



REVIEWS

MAKING SENSE OF BODY-WORN CAMERAS AS A VIOLENCE PREVENTION TOOL FOR AMBULANCE STAFF: REFLECTIONS AND POLICY IMPLICATIONS FROM A NON-SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Body-worn cameras (BWCs) were introduced for ambulance crews in England in 2021 as part of a package of responses to rising rates of abuse targeted towards ambulance crews by members of the public. As part of an evaluation of the effectiveness of BWCs as a tool for reducing occupational violence, we produced a non-systematic literature review to examine the real-world outcomes and cost-effectiveness of BWCs in a variety of settings. We also examined research on BWCs and other forms of surveillance being adopted in the healthcare sector in the UK, such as CCTV and vision-based patient monitoring and management systems (VBPM). Our review identified minimal literature relating to surveillance and BWCs in the ambulance sector. While there is considerable evidence relating to BWCs and violence prevention more generally, much of it is poor quality, anecdotal, and focused on specific professions with limited scope for making generalisations. There is some evidence that BWCs have, in combination with other measures, the potential to address violence and abuse directed towards ambulance staff. However, it is not a stand-alone technological fix and because its impact is mediated by other factors, any cost-benefit analysis should be treated with care. The literature is unclear about the underlying mechanisms through which BWCs might support violence reduction, and it is likely that any benefits will be mediated by the complex and unpredictable environment in which BWCs are being used, which is likely to have strong independent effects on outcomes. The more that BWC research is able to explore such mechanisms in detail to inform our understanding of how and under what conditions specific outcomes are observed, the more we will be able to make sense of the variable findings produced in this area to date.

This paper presents the findings of a non-systematic literature review produced as part of an evaluation of body-worn cameras (BWCs) commissioned by NHS England and the London Ambulance Service, concluding in 2024. BWCs were introduced in England in 2021 to address increasing abuse against ambulance crews, with physical assaults on staff rising by 30% between 2016 and 2021 (NHS England, 2021).

Healthcare organizations are increasingly introducing BWCs and other electronic monitoring tools like smart glasses, CCTV, and camera systems for buildings and response vehicles, GPS monitoring, and vision-based patient monitoring and management systems (VBPM) which track movements and monitor health functions (Foye et al., 2024; Griffiths et al., 2024; Sumner et al., 2024). Despite rising adoption, the evidence about the real-world outcomes and cost-effectiveness of these technologies is limited. This commentary examines how and why BWCs are being implemented in the ambulance sector before drawing on evidence relating to a range of sectors and technologies to identify lessons and policy implications. While primarily relevant to the ambulance sector, these insights will be of interest in relation to evaluation and impact studies of the use of cameras in healthcare more generally.

Our review found minimal research in the ambulance sector. The most substantial piece, a rapid review produced by Charles Stuart University for a concurrent evaluation of BWCs in the New South Wales ambulance service, identified no studies relating to ambulance staff and few independent external studies more generally. Noting that BWCs can ‘have many unintended or unexpected consequences,’ the authors called for a broader understanding of the costs and benefits of BWCs and stressed the importance of contextual factors like training and camera design (Bamberry et al., 2022). Our commentary builds on this review alongside new literature and prior work on mechanisms of camera operation, and a consideration of the costs and benefits of BWCs in relation to wellbeing and criminal justice outcomes. It also incorporates findings from a growing body of work on surveillance and monitoring in healthcare, including recent research on their use in mental health and acute wards in the UK.

That the England and New South Wales Ambulance evaluations are taking place on opposite sides of the world points firmly to the international relevance of this topic: with BWCs treading a similar path to CCTV as it moved from niche technology to near ubiquity, their use in healthcare is likely to expand significantly along with other forms of monitoring (Graham, 2002). Research indicates that BWCs, like other kinds of monitoring, are likely to produce variable outcomes depending on a variety of contextual factors, hence it is imperative that policy-makers seeking to implement these programs understand the potential nuances and design programs to adapt around them.

THE HISTORY OF BODY-WORN CAMERAS

BWCs were first used by police in the UK and Australia in the 2000s, but did not see widespread adoption until the following decade (Lum et al., 2020). Their use by police in the US is estimated to have doubled between 2013 and 2018, primarily in response to high-profile killings of unarmed black individuals by white police officers, and related public campaigns such as the Black Lives Matter movement which drew attention to racial inequality and the need for accountability in US policing (Hansen Lofstrand & Backman, 2021; Lum et al., 2020). In 2014, the Obama administration announced a \$75 million BWC program which it hoped would promote trust and reduce the wrongful use of force by police officers. While in some departments these changes had to be enforced via court order and decree, uptake was also supported by officers who believed BWCs could protect against false complaints and counter narratives produced by public recording of officers (Houwing & Eck, 2020; Lum et al., 2019). This reflects uncertainties in the evidence despite the proliferation of BWCs: by 2013, only five evaluation studies had

been completed (White, 2014). Failure to address key questions about who the cameras should be monitoring, why, and whether this would have the desired consequences, has led to BWC implementation being termed a ‘worldwide uncontrolled social experiment’ (Ariel et al., 2016).

Echoing the expansion of CCTV in the 1990s, BWCs have been implemented or trialled for use by social control professionals in countries including Canada, Mexico, Israel, Germany, and Finland (Laming, 2019). In a process of ‘surveillance creep’ (Leleux & Webster, 2020), the approach has expanded to encompass new goals, users, and subjects. This can be seen in the adoption of BWCs in the retail sector, by parking wardens, and other professions where users may be exposed to occupational violence (Bamberry et al., 2022; Marx, 2005). In the UK, BWCs and other kinds of surveillance are increasingly used in emergency departments and mental health units (Foye et al., 2024). Although these implementations share the primary use of BWCs as a violence prevention tool, the evidence for this is often minimal or non-existent.

HOW BODY-WORN CAMERAS WORK

Two mechanisms have been used to explain how BWCs can prevent violence.

Self-awareness theory posits that there is a state of objective self-awareness, in which one perceives oneself as an individual distinct from others and assessing how their actions correspond with their values. To avoid self-conflict, it is suggested that individuals in this state behave in line with their values. This state can be triggered by human observers and also by mirrors and cameras. It follows that BWCs could prevent violence by causing those observed to be more self-aware and behave in line with their own values (Choi et al., 2023; Patterson & White, 2021).

Deterrence theory states that punishment will deter people from committing crimes, particularly where the likelihood of being caught and the severity of punishment exceed the benefits. If BWCs increase the likelihood of punishment or prosecution for abuse or violence caught on camera, it follows this will reduce the likelihood of these behaviors (Choi et al., 2023; Patterson & White, 2021).

These elements underpin the assumption that BWCs have a ‘civilizing effect’ on either the wearer or subject. In assessing this effect, most research in the field has focused on metrics such as use-of-force, self-reported rates of violence, and complaints (Choi et al., 2023).

Nonetheless, the impact of these elements on the subject is highly situationally dependent, particularly on whether the subject is aware of the camera. When Assaraf and colleagues trialled a yellow sticker with a “VIDEO & AUDIO logo” on police BWCs in an RCT, it was correlated with an increased use-of-force by police officers. The authors suggested BWCs were more likely to be perceived by members of the public as a threat to their autonomy, resulting in an escalation and then use-of-force by the wearer (Assaraf et al., 2024).

EVIDENCE ON WEARER BEHAVIOR

Evidence relating to use-of-force forms the overwhelming majority of research conducted on the impact of BWCs on wearer behavior. However, based on the papers reviewed,

there is limited evidence to suggest that BWCs have consistent or statistically significant effects on wearer behavior.

Lum and colleagues examined 111 sub-studies within 70 articles, of which 32 concerned officers behavior measured through complaints or use-of-force. While officers wearing cameras appeared to receive fewer complaints, it is difficult to determine if this was because of changes in behavior or because BWCs deter the public from making complaints. Findings on use-of-force were also inconclusive, with a higher proportion of studies producing non-significant findings (Lum et al., 2019). While it has been suggested that discretion in turning on the camera is related to use-of-force, an RCT on the impact of activation on outcomes of officer-citizen interactions found activations were associated with a lower likelihood of contacts and complaints, and a greater likelihood of arrests and use-of-force (Huff et al., 2020). A further meta-analysis examining 30 different studies lends support to the conclusion that while BWCs have statistically significant impacts on complaints against officers, they do not seem to have a consistent impact on use-of-force, arrest behaviors, or officer-initiated proactivity (Lum et al., 2020). Another review which extended this meta-analysis with two additional studies found larger and more precisely-estimated reductions in complaints and use of force, but which were still not statistically significant (Williams Jr et al., 2021).

EVIDENCE ON SUBJECT BEHAVIOR

The scope of work on subject-behavior in relation to BWCs is smaller and while it captures other settings such as healthcare and transport, it fails to produce definitive or generalizable findings. The aforementioned meta-analysis by Lum et al. found no impact of BWCs on assaults against police officers. Although three studies from the UK suggested that visible BWC may reduce antisocial disorder and other crimes, a later quasi-experimental study reported no deterrent effects (Lum et al., 2020). Reviewing five studies looking at assaults on officers in law enforcement (including traffic wardens and prison guards), Wilson found that three reported no significant change, one reported no statistics, and one reported a statistical difference contradicted by an earlier study reporting an increase in assaults against officers (Wilson et al., 2022).

Some studies reported on other settings. For example, Ariel et al. found a 47% reduction of violence against BWC-equipped train station staff versus control locations, and a 26% reduction in assaults against employees in treatment versus control locations (Ariel et al., 2019; Wilson et al., 2022). While these findings are positive, they have yet to be corroborated. Two further studies on the mental health sector in the UK reported increases and decreases in violence, with variation between wards and some evidence of a reduction in serious incidents and the use of restraints. Nonetheless, there were methodological problems with both studies which call into question the quality of the evidence (Wilson et al., 2022).

Evidence on the impact of other surveillance technologies on subject behavior was similarly inconsistent. For example, there is evidence that CCTV increases or decreases crime dependent on the context, with no statistically significant effect observed for violent crimes or disorder (Simpson, 2023). A recent review of various technologies in inpatient and acute mental health settings found that there was insufficient evidence to confirm that outcomes are achieved, with limited published evidence or best-practice guidelines.

Qualitative interviews with patients and staff identified some benefits (e.g. improved patient and staff safety) but also raised concerns about the dignity and privacy of patients and the potential impacts on the therapeutic relationship (Griffiths et al., 2024).

Our review did not identify any studies on the impact of smart glasses or ambulance-fitted camera systems on the behavior of the subject. One mixed-method study examined the use of smart glasses in urgent care but with findings related to communication and workflow rather than patient behavior (Sumner et al., 2024). Similarly, another study found that smart glasses improved patient care time in the ambulance, suggesting that the glasses would 'support more effective patient evaluation, diagnosis, and treatment with reduced duration of time' (Apiratwarakul et al., 2023).

This leaves us without a clear sense of whether BWCs and other technologies deter violence from members of the public. This may say less about BWCs themselves than it does about the 'evaluability' of the technology. As Choi and colleagues argue, whatever 'civilizing effect' BWCs have will be modified by factors including geographical psychology, civilian stress, and attitudes towards police (Choi et al., 2023). Many civilians may not even be aware that a BWC is being worn or that it has been activated (Pezdek, 2022). Compounded by the impact of methodological issues such as low base rates and contamination, we would expect the complex context to produce ungeneralizable findings.

While most existing research has examined the impact of BWCs on wearer and subject behavior in discrete terms, the landscape appears to be moving towards an understanding of these elements as being connected. This can be seen in Assaraf and colleagues' work on BWCs and awareness, and Pezdek's recent chapter on the psychology of BWCs which suggests that officer behavior mediates the effect of the BWC on civilian behavior, which then determines whether force is applied (Assaraf et al., 2024; Pezdek, 2022). Finally, Drew and colleagues conducted interviews with 25 paramedics following patient-initiated violence and emphasized the paramedic-patient relationship in understanding violence against ambulance staff. The authors suggest that focus on soft skills and recognition of factors which can impact hostility in paramedic-patient interactions (e.g. fatigue, job demands) could result in improved patient care and reduce violence (Drew et al., 2024).

COSTS AND BENEFITS OF BWC

Our review found no primary studies on the costs and benefits of BWCs in the ambulance sector. This remains an under-represented area, possibly because the political context of implementation has contributed to trials not publishing data. 19 out of 52 studies examined in one review reported funding sources, with law enforcement accounting for 80% of those with undeclared funding (Wilson et al., 2022). Assessing the relative benefit of these programs through techniques like cost-benefit analysis or social return on investment (SROI) is challenging because our understanding of the impact of BWCs on behavior is still unclear, and many of the potential benefits of implementation are intangible (Poirier et al., 2023). Even if we can measure the costs of introducing BWCs, if we cannot measure direct benefits, we should be cautious about identifying cost-benefit ratios or even cost-consequence analyses.

A recent review of surveillance technologies in inpatient and acute mental health settings found that only two studies explored cost-effectiveness: one found that GPS mon-

itoring in an inpatient setting did not significantly increase costs, while one reported cost-savings resulting from VBPM (vision-based patient monitoring and management) use. Nonetheless, these analyses did not consider costs such as maintenance and training or downstream costs incurred from the impact of surveillance on outcomes (Griffiths et al., 2024).

Other estimates exist for outcomes relating to policing, such as a study involving the Las Vegas Metropolitan Police which reported net savings of between \$2,909 and \$3,178 per user per year due to fewer complaints of misconduct and violent incidents, and higher rates of arrest leading to more fines being dispensed (Braga et al., 2018). By contrast, the contributors to savings or return-on-investment in the ambulance sector are likely to be in relation to wellbeing or more effective prosecution in cases of violence or abuse. While there is no primary evidence on costs to draw from in relation to these areas, we can assess the potential wellbeing impacts of BWCs and their use for evidentiary purposes to ascertain whether we can expect BWCs to produce cost-savings or benefits.

EVIDENCE ON WELLBEING

One reason for BWC implementation is the belief they will improve the wellbeing of staff, either by reducing the risk of violence or abuse, or by increasing feelings of safety and institutional support. This could deliver significant cost-savings by reducing turnover of staff and sick-leave or presenteeism relating to mental health and experiences of abuse. However, the implementation and evaluation of BWCs has given only limited attention to questions about the work environment. Lofstrand and colleagues found five out of 90 articles examined tackled work environment-related issues directly, with 54 presenting no relevant results. The authors attributed the lack of research to the dominant rationale for implementation in many countries: to deter use-of-force by police through control and heightened monitoring (Hansen Lofstrand & Backman, 2021).

There is some indirect evidence of the positive impact of BWCs on wellbeing. In an RCT of train stations in England and Wales, Ariel and colleagues identified a 47% overall reduction in assaults against BWC-equipped staff at treatment versus control locations, and a 26% reduction in assaults against all employees at treatment versus control locations. Assuming one physical assault at work leads to 5.58 lost days, Ariel concludes, these reductions would represent the prevention of 4,928 and 2,728 working days per year lost respectively (Ariel et al., 2019). Nonetheless, these findings have not been corroborated for other sectors and do not consider whether long-term benefits of BWCs are offset by negative impacts.

Such negative impacts could include consequences for workplace culture or wellbeing. Adams and Mastracci located a statistically significant positive relationship between BWCs and officer burnout, potentially by decreasing officers' sense of management support and enforcing social norms related to negative emotional expression (Adams & Mastracci, 2019b, 2019a). However, there is also evidence that the social context of the workplace moderates against the impact of BWCs and that a 'positive leadership climate' produces better consequences for wellbeing (Adams & Mastracci, 2019b, 2019a).

Although primary evidence is limited, it appears that BWCs may positively impact wellbeing by reducing violence and abuse against staff in some cases and negatively impact wellbeing by promoting emotional suppression and reducing perceived organizational

support. These negative outcomes may also be harder to identify without long-term studies.

EVIDENCE ON SUPPORTING PROSECUTIONS

BWCs have also been used to provide enhanced evidence for criminal proceedings. If deterrence theory is to be believed, this aspect is crucial to an effective BWC program because individuals must believe they are more likely to be prosecuted in order to moderate their behavior (Petersen & Lu, 2023). The ability to deal with cases more quickly and accurately could also generate cost savings.

However, Peterson and colleagues failed to identify significant impacts on prosecutorial and court-related outcomes in a review of 8 studies. The authors were nonetheless optimistic about findings which saw the majority of the studies produce 'effects favouring BWCs' across three out of five outcome groupings. However, the value of these findings is limited by small sample sizes and weak methodology in the papers reviewed (Petersen & Lu, 2023). A recent experimental study by Peterson and colleagues analyzing 12-months of data from BWC use in Miami Beach, Florida, failed to identify any statistically significant relationship between BWC use and case outcomes after clustering data was taken into account, with the exception of crimes against police officers. The authors suggested that 'equipping [...] frontline officers with BWCs may cause variations in some criminal justice outcomes.' While notable, these findings fail to match up with the purported benefits of the technology (Petersen et al., 2021).

The value of evidence for the criminal justice process of BWCs (or 'evidentiary value') may also differ when considering different kinds of crime. For example, there is some evidence that BWCs improved the quality of evidence in cases of intimate partner violence (IPV), with cases in one study being more likely to result in charges filed, have cases furthered, receive guilty pleas, and receive guilty verdicts. Pezdek attributes these findings to the fact that BWCs captured physical and emotional distress (an important factor in IPV cases) and made it possible for police to prosecute when a victim was unwilling to testify (Pezdek, 2022). Evidence from a study related to drug-and-alcohol cases comparatively saw no impact on the number of guilty outcomes, with the authors suggesting that BWCs were less critical when the breathalyzer or blood test could be relied upon (White et al., 2021). While this suggests that BWCs may present evidentiary value in cases where they are perceived as more reliable than other evidence, this perception will be dependent on many factors and would be hard to quantify without further research. A further consideration would be that cases of violence towards ambulance staff may not be taken forward where the perpetrator has mental health issues or where substance abuse is involved. This imposes a ceiling on the potential evidentiary value of BWCs in practical terms.

Moreover, broader challenges have been raised about the evidentiary capability and objectivity of BWCs. For example: cameras that are body-mounted may risk 'over-representation' of the perspective of the individual, especially when the wearer has discretion over whether the camera is recording. Though the success of BWCs hinges on the perception of the footage as reliable and objective, over-emphasizing the objectivity of BWC evidence risks marginalizing other forms of evidence in the legal process. A national survey of US prosecutors found in 2016 that 66.9% 'feared that jurors might come

to expect BWC evidence and that a lack of a recording might lead jurors to question an account given by an officer or witness' (Christodoulou et al., 2019). That BWCs may prejudice evidentiary procedures against non-camera wearers is particularly concerning, and the element of individual choice in many BWC programs is problematic: while staff can choose not to wear a camera, they may not be immune to the broader consequences of implementation.

HOW CAN WE FACILITATE BETTER EVALUATION AND IMPLEMENTATION OF BWC?

There is considerable evidence relating to BWCs and violence reduction but much of it is of poor quality, anecdotal, focused on specific professions, or with limited scope for generalizing. There is sufficient evidence to consider that there may be some benefits for service users, staff, and the wider public interest to anticipate that BWCs may have the potential to address the very serious problem of physical and verbal violence. There is limited evidence that BWCs may cause harm, in particular the risk of 'surveillance creep' and the possibility that it may exacerbate some violent situations. Research on the costs and benefits of BWCs is limited, even within the context of policing, and much of it is dependent on assumptions about the broader consequences of BWCs which have not yet been supported. This evidence may justify further policy interest in BWCs, but it falls short of demonstrating effectiveness and value for money. Our review also examined other surveillance technologies such as CCTV, VBPM, and camera systems fitted to response vehicles. While the use of these technologies for the purposes of violence reduction is growing, evidence was limited both in terms of outcomes and purported costs and benefits.

It remains unclear which underlying mechanisms support violence reduction, and it is likely that benefits will be mediated by a range of implementation issues. The use of BWCs by police officers has measurable effects, but not necessarily including less use of force by officers. How cameras are activated, and how this is communicated, may have an independent effect in addition to using a BWC. It is also likely that effects vary with circumstances of subjects and observers. The deterrent effect may be weak for some subjects despite some early reports of success. For the police, at least, body worn cameras may reduce complaints from the public.

Poor quality evidence most likely does not relate to the competence of researchers and evaluators, but to interventions in complex settings which are not designed with delivering compelling evidence in mind. It is not feasible to produce strong scientific evidence where interventions vary in important, but unknown, ways from place to place, where training and support is ad hoc and variable, where cameras are used in non-random but unspecified ways, and where the criminal justice system works, and is publicized, in different ways to deter future violence. The problem of a lack of fidelity should discourage efforts to aggregate findings and reach a generalized conclusion about how BWCs work. Even something such as the size or appearance of the camera could have a substantial impact on the outcomes of a program. The complex environment of BWC implementation, where contexts are less likely to remain stable over time and have strong independent effects on outcomes, means identical interventions may have different outcomes (Woolcock, 2022). We tentatively suggest that the unit of analysis in the evaluation of BWCs would benefit from shifting from the camera itself to comparing packages of measures (for example, BWC plus training, plus communication, plus improved use of

video footage in the criminal justice system) and then comparing the effects of different packages.

While these conclusions appear to have daunting implications for the future of BWC research, there are still a finite number of relevant causal relationships underpinning how the cameras work (Flight, 2019). As Flight suggests, the more that BWC research is able to focus on explaining the mechanisms of the cameras in detail to identify how and under what conditions specific outcomes are observed, the more we will be able to see into the 'black box' and make sense of the variable findings produced (Flight, 2019). In turn, this will support the design of programs which can be tailored to produce specific outcomes based on these causal relationships.

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