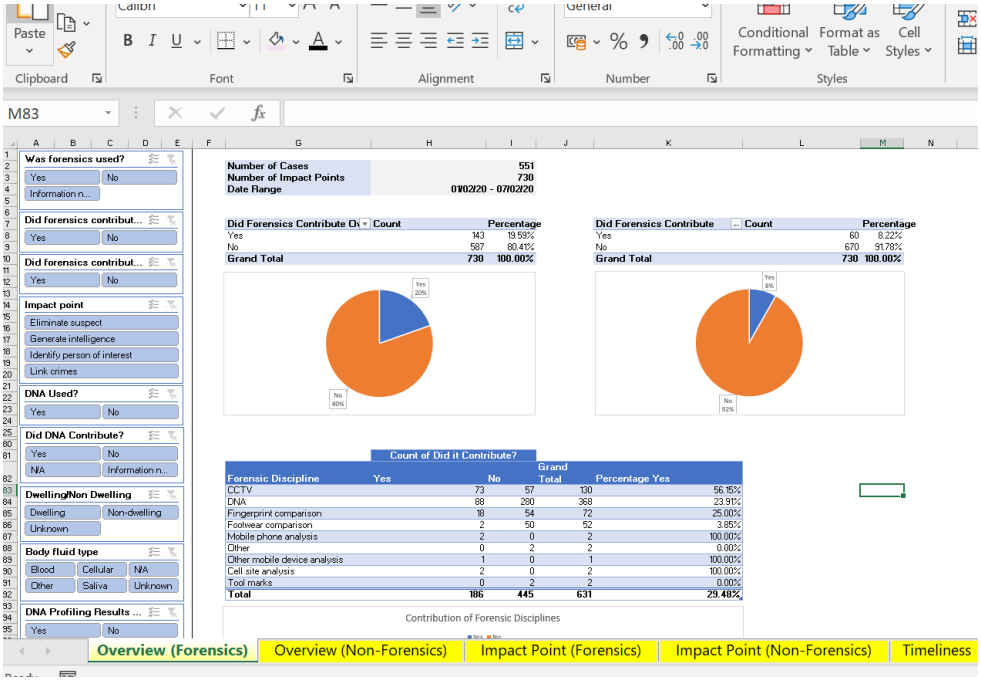


Figure 6. An example of an excel dashboard using pivot tables, pivot charts and slicer filters.

When analysing a data set to derive effectiveness metrics, we counted instances where forensic science had contributed and calculated those numbers as a percentage of all instances captured. When analysing a data set to derive timeliness metrics, we utilised power pivot tools to capture minimums, maximums, medians, and upper/lower quartiles.

6.4 Findings

The following sections will address the collective proof of concept studies' findings in the context of the wider project rather than the findings of the studies themselves, although those will be utilised for illustrative purposes. Several of the individual studies are the subject of their own separate reports and academic publications and each study's findings will be addressed there.

The findings are categorised by the success factors set out in section 6 above.

6.4.1 Finding and collecting data

Six studies were able to find and capture data relating to forensic impact. The data for studies was found in a broad range of case and crime management systems and other data sources. Data was principally recovered from police record management systems (RMS) such as Niche, forensic case management systems (such as SOCRATES) as well as local systems, databases, and spreadsheets.

By example, the study on the impact of digital forensics on online CSE investigations (Operation Safenet), found data in the following systems:

- Operation Safenet database
- Niche RMS
- ELF (MG forms)
- Digital Forensic Unit (DFU) Files
- DFU database
- SOCRATES
- Forensic Submissions Folder (MG21)

It was notable for all studies that these information systems sit both inside and outside of the remit of forensic departments and as such progressing this model of measurement will require significant collaboration across organisational boundaries within policing. For several studies the need to access wider force record management systems was a barrier to forensic staff completing some of the data capture, especially in relation to final outcomes and non-forensic interventions.

Within the systems utilised for the studies, data capture ranged from recovering data directly from an individual field, recovering part of the content of a field, inferring data from the content of a field and reviewing scanned documents held on systems. In the case of the latter source, it is important to consider the barriers this creates to automating data capture. Programmes that seek to standardise and digitise forms and processes, such as the Digital Casefile, should offer opportunities to simplify information management and so improve the prospects of automated data recovery.

Data capture was labour intensive and beyond the six studies that successfully recovered full data sets, two further studies failed to do so. This failure was principally due to the resource required to recover the data. The Covid19 pandemic meant that the Home Office project team was unable to provide the in-force resource originally intended where academic resource was not commissioned. In its existing form, using manual data capture, this approach is only suitable for relatively small, targeted studies due to the resource required to capture the data. While this is better than nothing and should mean the generation of important evidence on forensic impact, it is important to acknowledge how time consuming the exercises were. Opportunities to streamline data capture, especially by automation, are therefore now a priority.

There were some data capture issues relating to the model's definitions. The impact point definitions for example had been kept deliberately vague to allow their application to all forensic disciplines and to all crime types. When applied to a specific study though this was sometimes less useful, and a definition would need clarification in a specific study scenario prior to proceeding. It will be important to address this observation before wider application of this model of measuring impact. Researchers were given discretion on how to decide if an intervention had positively contributed or not albeit in the context of clearly defined questions at each impact point making some responses somewhat subjective. Again, refined definition of what represents a contribution will be needed going forward.

Researchers' interpretation of the definition of an "instance" of impact differed too. Different researchers interpreted this as either every occasion a forensic commission was made, another captured this as all the impacts of a whole case and others again for different exhibits within the case. As each line represented one instance and the effectiveness metrics counted instances this meant that these different interpretations had a significant effect on the derived metrics. This is the most important area to tighten the definition going forward.

Finally, on differing interpretations, researchers differed in their interpretation of what instances to include for some of the impact points specifically in relation to the pre and post charge nature of the instances. Most studies incorporated all instances of pre or post charge impact apart from where a distinction was made in the impact point definitions. One study however only incorporated pre-charge instances as this was the way they were depicted on the impact point diagram (figure 2). This will need to be resolved as the model is developed further.

The decision to make the studies retrospective led to some difficulties in capturing some specific types of data especially around timeliness. An observational study would have allowed the requirements of the data capture to have been designed into the study and additional fields of data or manual recording of data in real-time would have been possible. The manual version of the model therefore lends itself to pilot studies and randomised control trials.

It was interesting to note that several researchers described the act of recovering information as being valuable, even prior to any data analysis occurring. Researchers described having the

opportunity to look at forensic work in a different context and those who worked in or led forensic teams noted immediate improvements to services that they could suggest or where improved awareness training for officers might be valuable.

Data capture formats were successful but could be improved upon. There are lessons to learn from the data normalisation required. Fixed responses, data validation and look up tables are key. Excel had limitations as a tool that, while suitable for these smaller studies, is less suited to larger and more complex data sets.

In summary, 6 proof of concept studies were able to find and recover data successfully, albeit in a time-consuming, laborious manner. As such this part of the project met our stated success criteria.

6.4.2 Generating Impact Point Metrics

All 6 studies allowed the generation of a suite of performance indicators ranging in complexity. The additional use of the "impacting factors" data then further allowed these metrics to be sliced in an enormous number of combinations. This section will give examples of the indicators measured but many more were generated and many more again could have been generated.

Forensic effectiveness (i.e., the number and proportion of potential positive contributions at an impact point) was successfully measured in all 6 studies that had successfully gathered complete data sets. At its simplest this involved the count of positive instances of contribution and the calculation of these counts as a percentage of all instances.

Figure 7 shows the simplest effectiveness metrics from the study to measure the potential impact of digital forensic science on the investigation of RASSO cases. It draws comparison to the CJS outcomes recorded for those cases where forensic science was commissioned (with no judgement made on the impact that forensic science had on those impacts) with the impact point model of measurement.

Figure 7

Case Outcomes (Percentage)

Outcome	Case outcomes (percentage)
Positive	29%
Negative	44%
Case remains	27%

Did Forensics Contribute Overall (Percentage)?

Impact Point	Yes	No
Victim Assurance	29%	21%
Validate or refute account/sequence of events	73%	27%
Safeguarding	31%	69%
Referral for charging	45%	55%
Inform interview strategies	69%	31%
Identify victim	43%	57%
Identify person of interest	45%	55%

Guilty plea	32%	68%
Generate line of enquiry	70%	30%
Establish crime committed	36%	64%
Change	41%	59%
Admission of guilt	7%	93%

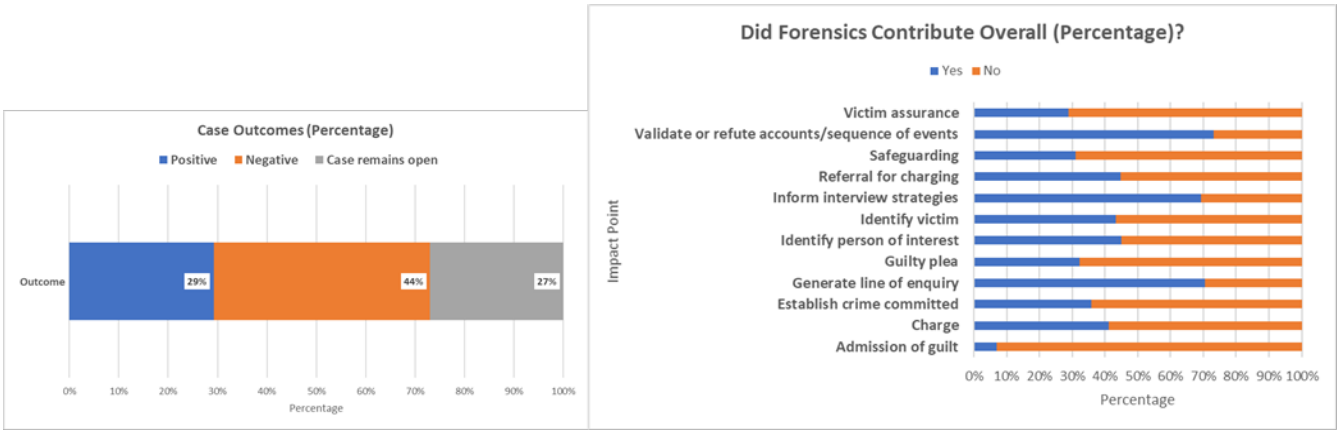


Figure 7. A comparison of the data provided for cases where forensic science has been used in cases of RASSO (n=93 cases, 1115 instances of potential impact) by an assessment of CJS Outcomes for cases (left) vs an assessment of whether or not forensic science delivered impact point contributions (right) as a measure of Forensic Effectiveness. The CJS outcomes are an important measure but offer a blunt tool to describe effectiveness. This study addresses the impact on cases with digital forensic submissions from Jan – June 2019 but at the point of data capture in early 2021 more than a quarter of cases still did not have a CJS outcome. Conversely the impact point metrics can show effectiveness metrics for all cases irrespective of whether they are complete and show the complex range of impacts delivered by the forensic interventions. Of particular interest are the high effectiveness metrics delivered for the impact of validating or refuting accounts/sequences of events, informing interview strategies and generating lines of enquiry. (Assessment of potential impact based on mix of quantitative and qualitative data dependent on Impact Point. Some assessments based on the judgement of the research team.)

Figure 8 shows the overall effectiveness metrics derived from two other studies – both "counts" of impact (to show the scale of effectiveness) as well as "percentages" (to show proportional effectiveness).

Figure 8

Did Forensics Contribute Overall (Count)

Impact Point	**Yes**	**No**
Link crimes	1	0
Identify person of interest	67	92
Generate line of enquiry	2	0
Eliminate suspect	44	1

Did Forensics Contribute Overall (Percentage)

Impact Point	**Yes**	**No**
Link crimes	100%	0%
Identify person of interest	42%	58%
Generate line of enquiry	100%	0%
Eliminate suspect	98%	2%

Did Forensics Contribute Overall (Count)

Impact Point	**Yes**	**No**
Link designated scenes	28	8
Link crimes	4	4
Identify victims	11	36
Identify person of interest	39	158

Establish crime committed	47	0
Establish cause of death	45	2
Eliminate suspect (pre-charge)	121	13
Eliminate suspect (post-charge)	1	0
Charge	50	12
Admission of guilt (pre-charge)	2	7

Did Forensics Contribute Overall (Percentage)

Impact Point	**Yes**	**No**
Link designated scenes	78%	22%
Link crimes	50%	50%
Identify victims	23%	77%
Identify person of interest	20%	80%
Establish crime committed	100%	0%
Establish cause of death	96%	4%
Eliminate suspect (pre-charge)	90%	10%
Eliminate suspect (post-charge)	100%	0%
Charge	81%	19%
Admission of guilt (pre-charge)	22%	78%

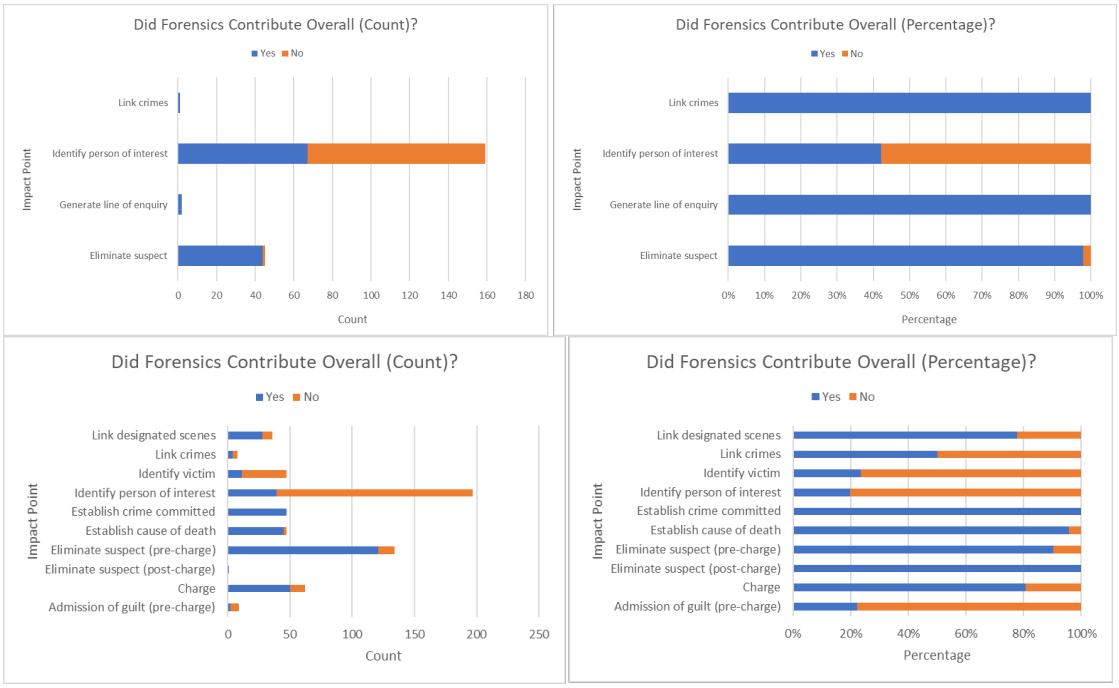


Figure 8 Further examples of forensic effectiveness indicators (assessing whether forensic science made a positive contribution to responding to the QP at any given impact point). Top charts show the count (left) and percentage (right) effectiveness of forensic science (principally fingerprints) where used to impact on drug crimes (n=148 cases, 207 potential instances of impact). Bottom charts show the count (left) and percentage (right) effectiveness of forensic science (all disciplines) impacts on homicide cases (n=44 cases 588 instances of potential impact). (Assessment of potential impact based on mix of quantitative and qualitative data dependent on Impact Point. Some assessments based on the judgement of the research team.)

These measures of forensic effectiveness provide a useful starting point to describe forensic value, although with nothing to compare them to they create a baseline of performance indicators. By using slicers to refine the effectiveness metrics using the impacting factors (e.g. demographics, exhibit type, victim offender relationships etc.) it was possible to compare forensic contributions within a study. This was especially informative in the study to measure the impact of digital forensics on online CSE investigations. Here, in addition to data on forensic contributions, data was captured on whether the case included at scene triage by a digital forensic expert rather than officers seizing exhibits and submitting them at the DFU. By slicing effectiveness metrics for cases with and without at scene triage the operational approaches are compared and measured. This is shown in figure 9 below:

Figure 9

Did Forensics Contribute Overall (Count) - No Triage

Impact Point	Yes	No
Validate or refute accounts/sequence of events	27	24
Safeguarding victims and suspects	19	11
Referral for charging	22	16
Inform interview strategies	3	10
Identify victim	13	6
Establish crime committed	46	9
Admission of guilt at an earlier stage	5	18

Did Forensics Contribute Overall (Percentage) – No Triage

Impact Point	Yes	No
Validate or refute accounts/sequence of events	53%	47%
Safeguarding victims and suspects	63%	37%
Referral for charging	58%	42%
Inform interview strategies	23%	77%
Identify victim	68%	32%
Establish crime committed	84%	16%
Admission of guilt at an earlier stage	22%	78%

Did Forensics Contribute Overall (Count) - Triage

Impact Point	Yes	No
Validate or refute accounts/sequence of events	124	40
Safeguarding victims and suspects	72	4
Referral for charging	111	21
Inform interview strategies	137	25
Identify victim	53	4
Establish crime committed	173	6
Admission of guilt at an earlier stage	64	66

Did Forensics Contribute Overall (Percentage) - Triage

Impact Point	Yes	No
Validate or refute accounts/sequence of events	76%	24%
Safeguarding victims and suspects	95%	5%
Referral for charging	84%	16%
Inform interview strategies	85%	15%
Identify victim	93%	7%
Establish crime committed	97%	3%
Admission of guilt at an earlier stage	49%	51%

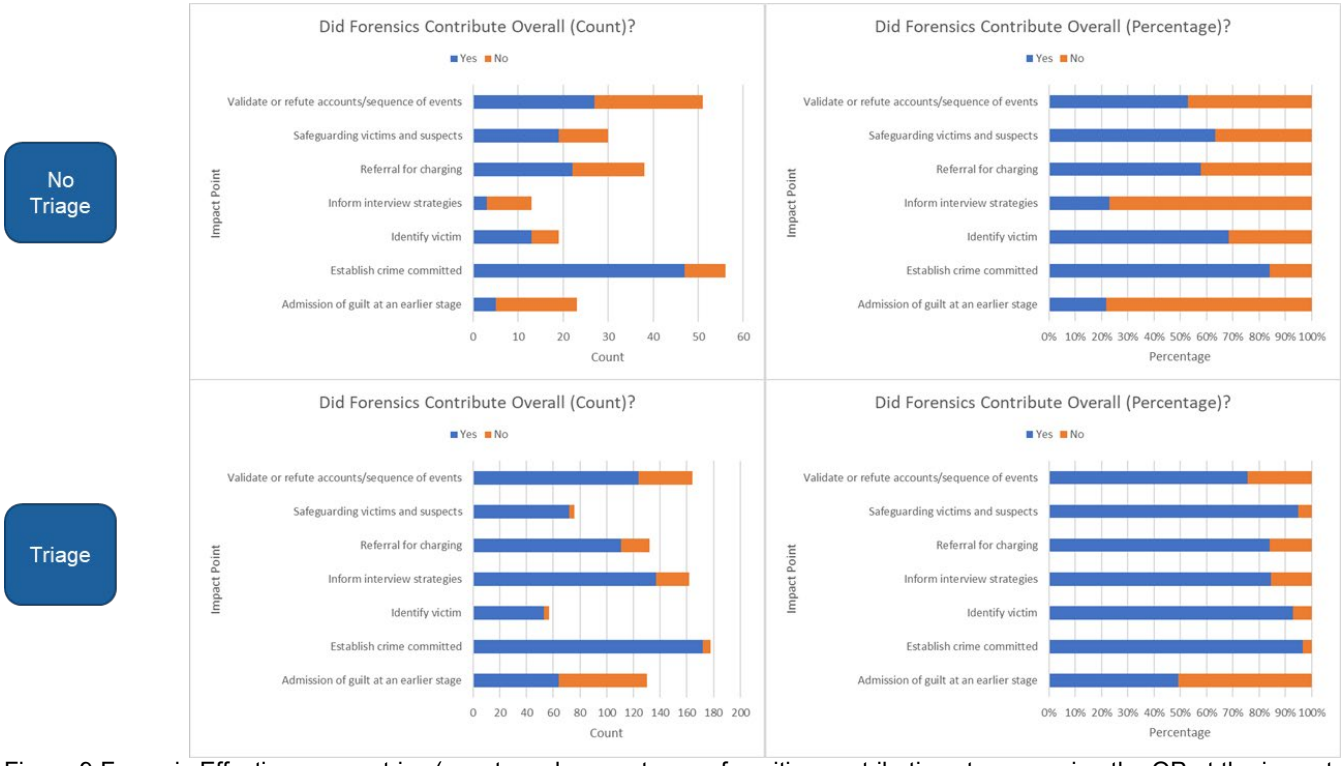


Figure 9 Forensic Effectiveness metrics (counts and percentages of positive contributions to answering the QP at the impact point) showing the impact of digital forensic science on the investigation of online CSE cases (n=217 cases, 1,129 instances of potential impact). The effectiveness without triage (top, n=51 cases, 229 instances of potential impact) can be compared to the effectiveness when triage was used (bottom, n=167 cases, 900 instances of potential impact). (Assessment of potential impact based on mix of quantitative and qualitative data dependent on Impact Point. Some assessments based on the judgement of the research team.)

The impact of forensic science on homicide investigations study offered another interesting perspective on the forensic effectiveness indicators as it allowed us to measure both collective forensic effectiveness as well as the effectiveness of individual forensic disciplines. Comparing charts of forensic effectiveness for different forensic disciplines illustrated what could be termed “impact profiles”, with different disciplines contributing at different impact points and to differing degrees of effectiveness.

Figure 10 demonstrates these impact profiles. The collective contribution of all forensic science showed a broad contribution across the impact points measured. This pattern reflected the individual impacts from different forensic disciplines which either were effective for very particular impact points (such as the impact profile of toxicology or fingerprints) or alternatively are effective for a broader array of impact points (such as the impact profile of CCTV).

Figure 10

Did Forensics Contribute Overall (Percentage)? – All Disciplines

Impact Point	Yes	No
Link designated scenes	78%	22%
Link crimes	50%	50%
Identify victim	23%	77%
Identify person of interest	20%	80%
Establish crime committed	100%	0%
Establish cause of death	96%	4%
Eliminate suspect (pre-charge)	90%	10%
Eliminate suspect (post-charge)	100%	0%
Charge	81%	19%
Admission of guilt (pre-charge)	22%	78%

Did Forensics Contribute Overall (Percentage)? – Fingerprints

Impact Point	Yes	No
Link designated scenes	80%	20%
Link crimes	0%	0%
Identify victim	80%	20%
Identify person of interest	100%	0%
Establish crime committed	0%	0%
Establish cause of death	0%	0%
Eliminate suspect (pre-charge)	88%	13%
Eliminate suspect (post-charge)	0%	0%
Charge	100%	0%
Admission of guilt (pre-charge)	0%	0%

Did Forensics Contribute Overall (Percentage)? – Toxicology

Impact Point	Yes	No
Link designated scenes	0%	0%
Link crimes	0%	0%
Identify victim	0%	0%
Identify person of interest	100%	0%
Establish crime committed	100%	0%
Establish cause of death	100%	0%
Eliminate suspect (pre-charge)	0%	0%
Eliminate suspect (post-charge)	0%	0%
Charge	100%	0%
Admission of guilt (pre-charge)	0%	0%

Did Forensics Contribute Overall (Percentage)? – CCTV

Impact Point	Yes	No
Link designated scenes	95%	5%
Link crimes	100%	0%
Identify victim	100%	0%
Identify person of interest	96%	4%
Establish crime committed	100%	0%
Establish cause of death	100%	0%
Eliminate suspect (pre-charge)	95%	5%
Eliminate suspect (post-charge)	100%	0%
Charge	100%	0%
Admission of guilt (pre-charge)	100%	0%

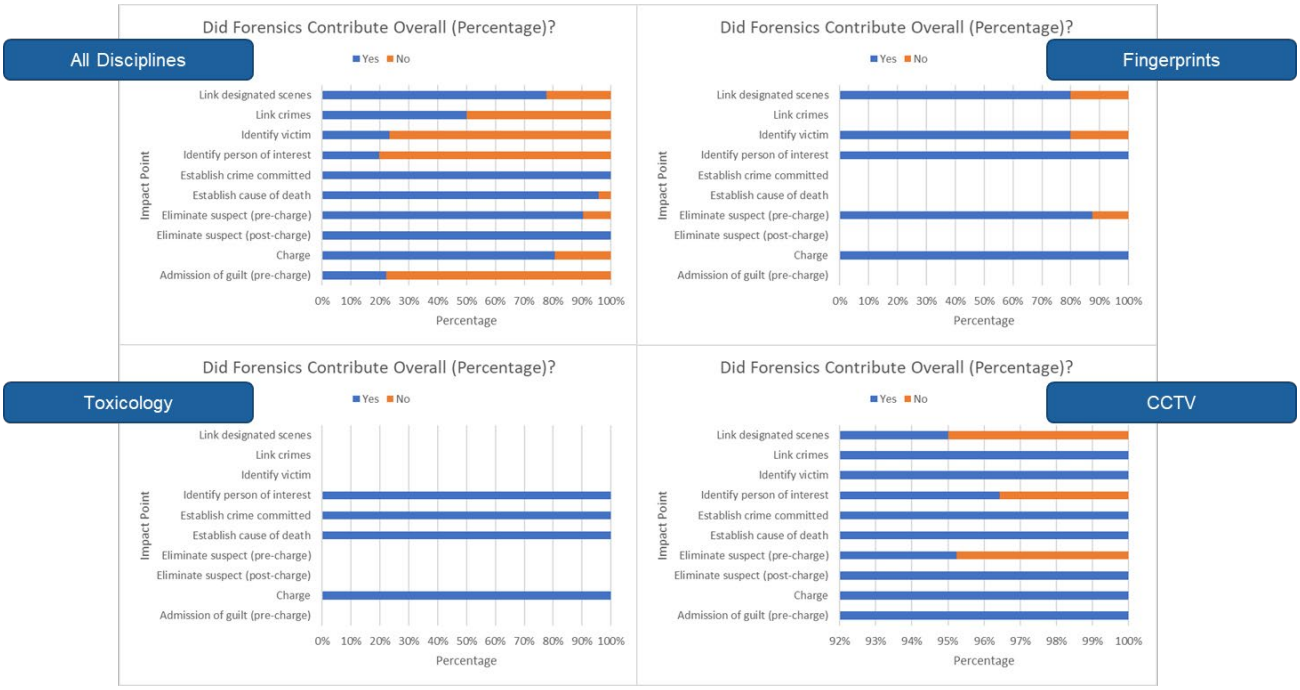


Figure 10 Examples of the forensic effectiveness "impact profiles" from the study to measure the impact of forensic science on homicide investigations (n=44 cases, 588 instances of potential impact), highlighting the different patterns of effectiveness indicators across different forensic disciplines. Fingerprints and Toxicology have very specific and very different impacts points where they contributed, while CCTV contributed across all the impact points studied. (Assessment of potential impact based on mix of quantitative and qualitative data dependent on Impact Point. Some assessments based on the judgement of the research team.)

The next metric category has been termed "exclusive effectiveness". These metrics were derived in studies where data was also captured for non-forensic interventions and provide a measure of where forensic science was the only thing that delivered an impact in any given instance. The concept of exclusive effectiveness is particularly important when assessing the impact of forensic science as it is essentially a measure of when the absence of forensic science would have meant the total loss of that impact. It could be argued that in some instances non-forensic methods were not needed and so not attempted but this doesn't detract from the finding that there was no other way the impact was delivered in the contributions studied. Figure 11 shows an example of effectiveness metrics compared to exclusive effectiveness metrics.

Figure 11

Did Forensics Science Contribute Overall (Count)?

Impact Point	Yes	No
Link Crimes	15	2
Identify person of interest	74	22
Generate Intelligence	44	278
Eliminate Suspects	10	2

Did Forensics Science Contribute Overall (Percentage)?

Impact Point	Yes	No
Link Crimes	88%	12%
Identify person of interest	77%	23%
Generate Intelligence	14%	86%
Eliminate Suspects	83%	17%

Did Forensics Science Contribute Exclusively (Count)?

Impact Point	Yes	No
Link Crimes	7	10
Identify person of interest	30	66
Generate Intelligence	18	304
Eliminate Suspects	5	7

Did Forensics Science Contribute Exclusively (Percentage)?

Impact Point	Yes	No
Link Crimes	13%	59%
Identify person of interest	41%	69%
Generate Intelligence	6%	94%
Eliminate Suspects	42%	58%

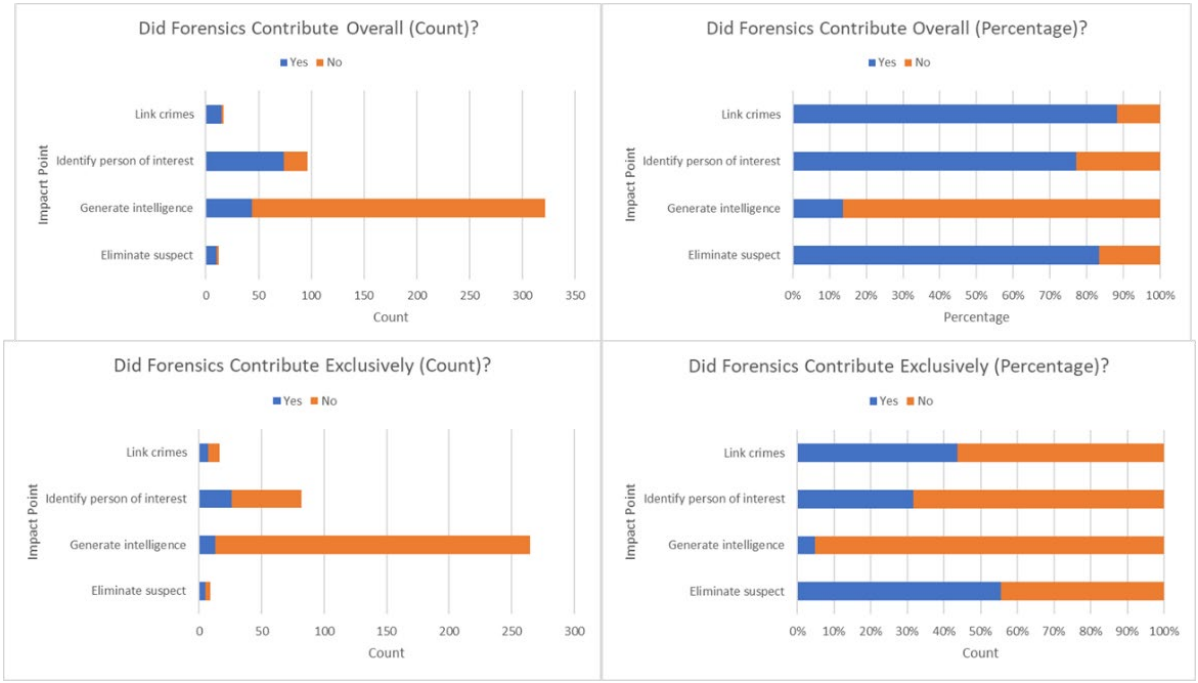


Figure 11. An example of forensic effectiveness metrics compared to exclusive forensic effectiveness. Top charts show both the count (top left) and percentage (top right) effectiveness (contributions delivered to respond to the QP at an impact point) of forensic science impacting on the investigation of burglary cases (n=551 cases, 730 instances of potential impact). Bottom charts show both the count (top left) and percentage (top right) exclusive effectiveness (i.e. where only forensic science delivered a contribution at an impact point) of the same study. (Assessment of potential impact based on mix of quantitative and qualitative data dependent on Impact Point. Some assessments based on the judgement of the research team.)

Examples of timeliness metrics were successfully generated for all 6 studies that had successfully gathered complete data sets.

Some of these were more meaningful than others. As mentioned in section 6.3 some researchers did not capture the time taken at instances of impact and so proxy measurements were needed including using dates of offence as a start point and a final report date to end. This missed the granularity of how each impact point was addressed – both in terms of when the work was commissioned, or the when the use of verbal updates or interim reporting informed investigators. Examples of timeliness metrics are shown in figure 12 below.

Figure 12

Estimated Time Taken to Answer the Questions

Impact Point	Count (Forensics)	Minimum (Forensics)	Median (Forensics)	Maximum (Forensics)	Mean Average (Forensics)	Standard Deviation (Forensics)
Admission of guilt (pre-charge)	2	2	2.50	3	2.50	0.71
Charge	50	2	7.00	793	71.74	145.24
Eliminate suspect (post-charge)	1	28	28.00	28	28.00	0.00
Eliminate suspect (pre-charge)	24	1	41.50	318	91.13	109.80
Establish cause of death	41	1	77.00	280	87.17	78.43
Establish crime committed	45	1	2.00	245	14.60	42.97
Identify person of interest	38	1	3.50	722	37.66	119.33
Identify victims	11	1	2.00	29	5.82	8.80
Link crimes	2	2	5.00	8	5.00	4.24
Link designated scenes	27	1	5.00	148	20.78	41.07
Overall	241	1	6.00	793	50.22	100.96

Row Labels	Count (Forensics)	Minimum (Forensics)	Median (Forensics)	Maximum (Forensics)	Mean Average (Forensics)	Standard Deviation (Forensics)
Admission of guilt (pre-charge)	2	2	2.50	3	2.50	0.71
Charge	50	2	7.00	793	71.74	145.24
Eliminate suspect (post-charge)	1	28	28.00	28	28.00	0.00
Eliminate suspect (pre-charge)	24	1	41.50	318	91.13	109.80
Establish cause of death	41	1	77.00	280	87.17	78.43
Establish crime committed	45	1	2.00	245	14.60	42.97
Identify person of interest	38	1	3.50	722	37.66	119.33
Identify victim	11	1	2.00	29	5.82	8.80
Link crimes	2	2	5.00	8	5.00	4.24
Link designated scenes	27	1	5.00	148	20.78	41.07
Overall	**241**	**1**	**6.00**	**793**	**50.22**	**100.96**

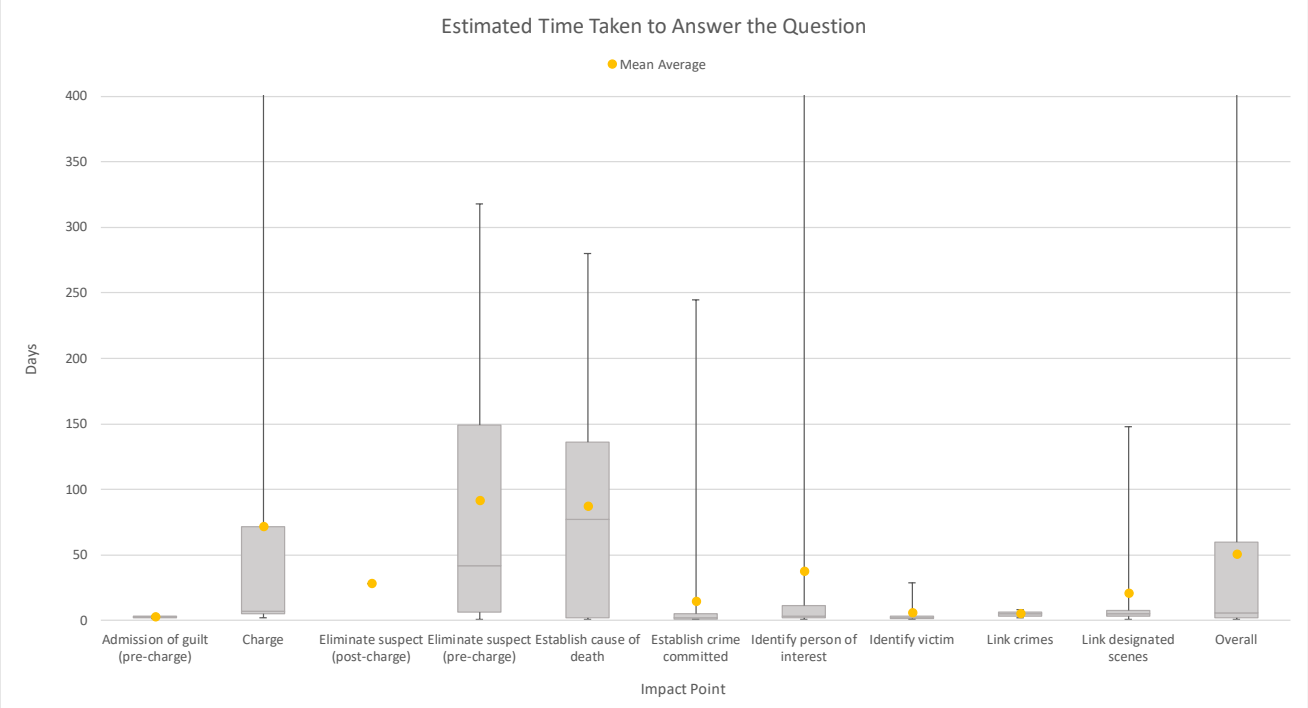


Figure 12. The timeliness metrics derived for the impact of all forensic disciplines on homicide investigations (n=42 cases, 241 instances of potential impact) for each of the impact points measured, displayed as a box and whisker chart. showing for the given set of data: the minimum value, lower quartile, median, mean, upper quartile, maximum value (often off the scale here).

Figure 12 demonstrates the value of measuring median values as well as or instead of mean values for timeliness. This set of metrics looked only at "live" homicide cases (the "cold" case was removed from this data set as some of the findings covered a more than 30-year period). The figure demonstrates how outlier data points can significantly skew mean measurements.

Timeliness metrics were also sliced using the impacting factors to refine understanding of the impact. Again, a particularly useful example of this is the study to measure the impact of digital forensics on online CSE investigations. Three time critical impact points were selected for more detailed analysis – "establish crime committed", "inform interview strategies" and "admission of guilt" and the timeliness of forensic interventions at each were measured with and without the use of at scene triage. The findings are set out in Figure 13 below.

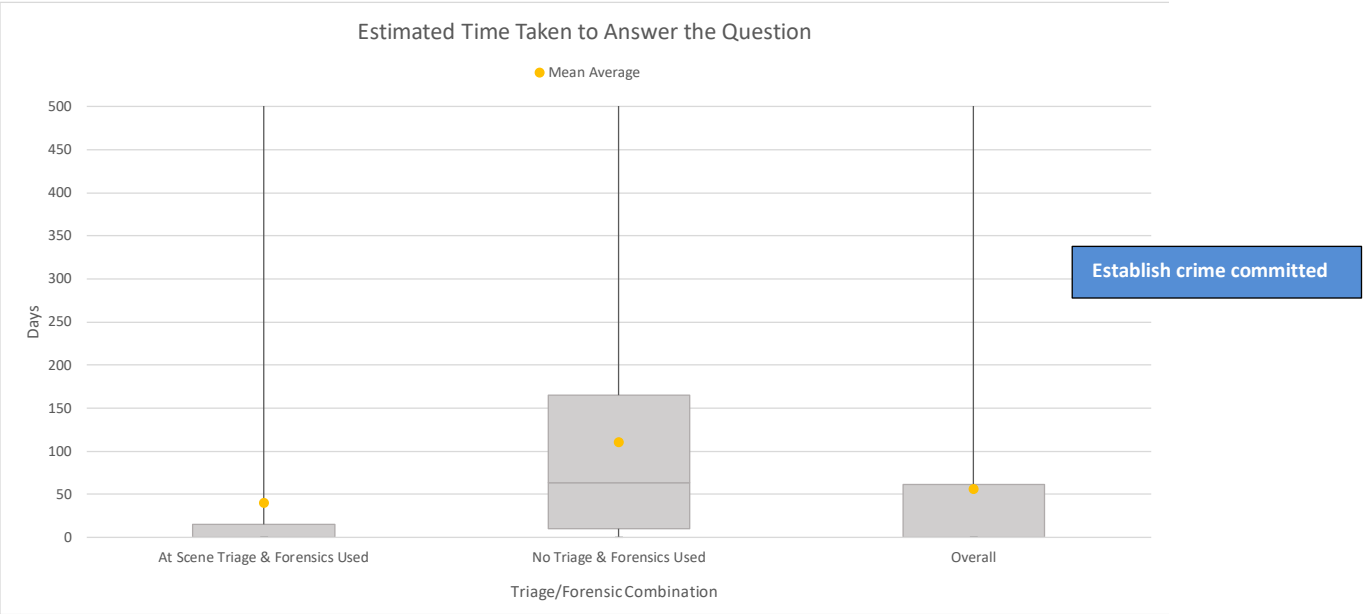
Figure 13

Estimated Time Taken to Answer the Question – Establish Crime Committed

Impact Point	Count	Minimum	Median	Maximum	Mean Average	Standard Deviation
At Scene Triage & Forensics Used	178	0	0	955	40.20	106.98

No Triage & Forensics Used	55	0	64	650	111.27	133.97
Overall	233	0	0	955	56.97	117.57

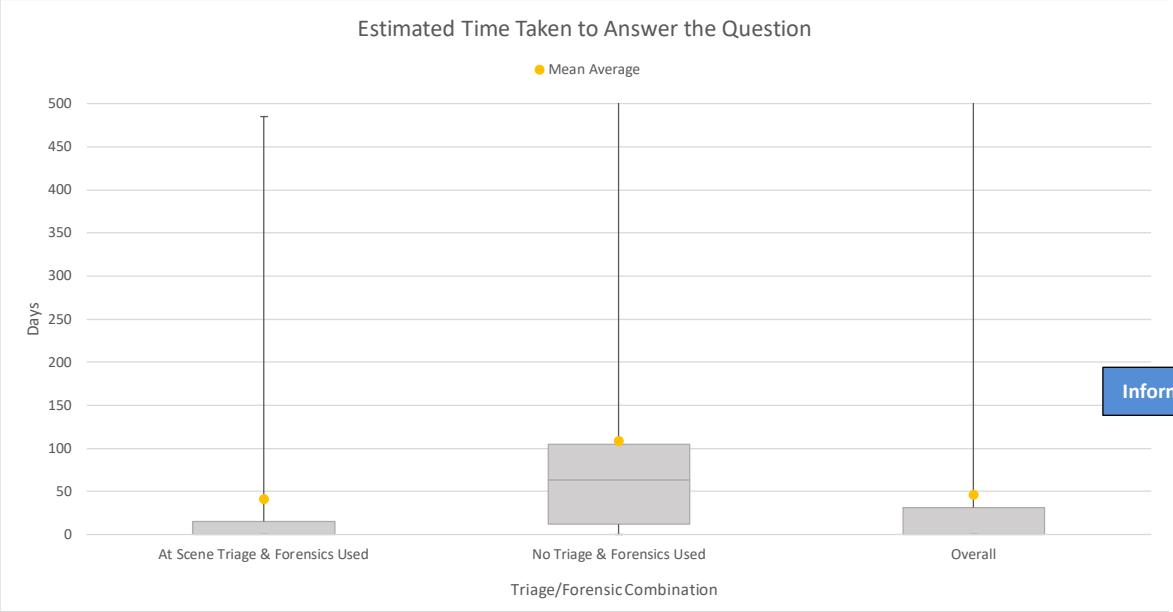
Impact Point	Count	Minimum	Median	Maximum	Mean Average	Standard Deviation
At Scene Triage & Forensics Used	178	0	0	955	40.20	106.98
No Triage & Forensics Used	55	0	64	650	111.27	133.97
Overall	**233**	**0**	**0**	**955**	**56.97**	**117.57**



Estimated Time Taken to Answer the Questions – Inform Interview Strategies

Impact Point	Count	Minimum	Median	Maximum	Mean Average	Standard Deviation
At Scene Triage & Forensics Used	160	0	0	485	41.90	96.42
No Triage & Forensics Used	13	0	64	557	108.92	149.61
Overall	173	0	0	557	46.94	102.32

Impact Point	Count	Minimum	Median	Maximum	Mean Average	Standard Deviation
At Scene Triage & Forensics Used	160	0	0	485	41.90	96.42
No Triage & Forensics Used	13	0	64	557	108.92	149.61
Overall	**173**	**0**	**0**	**557**	**46.94**	**102.32**



Inform interview strategies

Estimated Time Taken to Answer the Question – Admission of Guilt

Impact Point	Count	Minimum	Median	Maximum	Mean Average	Standard Deviation
At Scene Triage & Forensics Used	73	0	0	701	39.89	113.99
No Triage & Forensics Used	18	0	98.5	536	124.00	140.08
Overall	91	0	0	701	56.53	123.44

Impact Point	Count	Minimum	Median	Maximum	Mean Average	Standard Deviation
At Scene Triage & Forensics Used	73	0	0	701	39.89	113.99
No Triage & Forensics Used	18	0	98.5	536	124.00	140.08
Overall	**91**	**0**	**0**	**701**	**56.53**	**123.44**

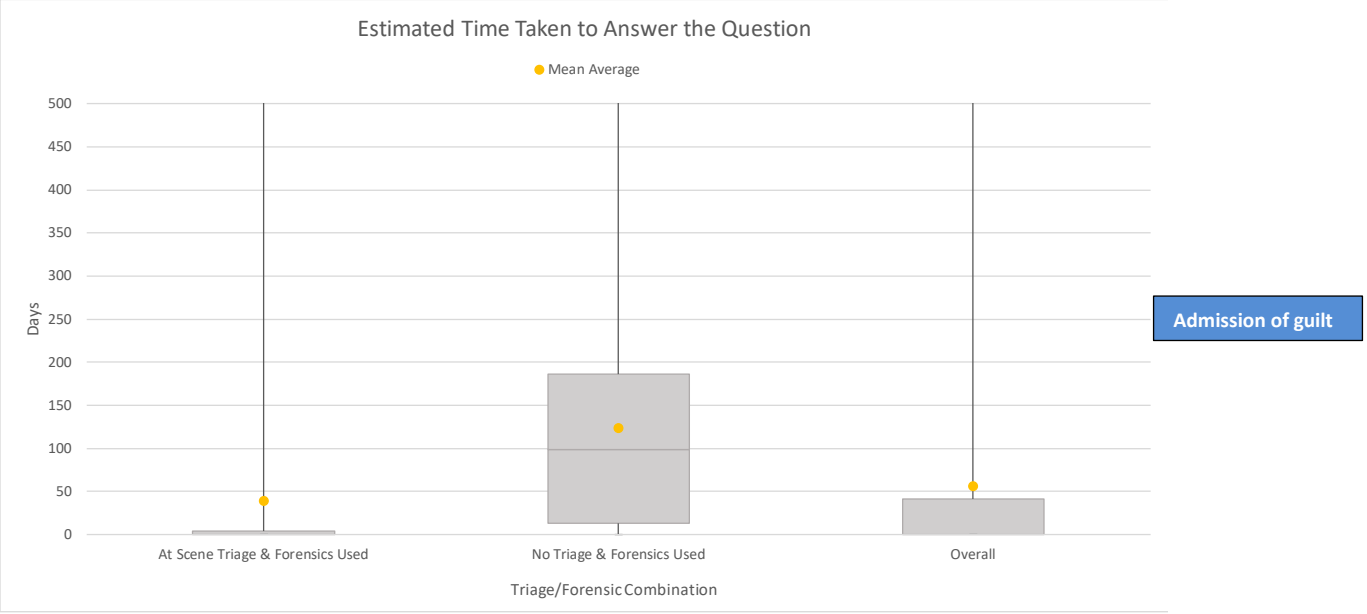


Figure 14. Timeliness metrics showing the impact of digital forensic science on the investigation of online CSE case. Here, in addition to data on time taken to deliver impact, data was captured on whether the case included at scene triage by a digital forensic expert rather than officers seizing exhibits and submitting them at the DFU. By slicing timeliness metrics for cases with and without at scene triage the operational approaches are compared and measured. The timeliness at impact points, "establish crime committed" (top, n=215 cases, 233 instances of impact), "inform interview strategy" (middle, n=135 cases, 173 instances of impact), and "admission of guilt "(bottom, n=79 cases, 91 instances of impact) with at scene triage (left in each chart) without triage (centre in each chart) and overall (right in each chart). Timeliness is displayed as a box and whisker chart. showing for the given set of data: the minimum value, lower quartile, median, mean, upper quartile, maximum value (often off the scale here).

In summary, multiple forensic effectiveness and timeliness metrics were generated for all 6 proof of concept studies that gathered complete data sets. Additional refinements of these metrics were demonstrated as well. As such, this met our stated success criteria.

6.4.3The usefulness of the metrics

The studies have generated examples of metrics that are the first step on a journey to improving our understanding of forensic impact. In particular, the proof-of-concept studies have identified data and generated indicators relating to a broad suite of potential impact points associated with forensic science.

It could be envisaged, for example, that measurement of the impact of a forensic discipline on a particular crime type might show high effectiveness metrics, informed by positive contributions at a range of impact points, across a broad impact profile but with poor forensic timeliness metrics. This type of pattern of performance indicator might suggest the need to explore the reasons for delays further and to review a case for investment in additional resources or automation to generate the most benefit from those strong contributions. Equally, measurement of the impact of another forensic discipline on a crime type might show low or limited effectiveness, perhaps in impact points already covered by other disciplines. This might suggest the need to explore the case for resources utilised there being better used elsewhere, or that reviewing the metrics of other forces utilising different submission policies or training approaches and achieving higher metrics might offer the opportunity to learn from their approach and improve effectiveness.

The metrics cannot offer detailed causes of impact or definitive assessments of value and should be considered as indicators to identify areas that warrant more investigation such as qualitative

analysis that can augment their findings. The metrics are not sophisticated enough for example to rank performance. They offer no detail on the degree of contribution at an impact point but rather a binary yes/no answer. One of the study leads suggested an improvement to this might be to rank the levels of contribution. This may add more useful detail for small studies or pilots but would also add more complexity to an already complex model and be cumbersome for a cross CJS, cross crime type, cross discipline application.

Examples of the metrics outlined in this report were presented to the project's oversight group – the Forensic Subgroup of the Criminal Justice Board. **This group of cross CJS stakeholders gave the approach their broad, positive feedback and confirmed our view that the metrics are useful. As such, this test of the project's success has also been achieved.**

7. Conclusions

This project has laid the foundation for creating a model and metrics for measuring forensic impact on an ongoing basis. It is an approach that can be applied to all crime types and forensic disciplines and can be applied across the organisations of the CJS.

It has been demonstrated that the data required to inform the metrics in the model can be recovered for existing data sources, albeit only manually so far. That recovery was laborious, and efforts should be directed to simplifying that, principally by automation of data capture and analysis. In addition, other projects aiming to simplify and harmonise CJS data streams should be identified as opportunities to make forensic impact measurement easier.

The metrics generated by the proof of concept studies offer indicators that are valuable and informative. The metrics move us to a better understanding of real-world impacts in a language that is important and understandable across the CJS, including to senior decision makers such as Ministers and Chief Officers. It is possible to envisage these metrics, with time, helping to deliver an evidence base that can inform policy, investment and resourcing decisions, change programmes, and considerations of best practise, improvements to efficiency and ultimately improved outcomes for the public. Opportunities to roll the model out to across policing and partners in academia should be prioritised to begin the creation of a robust evidence base on forensic impact to allow those applications to begin.

The approach has, so far, only been applied to the investigative phase of the CJS but there is no reason to think that the approach could not equally be applied to the charging and court phase of the CJS. This should be explored as a priority, ideally follow the passage of cases from crime scene to court and so understand the entirety of forensic impact throughout. Similarly, metrics on cost benefit have not been generated and alternative approaches to this must be explored in the next phase of the project. Beyond this, it is possible to envisage the application of this approach being applied to areas of forensic impact outside of the scope of this phase of the project, for example the impact of forensic science on crime prevention and disruption and these should also feature in longer term plans.

8. Next Steps and Recommendations

8.1 A manual model for measuring forensic impact

The Home Office will complete this first phase of the project by creating a simple package of documents including data capture spreadsheets as well as instructions on how to complete them and subsequently analyse data captured to determine forensic impact. This toolkit could be used by organisations such as police forces, the NPCC Forensic Capability Network (FCN), and academia,

to allow the measurement of forensic impact in small scale case studies to provide actionable knowledge about forensic value.

8.2 Rolling the impact point model out to policing

The FCN Expert Network on Performance and Risk should lead work to encourage police forces to utilise the model, metrics and definitions of impact and value developed during this project. As a minimum, policing (both locally and nationally) should incorporate this approach into measuring the benefits of pilot studies and change programmes. They should particularly look to utilise this model and metrics to increase the evidence base on high profile crime types and specific forensic disciplines. This recommendation is supported by the creation of a manual suite of documents (described in 8.1) that can be utilised to measure forensic impact on a small scale. Study designs involve challenges due to technical and ethical barriers around the creation of randomised control trials (RCTs) in the context of an investigative setting. However, the Home Office will continue to support and encourage the application of strong evaluation designs to build the most robust evidence base on the added value of forensic science.

The Expert Network should coordinate the creation of a refined version of the impact point approach by categorising impact points and determining which should be prioritised for different crime types and forensic disciplines. It should work toward the adoption of harmonised nomenclature and systematic definitions between organisations. Many of the priorities for this have been highlighted within this report. This approach should be incorporated into the FCN's developing performance framework and the way the FCN and wider policing community measure forensic benefit and so support identifying best practice. The Home Office will continue to support this work as part of its membership of the expert network.

8.3 Automating the impact point model

This phase of our project has shown that much of the information needed to measure forensic impact using impact points exists collectively on current case and crime management systems albeit in very differing formats. The FCN, on behalf of police forces and the Home Office, should progress the automation of data capture to allow the measurement of impact on an ongoing basis. This should begin with viability studies to capture the complexity of this ask in the face of the diverse systems and data that need to be captured and the need to normalise that data both within and across forces. Our suggestion is that this is best served by working with the Minerva and Athena programmes (which oversee the development of the Niche and Connect record management systems respectively), as well as police force forensic and data leads. Private sector forensic service providers also hold a wealth of data and are keen to be able to link that to the value it delivers, so opportunities should be explored to exploit that. It may be of value to explore opportunities to join up data sources by involving the Accelerated Capability Environment (ACE), a Home Office capability with access to a community of organisations and experts drawn from the private sector and academia, from which it selects and combines the capabilities best suited to any given problem. The Home Office will support this activity with joint bids for funding by the HO STAR fund and/or via a Comprehensive Spending Review as appropriate.

This viability work and subsequent roll out should include a vision for the development of trend analysis of these impact metrics, allowing the impacts of forensic science (and by extension of the FCN and policing policies and change programme's impact on forensic science) to be measured over time. The FCN should help the Home Office make the case to chief officers for this approach to the long-term measurement of forensic benefits to optimise forensic policy and resourcing decisions at both local and national levels. As stated in section 6.4.1, progress will require significant collaboration across organisational boundaries within policing.

8.4 Identifying opportunities to improve impact measurement

The Home Office will continue to identify relevant government programmes to improve CJS data streams and create cross organisational systems. Any such systems offer enormous opportunities to add more valuable detail to the metrics already described. The Home Office will champion forensic science as a priority stakeholder in those programmes. The Home Office will also continue to explore opportunities in Artificial Intelligence (akin to the National Data Analytics programme) for capturing information on forensic impact.

8.5 Developing the cost benefit metric

Financial information is not currently available in a form to allow simple cost benefit metrics based on individual instances of impact to be measured alongside the effectiveness and timeliness metrics. The Home Office will explore the Economic case for forensic interventions including the potential for a Green Book Analysis of forensic science (guidance by HM Treasury on how to assess the financial benefits of policies or programmes). In addition to this, the Home Office should work with police forces and the FCN to explore opportunities to address other ways to consider financial information such as departmental budgets to populate and measure cost benefit metrics for collective effectiveness and timeliness metrics.

8.6 Proving the concept beyond investigations

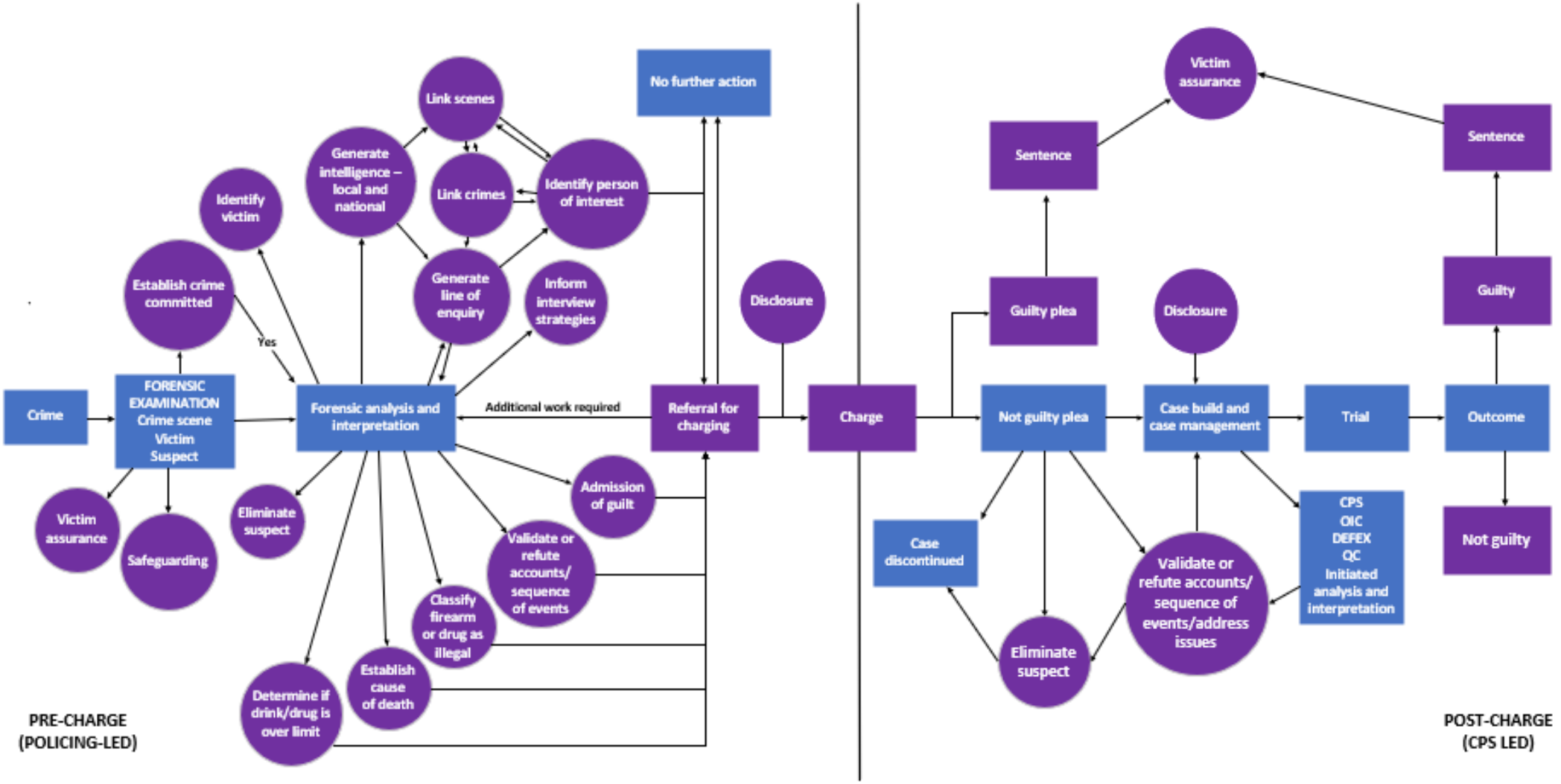
The Home Office should continue proving the principle of the Impact Point approach by initiating additional studies, this time focused on the charging and court processes. The Home Office should work with the CPS, Ministry of Justice, HMCTS and wider CJS stakeholders to identify data sets and opportunities to measure forensic impact there, while also identifying any opportunities to inform high priority gaps in the evidence base.

8.7 Expanding the scope of impacts to measure

The Home Office will consider plans to expand the project scope to incorporate wider forensic impacts on crime prevention, deterrence, reoffending, and disruption. The Home Office should continue to work with the University of Ulster as their public benefit of forensic science project comes to a close and look for opportunities to incorporate their work into the evidence base for understanding forensic value to the CJS and wider public in England and Wales.

Appendix 1 – Impact Point Definitions and Questions Posed

Impact of Forensic Science on the Criminal Justice System – The Impact Points, Definfitions and Questions Posed



Purple denotes that forensic science can have an impact at this Impact Point within the CJS

• Establish crime committed

Definition: Confirming or refuting that the reported crime has occurred. **"Can we determine if a crime has been committed?".**

Further information: Most forensic disciplines can contribute to answering the question. For the purposes of these metrics it is of equal value to determine if a crime has been committed as to determine if it hasn't, with the negative impact being unable to determine either way. Disciplines used are somewhat dependant on the crime type but include Crime Scene Analysis, Pathology, Fire Investigation, Toxicology, Drug Analysis, Biology and Chemistry trace evidence, Firearms classification, CCTV, mobile phone and computer analysis.

• Identify victim

Definition: The process of Identifying who a victim is. **"Can we determine who is the victim of this crime?"**

Further information: The need to Identify a victim can be associated with Homicide cases or Organised Crime (predominantly Cybercrime, Child Sexual Abuse (CSA) and human trafficking cases). Forensic disciplines that impact on Homicide Investigations are predominantly biometric fields such as DNA profiling (including the use of NDNAD, MPDD and VPDD) and Fingerprints. In Organised Crime, disciplines are predominantly digital forensics including Mobile device analysis and Imaging.

• Victim assurance (pre-charge)

Definition: The provision of reassurance and confidence to a victim of a crime that an investigation is proceeding. **"Can we positively contribute to victim assurance?"**

• Safeguarding

Definition: The protection of vulnerable individuals, especially victims, from additional negative impacts of crime. **"Can we positively contribute to safeguarding individuals"**

• Establish cause of death

Definition: To determine how an individual died. **"Can information be provided that establishes the cause of death?"**

Further information: The principle mechanism for establishing the cause of death is pathology but also toxicology.

• Generate intelligence

Definition: A broad category to cover the developing of information and material that will progress an investigation. For more meaningful assessments of where forensic science has delivered this impact it may be necessary to define specific examples of the intelligence generated for specific crime types, forensic disciplines or scenarios. **"Can we develop information that will assist the progression of the investigation of this or other crimes?"**

• Link scenes

Definition: Provision of evidence that links separate locations that may be involved in the same crime. **"Is there any evidence to link different scenes in this crime"**

• Link crimes

Definition: Provision of evidence that links separate crimes that may be involved in a series of crimes. **"Is there any evidence to link other crimes to this crime"**

Further information: Many forensic disciplines can impact on this point, but it is one of the key purposes of forensic databases, so the use of fingerprints, DNA profiling (NDNAD), footwear and firearms are particularly utilised. Drug profiling and physical fit (including press patterns) are other examples.

• Generate line of enquiry

Definition: Provide a thread of reasonable and relevant questions to be asked in the investigation of a crime including provision of hypotheses. **"Is there information that could generate a line of enquiry?"**

Further information: Many of the other impact points identified – linking scenes and crimes; identifying persons of interest will fall into this catch all category so it will be used for examples not covered elsewhere. All forensic disciplines can contribute to the point including many of the contact trace disciplines.

• Identify person of interest

Definition: To provide information about an individual that may have an involvement in a crime, either as a perpetrator or as a witness. **"Can information be provided about who was involved, either as a perpetrator of, or a witness to, this crime?"**

Further information: Many forensic disciplines can contribute to determining a person of interest with varying levels of precision. Biometrics such as DNA and fingerprints and their respective databases and CCTV and other digital forensic disciplines are predominantly used.

• Inform interview strategies

Definition: Providing information that can be used to formulate an approach to questioning suspects and witnesses. **"Can we determine information that will inform our interview strategy?"**

• Eliminate suspect (pre-charge)

Definition: The provision of evidence that excludes an individual as a suspect of perpetrating a crime prior to proceeding to any formal charges. **"Can information be provided about whether an individual was definitely not involved as a perpetrator of this crime?"**

Further information: Many forensic disciplines can contribute to eliminate a suspect. Biometrics such as DNA and fingerprints and their respective databases and CCTV and other digital forensic disciplines are predominantly used.

• Classify a firearm as illegal

Definition: To determine the classification of a firearm and whether is illegal under the Firearms Act. **"Can evidence be provided about whether this firearm is an illegal weapon?"**

• Classify a drug as illegal

Definition: To determine the identity of a drug and whether it is proscribed under the Misuse of Drugs Act. **"Can evidence be provided about whether this substance is an illegal drug?"**

Further information: Use of presumptive testing/screen (e.g EDIT) can be used, but forensic drug analysis is the sole mechanism to classify a drug as illegal.

• Determine if drink/drug is over the limit

Definition: Measuring the level of alcohol and/or drugs in an individual's breath, saliva, blood or urine to determine if they are over the proscribed limit for driving. **"Can we determine if the individual is over the proscribed limit for drink and/or drugs"**

Further information: Presumptive roadside screening for alcohol (in breath) or drugs (in saliva) is then confirmed by evidential breath testing in custody (for alcohol) or by the submission of a blood or urine test (for alcohol and drugs) for toxicology analysis. These are the sole mechanisms for determining if this type of crime has been committed.

• Validate or refute accounts/sequence of events (pre-charge)

Definition: Provide information that may support (or otherwise) the witness or suspect's version of events including the order that events occurred in prior to any formal charges being put for consideration. **"Can we validate or refute this account of events?"**

Further information: This would include suggesting alternative scenarios to those already described.

• Admission of guilt (pre-charge)

Definition: Provide information to investigators that leads to a suspect admitting that they have committed an offence prior to any formal charges being put for consideration. **"Was evidence provided that led to a suspect admitting their guilt prior to them being charged with the offence?"**

• Referral for charging

Definition: Provide evidence that leads to referral of a case to the CPS for charging advice. **"Can evidence be provided that will directly lead to the referral of case for charging?"**

• Charge

Definition: Sufficient evidence to provide a realistic prospect of conviction a decision to charge is made. Depending on the type and seriousness of the offence committed, this decision is made by the police or the CPS. **"Can evidence be provided that will directly lead to a charge?"**

• Disclosure

Definition: To ensure that all parties are aware of the information that has been collected (either used or unused) as part of the investigation and prosecution of a crime

Further information: Particular consideration is needed to the timeliness of the disclosure.

• Validate or refute accounts/sequence of events/address issues (post-charge)

Definition: Provide information that will support (or otherwise) defendant's version of events including the order that events occurred in after charging. **"Can we validate or refute this account or challenge to the evidence?"**

Further information: After charging evidence is served to the defendant (sometimes in the form of an SFR1 they will respond with what is accepted and what is disputed and why they dispute it. This will include the provision of expert witness evidence.

• Eliminate suspect (post-charge)

Definition: The provision of evidence that excludes an individual as a suspect of perpetrating a crime after they are charged, and they have responded to the evidence served on the defence. **"Can information be provided about whether an individual was definitely not involved as a perpetrator of this crime?"**

Further information: This may differ from the impact pre-charge and will be the result of considering additional information provided by the defence.

- ## Guilty plea

Definition: Provision of evidence that leads to a suspect admitting that they have committed an offence once they have been formal charged with that offence. **"Was evidence provided that contributed to a suspect admitting their guilt after they were charged with the offence?"**

- ## Guilty

Definition: When a defendant is found Guilty of a crime by the Magistrates or Jury. **"Did the evidence impact on the Guilty finding?"** ***Note – there is little prospect of being able to measure this impact as jurors cannot be interviewed. Consider capturing as a factual finding and look for associations with forensic science***

- ## Sentence

Definition: The impact made to the length or type of sentence imposed on an offender by a Judge or Magistrates. **"Did the evidence provided influence the sentence?"**

- ## Not guilty

Definition: When a defendant is exonerated of crime by the Magistrates or Jury. **"Did the evidence impact on the Not Guilty finding?"** ***Note – there is little prospect of being able to measure this impact as jurors cannot be interviewed. Consider capturing as a factual finding and look for associations with forensic science***

- ## Victim assurance (post-charge)

Definition: The provision of reassurance and confidence to a victim of a crime that in the justice process. **"Can we positively contribute to victim assurance?"**