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Review

Evaluations of Speed Camera Interventions Can Deliver a Wide Range of Outcomes: Causes and Policy Implications

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Abstract: Speeding (travelling at speeds above the speed limit) is proven to be a major contributor to serious crashes, and speed management interventions including speed cameras are shown to reduce speeds, crashes, and trauma. However, the present review identifies that the range of outcomes reported in evaluations of speed cameras is large, complicating the understanding of effects, and inviting scepticism about the value of speed cameras despite the large numbers of reported successes, as well as systematic reviews and meta-analyses that demonstrate their life- and injury-saving value. Therefore, this review is focused on the factors that contribute to the large range of findings, including reasons for genuine differences in the outcomes delivered by different camera programs and variations in evaluation methodology that influence the extent to which real benefits are detected. Finally, recommendations are offered to maximise the safety benefits of speed-camera programs (including ensuring the full chain of requirements for general deterrence is met; strong communications about new programs and expansions at least several weeks in advance of implementation; and unpredictability of enforcement versus signposted cameras) and to improve evaluation methods (especially around determining the road lengths/locations assumed to be treated by the cameras and use of control locations).

Keywords: speed and crashes; speed enforcement; speed cameras; speed-camera evaluation; evaluation methodology; speed-camera outcomes; general deterrence

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1. Introduction

A substantial body of evidence demonstrates that speed is a fundamental risk factor in road safety, contributing substantially to both crash occurrence and severity. This evidence has been comprehensively and systematically reviewed, consistently finding a vital role of speed in road trauma [1–7]. This article does not re-review this evidence. Rather, instead of the typical focus on the mean of outcomes, this article is focused on the reasons for, and implications of, the large range in outcomes found in evaluations of speed enforcement.

One of the key mechanisms by which speed is managed across almost all countries is enforcement (see the World Bank [8] for a review for low- and middle-income countries, with evaluations cited below reporting many examples mostly from HICs), with road engineering and vehicle technologies also commonly employed [9]. Many countries have speed-camera numbers in the thousands (Brazil, France, Germany, Italy, Sweden, the United Arab Emirates, and the United Kingdom). A large body of evidence points to the benefits of speed enforcement with evaluations of various forms of enforcement showing lives and injuries saved and crashes avoided (for reviews and meta-analyses, see [7,10,11]). Multiple evaluations show that fixed speed cameras deliver savings of lives and injuries [7,12–15], with similar safety successes for mobile speed cameras [16–18] and for average speed cameras or section control [11,19]. In addition, reducing camera numbers or turning them off (with the community knowing or becoming aware of the reduced risk of detection) leads to increases in speeds and crashes [20,21]. There are also studies of increased police enforcement of speeding, which show strong safety benefits [22,23]. However, studies of police enforcement tend to be less common, for several reasons. First, such enforcement

has occurred for many years, and so there is no discrete start time allowing clear before-to-after analyses. Second, evaluations of police enforcement are less able to specifically identify locations in order to evaluate benefits. Finally, police enforcement influences many elements of driver behaviour, and thus pure effects of speed enforcement are difficult to evaluate. Similarly, combined red-light running and speed cameras were not included here because these enforce red-light disobedience as well as speeding, and thus the pure benefits of speed enforcement cannot be determined. For these reasons, the present article considers only evaluations of speed cameras of various forms.

One challenging feature of this body of evidence is that the range of the beneficial outcomes (lives, injuries, and crashes saved) in evaluations is sometimes substantial. For example, Wilson et al. [7] presented a methodologically rigorous review of the evidence on speed cameras. They conclude: "Despite . . . . the variability in degree of signal to noise effect [effect of cameras versus other variations], the consistency of reported reductions in speed and crash outcomes across all [methodologically rigorous] studies show that speed cameras are a worthwhile intervention for reducing the number of road traffic injuries and deaths." They identified 28 studies that met the requirements for inclusion as methodologically sound evaluations. All 28 studies found a lower number of crashes in the speed-camera areas after implementation of speed-camera programs but with significant variation in the strength of the effects. In the vicinity of camera sites, the reductions ranged from 8% to 49% for all crashes, and for crashes resulting in fatalities or serious injuries the reductions were in the range of 11% to 44%. The effects over wider areas showed reductions for all crashes ranging from 9% to 35%, and for crashes resulting in death or serious injury reductions ranged from 17% to 58%. Studies reported since this review was undertaken showed an even wider range of outcomes. One study [24] reported a small (non-significant) reduction in fatal crashes in Saudi Arabia associated with mobile speed cameras, and another [4] found a 89% reduction in fatalities around fixed speed cameras in New South Wales, Australia.

This large range of outcomes is the focus of the present article because of the important potential implications of this range of findings. First, evaluations of the extent to which managing speed reduces the numbers of deaths and injuries provides a guide to the extent of the contribution of speeding to serious crashes, addressing a question that is not readily answered from other data sources including crash data in which the under-estimation of speeding is well recognized [25]. Second, the range of outcomes invites scepticism about the benefits of enforcement and a focus on the rare studies showing small effects, especially in a context in which political decision makers are often more inclined to push for personal responsibility as a solution rather than systemic action on their part (for examples, see [26,27]). The media can be negative about speed enforcement, presenting it as motivated purely by revenue raising but without presenting evidence that this is the motivation, just evidence that revenue is raised, and often ignoring the evidence that lives and injuries are saved [28,29]. Given the media's common approach to speed cameras, it is not surprising that the community has mixed views of enforcement and the role of speed. However, often a clear majority of the community agrees that higher speeds create more risk of crashing and supports speed enforcement [30]. These voices are less likely to be presented in the media. Reporters have told the author directly and in confidence that they attacked the speed camera aspect of government policy as revenue raising because that government was performing poorly on the economy or for various other reasons not related at all to speed cameras.

In this context, it is important to appreciate key reasons why evaluations of enforcement interventions, in particular, may generate a wide range of outcomes. In addition, underlying factors in the extent of benefits achieved assist in identifying best practices in speed enforcement to maximise the lives and injuries saved. Thus, this article explores the reasons for the large range of outcomes of evaluations of speed enforcement. This article has two purposes: First, it offers explanations of this wide range of outcomes from automated

speed enforcement, and, second, it considers the implications of these explanations for the real effects of speed cameras as enforcement tools and for evaluation methods.

2. Causes of the Wide Range of Outcomes

The scientific literature and core logic identify a number of factors contributing to the range of beneficial outcomes observed in evaluations of speed cameras. These can usefully be divided into explanations of a range of real effects of speed cameras, and variations of key features of evaluations.

2.1. Causes of a Range of Real Effects of Speed Cameras

Eight broad features of speed cameras and the circumstances of their implementation can substantially influence the extent of safety benefits observed, as described below.

1. *The extent/intensity of camera enforcement deployed*: The number of fixed speed cameras installed and their concentration (measured, for example, as cameras per 100 km of road) will influence the extent to which drivers slow down and thus the extent of safety benefits achieved. For example, installing one fixed camera on a 30 km road is not likely to have as much impact as installing a camera every 2 km along that road. One study [14] specifically examined this issue in an evaluation of speed cameras in the UK, finding that multiple camera sites (sites with cameras in close proximity) produced larger crash reductions than did single-camera sites. The numbers of cameras in the study were so large as to allow for analysis of the ideal distance between cameras. Multiple speed camera sites are found to be most effective with a radius of 200 m between cameras with injury crashes reduced by 21.4% more than the reductions achieved by single cameras. There was still a benefit at a radius of 300 m, with a reduction that was 13.2% more than single-camera locations. Mobile-speed-camera intensity can be measured in terms of hours of enforcement operation for a set region, state, etc., and this influences lives and injuries saved. For example, mobile-speed-camera hours of operation were doubled in Victoria, and this was associated with a significant additional reduction in crashes. However, this evaluation is confounded by other relevant policy changes made during the study period [31].
2. *The type of cameras deployed and their visibility*: Fixed speed cameras inevitably focus on suppressing speed at specific locations, whereas mobile-camera programs are often implemented with the aim of a broader suppression of speeding across the road network or large segments of it through less predictability of enforcement location than for fixed cameras. This changes the focus of programs for evaluation purposes and influences the extent of driver judgement of the risk of detection. For fixed cameras, the risk of detection and punishment approaches 100% at camera locations, and thus suppression of speeding is substantial but quite location-specific, especially if camera locations are signposted ([32] and see Figure 1). On the other hand, a (hypothetical) program of 50 mobile cameras operating across a state with 300,000 km of road means that even if the cameras are operating 100% of the time, only 1 in every 6000 km of road contains a mobile camera, and thus the percentage reduction in speed and in deaths and injuries might reasonably be smaller. However, such programs remain vital because the effect is spread over a much larger area, capturing benefits of smaller percentage reductions of much larger baseline numbers of deaths and injuries. For example, Table 1 compares two evaluations reported from the state of New South Wales, Australia, highlighting that the much higher percentage reduction in deaths for fixed cameras did not save as many lives as the smaller percentage reduction achieved by the re-introduction of a state-wide mobile speed cameras program.

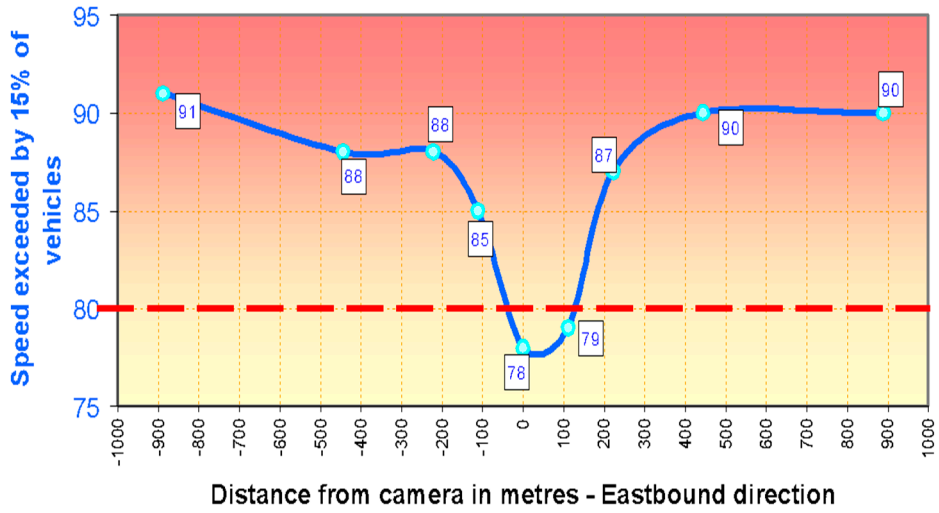

Figure 1. A typical result for speeds around visibly signposted fixed cameras, showing common speeding on approach and departure from the camera, with drivers reducing speeds around the camera. (Source: Job, 2013 [32].)

Table 1. Comparison of percentage reductions and absolute numbers of lives saved through mobile and fixed speed-camera program introductions in New South Wales, Australia.

Camera Program Type	Source	Evaluation Location	Percentage of Lives Saved	Estimated Absolute Number of Lives Saved (Extrapolated over 5 Years in Both Cases for Comparability)
Fixed Speed Cameras	Job and Sakashita, 2016 [4] Job, 2013 [32]	Black-lengths of road treated at each fixed camera location (n = 28)	89%	25
Mobile Speed Cameras	Job, 2013 [32] with additional data from NSW Centre for Road Safety, 2012 [33], for annual comparisons	Entire state of NSW	11%	240

Similarly, an evaluation of mobile versus stationary police car enforcement showed that the spread of the effect of mobile enforcement was greater [22].

3. *Camera Visibility and Signage*: The efficacy of camera programs also depends on the visibility of the cameras, with the combination of visible and covert mobile camera enforcement shown to be more effective than visible only [18]. Average speed cameras (also called section control or point-to-point) may be an exception to this, because they aim to address speeding along a designated length of road over which they operate, delivering strong benefits in these sections [11]. The sections may be long, and thus average speed cameras already manage speeds along significant proportions of the network. For example, average speed cameras in the state of New South Wales, Australia have lengths over 60 km long, though unfortunately the political decision to limit their enforcement to heavy vehicles significantly retards their safety benefits.
4. *The extent to which speeding is occurring*: Automated speed enforcement treats the risks of travelling at a speed above the posted speed limit. Thus, the benefits obtained from speed cameras will depend on the extent to which drivers are travelling above the speed limit. If this is quite rare in a given location, then speed enforcement of that location is not likely to deliver substantial safety benefits.

5. *The extent to which serious crashes are occurring:* Inevitably, speed cameras can only reduce serious crashes at maximum to the extent that they are occurring on the roads on which speeds are influenced by the enforcement. The extent of speeding and the extent of crashes are often combined to select speed enforcement locations based on identified serious crashes involving speeding. However, based on the substantial extent to which speeding is missed as a factor in crash reporting [25] this will greatly under-estimate the extent of speeding in serious crashes.
6. *The size of the enforcement tolerance*: This refers to the margin above the prescribed speed limit within which motorists will not be cited for a speeding violation [34]. A tolerance level is ideally used to account for factors such as inconsistent vehicle speedometers (a less-concerning factor in recent decades, with speedometer accuracy being better regulated) and the calibration of speed-detection equipment. However, enforcement tolerances sometimes become a political tool damaging road safety benefits of speed enforcement. For example, when the Government of Poland legislated a large enforcement threshold this was widely publicized as creating *de facto* speed limits well above the posted limits, with Poland suffering from high proportions of vehicles travelling above the speed limit [35]. Community surveys show awareness of speed tolerances [36].
7. *The benefits of any enforcement, including automated speed cameras, depend on a chain of key enforcement processes*: The chain of events required for enforcement to be effective must deliver swift, unavoidable, and deterring sanctions. This chain includes a sufficient penalty to deter; enforcement and judicial mechanisms by which the penalty can be applied in a timely manner, and minimal avoidance through corruption; and community belief that these features exist [34]. Thus, many aspects of the chain of processes to deliver these features of success can be strong or weak, and these features will influence the extent to which a speed-camera program can deliver safety benefits. For example, implementing a speed-camera program is likely to have limited benefits if: there is no visible public communication or campaign with the community to promote general deterrence [35,37,38], if the penalty can be ignored or substantially delayed or avoided through corrupt means, or if the community believes one or more of these problems to be the case [35,39,40]. Typically, the extent of any of these features is not provided in evaluation studies of speed cameras, and thus the extent of their limiting effects on benefits is not known. However, such factors are sometimes reported. For example, Alamry and Hassan [24], who reported the only study cited in the present article that found no benefits of speed cameras, noted problems with the private operator's selection of camera locations in Saudi Arabia. Additionally, Saudi Arabia has significant corruption challenges to manage [41,42].
8. *The benefits of speed cameras depend on critical logistics:* Required logistics for an effective speed-camera program include vehicles mostly being registered and carrying legible number plates allowing the cameras to detect and record them, registration records that allow for identification of the driver/owner for communication of the penalty, and a maintenance regimen to keep the cameras operating [34]. As an example, Santos et al. [43] reported significant safety benefits of speed cameras in Portugal but noted that the benefits weakened over time, which is an atypical result [7,19]. Santos et al. noted that this was due to problems with ensuring that the penalties were applied ("inefficient sanctioning") and malfunctioning equipment not being repaired in a timely manner, which was evident to road users.

2.2. Variations in Key Features of Evaluations

In addition to the above set of issues that influence the extent to which speed cameras deliver safety benefits, various features of the evaluations themselves influence the extent to which benefits are identified. Four substantive features of speed-camera evaluations, which may add to the range of outcomes identified by significantly influencing the extent to which benefits may be identified, are described below.

1. *Locations (lengths of road) employed as treated by the cameras*: The lengths of road employed as treated by the cameras vary from study to study. For example, Santos et al. [43] evaluated cameras over a 150 m distance from the camera; Quistberg et al. [44] used speed data only at the cameras; De Pauw et al. [45] used a 500 m distance; and the study noted by Job and Sakashita [4] of fixed speed cameras in New South Wales, Australia examined the benefits of the cameras to treat the length of blackspot/section in which the camera was placed, which varied in length with some over 1 km long. This will influence the percentage reductions in crashes, injuries, and deaths, because speed reductions are stronger in closer proximity to cameras or likely enforcement locations (see Figure 1 for an example from a visibly signposted fixed camera). Because greater reductions in speed deliver greater reductions in deaths and injuries [2,5], those evaluations that are concentrated closer to the cameras are likely to demonstrate higher percentage reductions in serious crashes. Similarly, the safety benefits of mobile cameras will vary with the road asserted to be treated, from nearby the enforcement locations to the entire state or province [16]. Keall et al. [18] reported results in sufficient detail to allow a check of this effect for mobile cameras: they reported evaluation data for the mobile-speed-camera areas and the broader road network on the region being targeted, finding that casualties (people killed or injured) were reduced by 19% across the broader network but 29% in camera areas. Evaluations based on the broader (such as state-wide or across a large section of the road network) effects are likely to show smaller percentage reductions but greater absolute numbers of serious crash reductions (because these evaluations are capturing the broader area-wide benefits of less-predictable enforcement, which can cause a general suppression of speeding, especially if much of the mobile camera operation is covert) [18].
2. *Study design variations on control groups and the extent of spillover (halo) effects*: A spillover or halo effect is where an intervention creates an effect over a broader area than is treated. So, in these cases, the spillover is that the enforcement in a specific location creates greater compliance in nearby locations as well. These occur in road policing generally [46] and can be strong for evaluations of speed cameras [16]. Spillover effects are of course desirable and sought in a practical sense in that they mean that the benefits of the cameras are spreading more widely than just the camera-enforcement locations. However, this can result in under-estimates of the benefits of cameras, by creating improved safety outcomes in control locations, and thus reducing the apparent difference between treated and control locations. Some studies report an appreciation of this, but many do not use control locations near the treated locations. Chen et al. [47] noted a strong spillover of benefits to their intended control locations and thus revised their study design.
3. *Statistical testing employed*: Statistical analyses employed vary from direct before-to-after comparisons to log-linear modelling [48], to methods for controlling for trends and regression to the mean [49], such as inclusion of reasonably matched control groups, Bayes evaluation [12], and time-series analyses with controls [49]. The risk of regression to the mean effects are also reduced by including longer periods of pre-enforcement data, which add to the statistical power of the evaluation and reduce the risk that effects observed are due to recent (quasi-random) increases in serious crashes at the location just prior to enforcement.
4. *Confounding factors*: Confounding may arise from different sources, such as the influences of the COVID-19 pandemic on travel patterns, which could confound evaluations going on at the time. Government policies and programs other than speed cameras may be introduced at the same time as the cameras or at a critical stage in the evaluation process. However, there are two mechanisms by which these may be controlled to avoid them confounding an evaluation. First, the use of control groups allows extraneous factors to be controlled out, because these factors, such as COVID-19 or a significant change in the economy, will influence safety at the control locations

as well as at the treated locations. However, confounding factors may occasionally still create concerns despite control areas, if they are local to specific areas and thus may occur in the trial area but not in the control area, or in the pre-camera phase and not the post-camera phase. For example, Keall et al. [18] noted that a local drink-driving campaign occurred in part of the trial area risking a confounding. However, the drink-driving campaign mainly ran during the pre-change period, and thus any safety benefits of the drink-drive campaign would reduce the apparent safety value of the speed-camera change being evaluated, not enhance it. Second, in some enforcement trials, the crash causal factors can be used to select out the effects of policies on particular causal factors—for example by considering only drink-driving-related crashes and fatalities. However, in the case of speed, this is not likely to be effective because of the recognized difficulty of identifying speeding in crashes [25,50]. Such factors are often noted by researchers (and are noted herein), such as the changes made in the state of Victoria, which accompanied the increase in mobile-camera operating hours. Finally, other changes may be caused by the instillation of the cameras. For example, police are likely to reduce their enforcement activities around camera locations moving these efforts to other locations. This may result in reducing the impact of the cameras and creating more improvement in the control location, which may then have a greater police presence.

3. Recommendations

This review highlights factors that result in weak or powerful safety benefits being generated by speed-camera programs and being detected in evaluations. The recommendations arising from this review are presented here.

3.1. Recommendations to Maximise the Safety Benefits of Speed-Camera Programs

1. The identified wide range of outcomes should not be interpreted as indicating an inherent unreliability in the safety benefits of speed cameras. This review indicates that this wide range arises from various factors of implementation of camera programs and of evaluations processes.
2. Consideration of the range of safety benefits seen in evaluations of cameras is an important guide to decisions to implement speed cameras as well as related policy decisions. Many of the factors influencing the wide range of outcomes of speed-camera programs are predictable from systematic features of a country or state, and thus the likely real value of implementing a speed program can be predicted on the basis of features such as the level of corruption, the efficacy of speeding penalties, the generally effective registration and identification of vehicles, as well as administrative and judicial systems that ensure timely payment of penalties. The decision to implement speed cameras should include consideration of these system features. In jurisdictions in which the many factors influencing the extent of benefit are well managed, the upper end of the range of detected benefits may be a better predictor of outcomes than measures such as the mean outcome from many evaluations. Conversely, where many factors influencing the extent of benefit are poorly controlled then fewer safety benefits can be expected.
3. Selection of enforcement locations is vital and influences the extent of safety gains achieved. Cameras treat speeding, and thus the best locations include long lengths of road or networks of roads for treatment where both speeding and serious (injury and fatal) crashes are common. These combined criteria are superior to seeking locations where speeding-related crashes are reported, because the latter are clearly underreported in crash databases. For similar reasons, narrowing evaluation outcomes to speeding-related crashes will also miss many actual speeding crashes. This review of the range of safety benefits reported in evaluations of speed cameras also provides further support for practices supported by other evidence. For safety benefits, these include:

4. The range of safety benefits from camera programs is contributed to by the breadth of influence achieved. Unpredictable enforcement (such as programs including unmarked mobile cameras) deliver gains over wider areas due to halo (or spillover) effects but lower percentage reductions in serious crashes. Unmarked cameras are recommended because they save more serious crashes because of the breadth of their impact across more kilometres of road. Having all visible automated speed enforcement invites the view that drivers can speed but avoid detection by slowing down when they see a camera or signage ahead, thus damaging both general and specific deterrence, and this reduces observed benefits beyond the known speed-enforcement positions.
5. Effective enforcement maximises general deterrence as well as specific deterrence, which requires a chain of processes to ensure that enforcement delivers swift, unavoidable, and deterring penalties for the unsafe behaviour, and the target community must believe this is the case. The chain is as strong as its weakest link: if the penalties issued are not deterring and if the penalty is readily avoided (or the community believes that it is), then adding more enforcement will not be effective. Surveys of community attitudes and beliefs are important in designing enforcement programs and communications so that the weakest links and the relevant beliefs of the community are known and addressed as appropriate in program development.
6. Speed-camera programs are more effective if preceded by strong communications (likely including paid campaigns) to ensure that the community knows the change is coming, as established in the existing literature. This increases the efficacy of the enforcement by facilitating general deterrence and the desired behaviour change as well as increasing community acceptance of fairness and openness. If the added enforcement is not known to the community, then the additions are relying on the impacts of specific enforcement without capturing the typically much larger benefits of general deterrence. This review highlights that such factors should be considered not only in planning for speed cameras but also in interpreting the outcomes of evaluations of camera programs.
7. Evaluations reveal that the benefits of camera programs are influenced by the size of the program. Thus, the implementation of a significant program of cameras, not a small number, adds to the safety benefits of the cameras.
8. The size of the enforcement tolerance influences the extent of real benefits of speed-camera enforcement. Low enforcement tolerance allows speed enforcement to be more effective, whereas high tolerance send a message that speeding is really acceptable and that speed limits are not appropriate because higher speeds are accepted.

3.2. Recommendations for Evaluations of Speed-Camera Programs

1. The wide range in camera evaluation outcomes is contributed to by several features of evaluation design. It is recommended that these be precisely considered in designing an evaluation in order to address the factors identified in this review. These include:
    a. The extent of detected benefits is greatly influenced by the locations over which the cameras are assumed to treat speeding. Evaluation locations should be chosen to match the aims of the camera program, especially in relation to targeting speeding at the camera location versus a wider network effect. It is most useful to evaluate both these possibilities in evaluations.
    b. The inclusion of control locations (ideally matched to enforcement locations) has significant advantages in controlling for trends and broad confounding factors. However, judgement is required in the selection of control locations to ensure similarity but to avoid the risk that the control locations benefit from a spillover (halo) effect, which thus damages the detection of benefits. This judgement should be evidence based, with the spillover effects of various types of enforcement programs known. It is also recommended that evaluations

consider including larger and more-distant control areas so that the extent of a spillover benefit to closer control locations can itself be assessed.

2. The range of outcomes is influenced by the outcome measures reported. Evaluations should report both percentage changes and absolute changes in serious crashes or casualties. This allows a full picture of outcomes and avoids the risk that higher percentage changes are seen as inevitably saving more suffering, whereas in reality programs that achieve a lower percentage reduction over a much broader area will typically save more lives and injuries.
3. It is also recommended that evaluations assess changes in speed and crash outcomes around camera locations as well as over the wider areas that may be influenced by the program. Thus, both local and broader influences are reported, which will help to build a better knowledge base of the breadth of effects of speed cameras. The reporting of both local and broader effects is currently rare in evaluations.
4. Many factors influence the extent of safety benefits achieved by speed cameras (the level of corruption and the penalty availability, the deterrence value of penalties, the percentage of vehicles that are registered and identifiable via the cameras, the extent of any communications campaign accompanying the cameras, etc.), yet these are rarely reported in evaluation studies. None of the studies reviewed in the article systematically reported these factors. The reporting of these factors is recommended, to allow a greater understanding of the factors influencing the benefits obtained from cameras and the building of a body of studies for systematic analysis of these factors in predicting the extent of benefits achieved. This review of the range of safety benefits reported in evaluations of speed cameras also provides further support for practices supported by other evidence. For evaluations, these include:
5. Randomized control trials have become recognized as the single gold standard for evaluations. While it is inappropriate that this is recognized so singularly (compared with matched controls and other rigorous methodologies), these are rare in evaluations of speed enforcement, and it is important that such studies of speed cameras are undertaken.
6. The extent of detection of benefits from speed cameras may be confounded by associated changes in police activities. It is important to work with police to avoid confounding factors such as reduced police enforcement in areas treated with cameras.

4. Conclusions

The data irrefutably demonstrate that speed-camera programs reduce speeds and reduce road-crash trauma. However, evaluations of these programs produce a wide range of outcomes from dramatic reductions to small (sometimes statistically non-significant) improvements.

This review identified various factors as influencing the extent of real benefits of cameras and the extent of their detection in evaluations. Overall, these are more likely to cause under-estimation of the potential value of speed cameras for safety rather than over-estimation, which is especially concerning in relation to the many weaknesses in the enforcement chain that are likely to limit the benefits of camera enforcement. The meta-analysis reported by Elvik et al. [10] selected studies for methodological soundness and found an overall decrease of 16% in the number of injury crashes and a 39% decrease in fatal crashes. However, such meta-analyses are likely to under-estimate the potential benefits of well-targeted deployment of speed cameras, because these analyses include evaluations of programs weakened by various factors. Thus, consideration of the range of safety benefits of cameras is an important guide to policy, in addition to the more common measures of a central tendency such as the mean.

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