Smart Policing: Ethical Issues & Technology Management of Robocops

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Abstract—The killing of George Floyd in the United States has drawn attention to police brutality worldwide because it was caught on video. The frequency of incidents of police brutality has resulted in mutual distrust and fear between police and citizens. Repeated stories of police violence suggest policing needs a reimagined overhaul that addresses human rights. New ubiquitous technologies point to a need for greater smart policing research, development and technology management. Surveillance cameras and robotics are considered forms of smart policing. Robocops are currently out on patrol in many jurisdictions around the world. Smart technologies have the potential to improve policing and ethical outcomes through technological objectivity. Smart policing can potentially alleviate racial bias through technology management.

Many reported incidents of police brutality in the United states involve traffic stops. While there is likely a need for traditional policing in cases such as rape and murder, violent—often fatal—incidents stemming from community policing interactions should be examined. This systemic review finds that there are few studies that address this gap. The "defund the police" movement in relation to minor crimes includes the reallocation of funds toward community services and community policing. This research focuses on how police funds can be better allocated toward social services, community policing and smart policing that results in much needed police reforms.

I. INTRODUCTION

In March of 2020, Breonna Taylor was shot and killed by police at her home in Louisville, Kentucky. A grand jury indicted a police officer for wanton endangerment and dismissed another for the extreme indifference to the value of human life [1]. Also, in March of 2020, Daniel Prude died after complications of asphyxia under physical restraint by the police. A Rochester, New York policeman put his body weight over Prude's head while pushing it into the pavement after covering his face with a spit hood. The death was ruled a homicide [2]. In May of 2020, George Floyd met a similar fate in Minneapolis, Minnesota. Following the death of George Floyd at the hands of police, there was a call to 'defund the police' and protests [1]. Despite the protests, there have been continued stories of alleged police misconduct, e.g. Jacob Blake was shot in the back seven times by policemen in Wisconsin in August of 2020. He is paralyzed from the waist down [3]. US Senator Clyburn stated that the US Congress would not defund the police; but would rather 'reimagine policing'[4]. This study provides evidence that the reimagined policing should include investments in smart policing. For example, use of police 'Robocops' may decrease risks of injury to criminal suspects and make detentions, arrests and searches safer. The use of robotics may also remove police officers from potentially violent situations and improve their safety [5].

Public safety and policing are social issues that are important to the field of technology and innovation management [6-9]. Several studies have focused on the efficiency and effectiveness that these technologies are able to produce in Smart Policing technologies [10-14]. Yet, the direction of technological change through improvements in efficiency is not widely covered. Thus, this study examines the question of whether research on Smart Policing covers broader issues of policing performance beyond efficiency. In essence, we examine the research directions that are pursued to understand the possible directions of technological change.

This study considers Smart technologies that are being applied to community policing, i.e. Smart Policing, and research being done on it. Studies on innovation and technology management focus on how to improve innovation performance or create technological change. The Abernathy-Utterback model of technological change suggests that business activities create process changes that increase efficiency or create new products that meet previously unmet demand [15]. Technological change is also constrained by technological paradigms and change trajectories depending on the forces of market demand-pull or technology-push [16]. This study considers the exploration – exploitation aspects of current research applied to the technological paradigm of public safety and policing, i.e. Smart Policing.

In the innovation of industrial production, a new scientific discovery may improve processes that lead to more efficient production of an existing product line, or it may create a new product or service for a previously unmet demand. When considering Smart Policing, new scientific discoveries can be applied to improve community policing as a public service. If the new form of policing improves the rate at which criminals are arrested and charged with crimes, even providing more accurate evidence, policing efficiency would be raised. How can Smart technologies be applied to improve Smart Policing through new economic utilities that were not previously identified or matched with an existing policing service?

Earlier studies on Smart Policing limited the definition by following boundaries set by national institutions like the US Department of Justice (US DOJ). Smart Policing initiatives were defined as those that target homicide, violent crime, gangs, gun violence, and drugs, domestic violence, property crime, repeat

offending, and neighborhood disorder [3]. The Bureau of Justice Assistance of the US DOJ focuses its Smart Policing Initiatives (aka Strategies for Policing Innovation) on offender- or placed-based, gun-related and violent crimes [17]. The narrower definition of Smart Policing may target more egregious crimes but leaves out most interactions with the police.

Therefore, this study takes a more agnostic view of Smart Policing. Like most other Smart technology studies, we define Smart Policing based on the technologies that are deployed for policing activities including CCTV, drones, GPS, robotic devices, Whole Spectrum Detection, laser scanning, high-frequency security cameras, acoustic sensors, smart barriers, and mobile devices that are increasingly combined with built environments and data analysis [18].

Smart policing is the use of data, analytics and innovations to reduce crime [19]. We focus on crimes that involve police-civilian interaction when many misdemeanor arrests have escalated into major confrontations between police officers and civilians, who are suspected of committing crimes.

The potential for harming humans exist especially in spying, bomb disposal and armed robots designed for military combat environments. Modern day robots are much more complex than 75 years ago [20]. Yet, by focusing on potential dangers of distant technologies, the immediate benefits and challenges of existing or near-future technologies may be overlooked.

There has been advocacy for the use of AI in policing. There are advocates for the idea that people should not be hired into policing if there is a need to train away their racism and violence. Artificially intelligent algorithms are available that can identify individuals with the propensity toward brutality or eliminate the confrontations that escalate as a result of personal bias. There is also advocacy for the idea that the police need to focus more on crimes such as murder and rape rather than minor violations.

This study redefines the boundaries of Smart Policing along more conventional lines of Smart technology studies. By taking a comprehensive, systematic look at the literature, this study examines what topics that affect communities that are policed have been the focus of researchers in academia. The framework of analysis considers the topics that have been covered in the literature on Smart Policing.

A. Contact with the Police

1) Community policing

The Camden, New Jersey police department is considered a model for change. It was dismantled in 2012 [6], all of the police were fired, and they reopened with new procedures to deal with the police that cause complaints, discipline them and improve the department's organizational culture. They wanted a reputation for improvements in community policing. Community policing is emphasized and violent crime rates are down [21]. Community policing is defined as "a philosophy that promotes organizational strategies that support the systematic use of partnerships and problem-solving techniques to proactively address the immediate conditions that give rise to public safety issues such as crime, social disorder, and fear of crime". There are three (3) components to community policing: (1) community partnerships, (2) organizational transformation, and (3) problem solving. Problem solving can be accomplished

with the SARA concept model which stands for Scanning, Analysis, Response and Assessment. Community police scan to identify and prioritize problems. They can conduct investigations to analyze problems. They can respond to problems by developing strategies to address the problems. Using assessments, community police can evaluate how successful their responses are [22]. Herein, there is evidence that smart policing can assist with these types of police reform goals.

One thing that Camden did was replace its previous policing model with a high-tech surveillance model. However, 'Community Resource Hub for Safety and Accountability' researcher Philip McHarris of Yale University's Sociology and African American Studies Department has argued that the use of high-tech surveillance does not create safety in a fully transformed way. Safety is more than just statistics as evidence of reduced crime rates. A more holistic approach that provides for economic security and quality education is important [23].

2) Traffic encounters

Traffic encounters alone comprise the majority of face-to-face interactions that civilians have with police officers in the U.S. Yet, of the over 11 million arrests made in the U.S. In 2014, the percentage of crimes covered is less than a third of the arrests made [24]. Moreover, the majority of 71 million face-to-face interactions in 2005 with police involve traffic-related contact [25]. Although just over half of searches during traffic stops are done with consent, only one-ninth of them turn up criminal evidence [25]. During these face-to-face encounters, the decision for pulling a driver over is based on the officer's judgement.

B. Smart Technology in Policing

1) Robocops

Some police departments are moving toward reducing the use of humans and making use of robotics in policing. However, the use of robotics has challenges. In December 2013, the California startup Knightscope showcased the K5 autonomous robotic security guard. It is capable of sensing sound, vision, touch and smell in order to predict and prevent crime [26]. The K5 has four (4) cameras, microphones, radar and environmental sensors. Using Wi-Fi, it can report its findings [27]. The K5 has had performance issues. In 2016, it had a hit and run incident with a toddler in a mall leaving the child with minor injuries [28].

In June of 2019, Huntington Park, California's police department revealed the HP Robocop. It has 360 degree cameras for use in police surveillance and monitoring [29]. The HP Robocop was deployed because it can tirelessly patrol large open spaces such as parks, deter criminal activity and give police more time to focus on other community issues [30]. However, in October of 2019, a woman rushed over to the robot to report a violent nearby brawl. The robot stated "step out of the way" and rolled away humming a tune and repeatedly stated 'please keep the park clean'. People hurt from the violent brawl were eventually ambulanced away after someone called for police help [31]. This is evidence that these robots are only as good as they are programmed to be.

In 2017, Dubai revealed the 'Robocop' fitted with emotion detectors that can detect a person's emotions, facial expressions, gestures and hand signals. It can also change its expression

accordingly and greet people [32]. It is a REEM humanoid robot designed by PAL Robotics [28]. It has been described as a glorified kiosk because it includes an integrated tablet that people can use to report crimes, submit paperwork and pay fines [33]. This Robocop weighs 220 pounds [28]; and it is 5 ft 5 inches tall and is multilingual [34]. The Robocop's has cameras in its eyes that send live feeds to a command center [28]. Robocop moves around on wheels rather than walk. It can move autonomously or be piloted remotely [35]. The City of Dubai decided to not allow 'Robocop' to carry a gun because it's designer has a policy to not engage in military style projects [28].

Dubai's goal is to use Robocops in 25% of its police force [34]. The goal is "to relocate police officers so they work in the right areas and can concentrate on providing a safe city" [36]. The belief is that reliance on AI would reduce and prevent human errors [37]. It is believed that the robots will allow the police to focus more on investigating crimes and making arrests [38]. Further, by the year 2030, Dubai seeks to advance completely into 'smart policing' including utilizing a smart police station that does not require humans [33]. One concern about the increasing use of robotics in workplace is the displacement of humans in jobs. In December 2017, McKinsey reported that there is are 60 to 375 million employees world-wide work in jobs that can be automated by the year 2030 [39]. Dubai's police department plans to reassign the humans into different fields [28].

Unlike Dubai, Russia previewed a gun toting android built by the Russian Foundation for Advanced Research Projects in their Defense Industry. The android is named FEDOR (Final Experimental Demonstration Object Research) and can drive cars, shoot and walk [28].

Like Dubai, India's police force seeks to make use of Robocops in-house. They are piloting the KP-Bot which records complaints and directs visitors at a pol ice station's front desk China is also making use of a Robocop [40], in February of 2017, it began using the Anbot which uses facial recognition to identify criminals and follow them around until the police arrive [41]. China is also piloting the use of robotics for in-house criminal prosecution in the Jinagsu Province. They use a 'legal robot' for the administration of criminal cases. The robot reviews cases, checks facts, handles arrest warrants, approves indictments, and offers sentencing opinions. The robot has assisted with 15,000 cases such as traffic violations. It is objective and has caught mistakes in many cases from which 541 convictions were commuted [42].

Similarly, although banks deploy security guards, these guards cannot surveil the digital terrain. There are banking robocops to detect criminal fraud, collusion, terrorism and market manipulation. Since 2013, the US Security Exchange Commission (SEC) has used an Accounting Quality Model (AQM) that the financial industry calls 'Robocop'. It searches corporate filings for violators of financial reporting regulations [43]. The company Digital Reasoning design the Syntheses technology for digital surveillance [44] .

2) Surveillance Technology

Surveillance technology encompasses many different technologies including CCTV, drones and unmanned vehicles. Dubai is making use of drones and the O-R3 autonomous police cars that are equipped with facial recognition, laser scanning, lidar, GPS, thermal imaging and license plate reading. The autonomous police car makes use of a machine learning algorithm that gathers and synthesizes data in real time [45]. Also, the Reaper drone has been used in military operations in Afghanistan, Iraq and in other countries. It is equipped with cameras and sensors capable of remote monitoring; and it is heavily armed. However, there are accounts that the Reaper is accident prone can lose control if hacked [26]. One obvious risk in applying drone technologies for urban surveillance is the further contribution to what has been termed the 'militarization of urban spaces.' [46-48].

3) Automated Law Enforcement

Surveillance technology is one of the earliest and prolific forms of law enforcement. Traffic cameras and sensors are commonly used to enforce speed limits and traffic controls, i.e. stop lights. South Korea implements an Automatic Traffic Enforcement System (ATES). The country uses a Traffic Center is linked to surveillance cameras that capture and recognize vehicle plate numbers for vehicles that violate traffic rules. The Traffic Center matches the plate numbers against a database of registered vehicles and issues a penalty charge. This reduces police interactions. It reduces traffic accidents and the inconveniences caused by vehicular drivers that break rules such as speeding, signal violations, overloaded vehicles, driving in the bus lane, and illegal parking [49, 50].

Other automated law enforcement is used for public health. Some cities like Dubai consider violators of the COVID-19 two (2) meter social distancing instructions serious criminal offenders. Dubai is making use of CCTV to get notices about individuals that violate social distancing rules. These security cameras are equipped with temperature detectors to automate the detection process [51].

4) Big Data Analysis and AI

As the definition of Smart Policing has evolved, more and more different technologies are associated with it. One of the main technology applications is the use of Big Data analysis and AI. The strategic, data-driven approach to policing was meant to improve policing and ethical outcomes by identifying patterns of criminality and by removing the human judgement from certain points in the process of policing. Policing policies were designed based on the data collected in the database that allowed allocation of personnel and resources, known as "crime mapping." The award-winning CompStat was implemented in New York City in 1994 for this purpose [52].

Algorithmic policing as a means to improve policing outcomes through AI has become popular again as newer software programs have been developed to address some ethical issues, e.g. Patternizr [53]. Researchers have studied the collection and analysis of big data during COVID-19 in South Korea and noted difficulties with balancing public safety and privacy concerns. The researchers advocate that improved privacy safeguards are needed such as consent procedures and the de-identification of personal information [54].

C. Ethical Issues in Policing

1) Bias in Policing

Several studies have found differences in violent outcomes in police interactions with suspects depending on the race of the officers and suspects [55-59]. In 1968, in Terry vs. Ohio, the US Supreme Court held that the stop-and-frisk practice was different than a search or seizure specified by the Fourth Amendment. The court held that police officers can stop a suspect if there was a reasonable suspicion. The police could pat the suspect down to make sure that the suspect did not have a weapon that could be used against the police officer (392 U.S. 1, *John W. Terry v. State of Ohio*). These stops are called "Terry stops". The stop-and-frisk crime prevention strategy was used for decades and spread with the adoption of the data-driven CompStat management system in the 1990s. This system allowed police to track and respond to crime trends in real time [58]. A 1999 report commissioned by the New York State Attorney General found that the New York Police Department (NYPD) stopped and frisked minorities disproportionately and often failed to meet the legal threshold of reasonable suspicion [60].

However, over the years, racism and implicit bias led to misuse of this police power. Stop-and-frisk is a practice that makes sense if the decision does not depend on the race and ethnicity of the potential suspect [61]. Although few stop-and-frisks led to arrests or uncovered weapons in New York, when the stops were based on specific suspicions rather than racial profiling, the stops helped to reduce crime [62]. In 2013, a federal judge ruled that the NYPD's stop and frisk program used indirect racial profiling policies which violated the constitutional rights of minority race citizens in the city. Police officers routinely stopped Blacks and Hispanics. The federal judge ordered a pilot program that required: (1) police to wear body cameras, (2) community meetings to solicit public comments, and (3) use of a former prosecutor to serve to monitor the police department's policing strategies [63]. Furtive movements (i.e. done in a quiet and secretive way to avoid being noticed) were cited for 48% of the stops of Black Americans and 45% of Hispanics stopped and frisked [64].

Bias in policing is not unfounded. For example, Black Americans are nearly twice as likely to be pulled over than White Americans on traffic stops; and Blacks are more likely to be charged for drug crimes than White people [65]. An unarmed Black American is more than three times more likely to be shot by the police than an unarmed White American [66]. Baltimore's Police Department has 40% African American police and in 2016, the US DOJ concluded that the department consistently practice racially biased policing and had a problematic culture [67]. In Boston, Blacks make up 25% of the city's population but constitute 69% of the people stopped by city police [68].

In August 2014, a Ferguson, Missouri policeman asked Michael Brown and other Black Americans to leave the street pavement they were standing in the middle of. The policeman said that thereafter he suspected them of being in a robbery. He told them to stop and he claimed that Michael Brown reached into his vehicle and grabbed him. A witness stated that this did not occur. Instead, Michael Brown allegedly raised his arms and stopped. Then the officer fired 12 rounds and 7 hit Michael Brown. The police left Michael Brown laying in the street for 4 hours. Citizens were outraged. A US DOJ investigation found that the police were quick to escalate force; African Americans accounted for 90% of the use of force; and that there was explicit racial bias in communications between the police and court [69]. After the Ferguson incident, President Obama's administration formed a task force on policing. The task force recommended training and the use of body cameras. The US Congressional House of Representative proposed a bill entitled the 'Justice in Policing Act'. This Act would require police departments to: (1) required racial bias training; (2) ban choke holds and no knock warrants in drug cases; (3) undergo independent investigations of misconduct by state attorney general offices; and (4) send the federal government use-of-force data. The task force required bias and de-escalation training and the use of body cameras. However, the Chairperson of the New York City Finance Committee has stated that the training has not worked to prevent police brutality because the organizational culture has not changed [70]. Philip McHarris states that trainings and body cameras have not brought about change [71].

The change in New York City laws allowed the online release of over three-hundred thousand complaints of police misconduct since 1985 [59]. This occasion highlights some challenges that stem from police bias. While the database provides an opportunity to create reform by increasing transparency and accountability, it may also create an environment in which police "cannot or will not do their job" [59]. The question is how to remove bias in policing while maintaining or improving police services.

2) Militarization of Policing

Ninety percent of police calls for service are nonviolent encounters. The encounters may turn violent and sometimes the police contribute to the escalation since they are trained in use-of-force tactics [72]. When there is unrest over police brutality, protesters are threatened with police. In a 1976 lecture, French social theorist Michel Foucault expressed concern that Western colonization with the use of military force would boomerang and result in the militarization of urban streets domestically in the West [46]. This phenomenon is sometimes referred to as "Foucault's Boomerang". When protesters demonstrated against police brutality after the death of George Floyd, there was aggressive and militarized policing against these public demonstrations [73]. When police are armed with millions of dollars in military grade equipment, policing is seen as an act of war and more civilians are likely to get hurt [74]."Instead of threatening protesters with police, we could deal honestly with the pain driving people to the streets" [75].

"To fix policing, we must first recognize how much we have come to over-rely on enforcement" [76]. In the United States, police departments have taken on more duties and their budgets have grown. Defunding the police is a version of the 'divest and invest' model by the Urban Institute. The idea is to divest funds from police budgets and invest the funds into mental health, substance abuse counseling, youth development, social work services and community programs [70]. An alternative to defunding the police is to train police officers to better respond to people in mental health crises and to not criminalize acts committed as the result of addiction and poverty [76]. One desire

with defunding the police is to reduce police interactions and surveillance activities that result in racial profiling [77].

3) Quota-based policing

Another CompStat era issue with police management and the evaluation of police officer performance is the use of quotas. Police officers are trained to exercise discretion when selecting potential perpetrators to arrest. Quotas reduce discretion and promote the use of enforcement activity for reasons outside of law enforcement's legitimate goals [78]. "The worst thing you can have is a police officer that needs an arrest for the month. There's no discretion" [79]. Quotas are used by supervisors to assess the amount of work a police officer does. However, the Police Executive Research Forum suggests a more complicated way to evaluate performance. They suggest that 7 dimensions be assessed: (1) reduction of criminal victimization, (2) conviction and clearance rates that call offenders to account for their crimes, (3) enhancing personal safety and reducing fear, (4) guaranteeing public space safety, (5) using financial resources fairly, efficiently and effectively, (6) using force and authority fairly, efficiently and effectively, and (7) satisfying customer demands. However, supervisors who are over-worked want an easier way and use quotas [78].

In some jurisdictions, traffic fines are a significant source of revenue for the local government. In another case, Sandra Bland was arrested for a minor traffic law violation before her death while in custody. She had had several traffic summonses because she had lived in such a jurisdiction [80].

Some states have enacted bans against quota-based policing. But, despite these laws, the practice continues. In quota-based policing, traffic tickets and arrests get counted. Police departments may not talk openly about the practice, but continue to exercise this practice. It is part of their culture [81].

The organizational culture in some police departments is an "us-versus-the-world" and "we-strap-on-the-armor-and-fight" street warrior, soldier and siege mentality which results in dehumanization and cruelty [82]. These street warriors and soldiers shoot in response to fear. They are trained to believe that they should be afraid as a matter of survival [83].

There are individuals that do not approve of investments in hardware and surveillance. For example, the author of the book 'The end of policing' is Brooklyn College Professor Alex Vitale who has stated that the "alternative is not more money for police training programs, hardware or oversight. It is to dramatically shrink their function. We must demand that local politicians develop non-police solutions to the problems poor people face. We must invest in housing, employment and healthcare in ways that directly target the problems of public safety" [84].

The goal of this study was to systematically review peer-reviewed literature in order to test hypotheses related to the advantages, disadvantages, strengths and weaknesses of smart policing.

II. METHODOLOGY

A. Systematic Literature Review

This research study provides for a systematic bibliometric literature review void of a quantitative synthesis. The Cochrane

Method is regarded as the "gold standard" of rapid reviews in biomedical research [62]. The Cochrane Collaborative is a leading international group of medical researchers that conduct systematic reviews on biomedical research. Although the method is now broadly used in healthcare research, the methodology is also often applied in software development research to leverage advantages of rapid review, evidence-based implications, and applicability of theory to application [85].

Systematic reviews differ from traditional narrative reviews because systematic reviews require the use of a pre-planned standard format and scientific method. In a traditional review, the researchers would generally look for research papers that support or not support the researchers' hypotheses. With regard to the scientific method, there are four (4) steps that differentiate a systematic review from a traditional narrative review. The traditional review: (1) identifies all evidence on the topic; (2) selects evidence that meets inclusion/ exclusion criteria; (3) appraises the quality and validity of the evidence; and (4) summarizes the results. In comparison to the traditional review, in the systematic review, a standard format is used in an effort to conduct a higher quality, more sophisticated, comprehensive, extensive and unbiased review. There is a clearly specified method of identifying, selecting, validating and including information so that it is clear, transparent, recordable and reproducible. The transparency is in the process documented in the protocol for the systematic review. Using a clear and transparent process helps minimize bias and systematic errors in summarizing the evidence. When appropriate, there is also a quantitative synthesis to integrated the information from multiple studies.

Using their *Cochrane Handbook for Systematic Reviews*, the first step in this systematic review was to develop a protocol which outlined the steps for doing the systematic review based on the Cochrane Method [86]. The protocol included data collection, screening the results, abstracting data, appraising the risk of bias, synthesizing the findings, and interpreting the results.

Given the presence of police brutality, this study aims to answer how research on Smart Policing addresses policing and ethical outcomes. The following questions were tested with this systematic review:

- *Research Question 1*: What technological capabilities are available that can improve Smart Policing by providing technological efficiency and objectivity?

- *Research Question* 2: What are the topics and/or social issues that are considered in studies on smart policing?

- *Research Question 3*: What types of civilian-police interactions i.e. SARA are addressed by the studies?

- *Research Question 4*: What ethical issues e.g. bias and police misconduct are (or are not) being addressed at the intersection of these topics in the literature?

B. Data

In this systematic review, a comprehensive list of phenomenon-specific search keywords was created. Keywords were selected using the Cochrane Collaboration recommended

PICO strategy. The benefit of using the PICO strategy is to ensure a well formulated research question [86]. In PICO, research questions are broken down into concepts which include the research *Population*, *Interventions*, *Comparisons* and research *Outcomes*. The setting and population in the following research questions for this study are related to smart policing.

P = **P**opulations engaged in smart policing

I = **I**nterventions such as robotics (robocops, drones)

C = **C**omparison of analyses of technologies

O = **O**utcomes including strengths and challenges

We attempt to identify all studies that are related to Smart Policing by searching terms based on the PICO framework. These parameters were translated into the following general Boolean format that a database could understand: (Population OR synonym1 OR synonym2) AND (Resource1 OR synonym1 OR synonym2) AND (Outcome1 OR synonym1 OR synonym2). Thus, the initial search for the research questions would utilize the keywords that correspond to the PICO criteria (Table I).

TABLE I.   PICO FRAMEWORK SEARCH STRATEGY

FOR SMART POLICING ANALSYES

Search Categories	Search terms to screen articles in research databases
Populations	police OR 'law enforc*'
Interventions	drone OR 'smart policing' OR robot* OR Robocop OR camera* OR cctv OR 'facial recognition'
Comparator	analy* OR exami* OR eval*
Outcomes	bias OR ethic* OR discrimin* OR objectivity OR neutral*

To record all of this data for the systematic review and meta-analysis, the PRISMA method of transparent reporting was used. PRISMA was used to ensure a high-quality rigorous review [87]. The PRISMA information flow chart is provided in Fig 1. The goal is to capture the most comprehensive set of articles that specifically addressed the issues targeted by the research questions. Thus, we use concise concept terms to maintain a manageable set of results in the keyword searches. Keyword searches are any type of free text searching conducted to look for words in abstracts and other database fields. Since the concept of Smart Policing is relatively new, no time constraints were placed on the search to have a comprehensive dataset on the topic. Since it takes an extensive amount of time to hand search all of the literature, a search strategy for databases is estimated and this is augmented with enough manual searching to ensure that the systematic review is being conducted in a full and comprehensive manner. Searches were conducted in the research databases *Web of Science* and *EBSCO Academic Search Complete.*
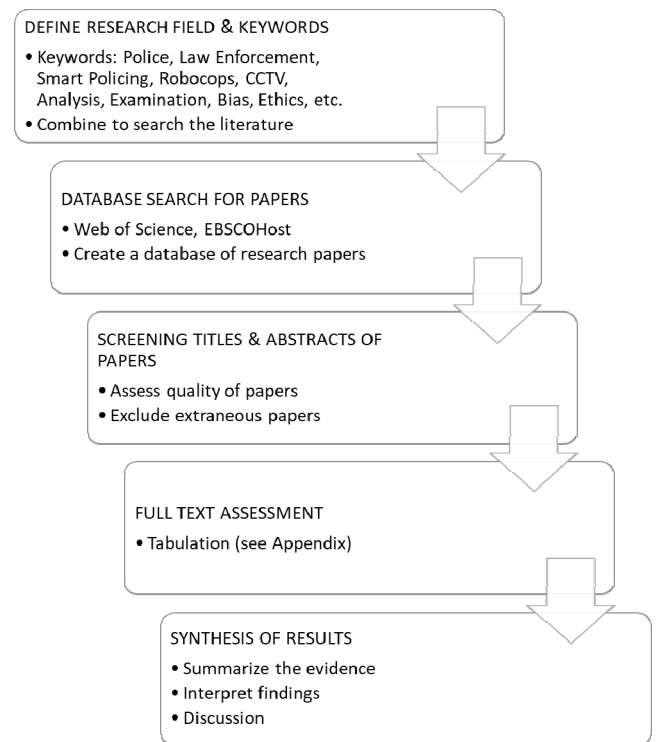

Fig. 1. PRISMA Flow Chart

The search strategy was iterative in that a table was created listing the keywords listed in each study; and as new keywords were found, the search strategy was revised using those terms. The search was rerun and documented. The goal was to create an optimal search strategy in order to retrieve useful citations. This process was done for each database in order to achieve a comprehensive systematic literature review of smart policing literature. The results were combined to eliminate duplicates.

Following the PRISMA Model, data was added to a table which included the data that a reference was found and the source of the data (i.e. the database, hand search, and internet search). The search strategy used to find each reference (i.e. keywords); and the name of the reference and findings were noted. In order to minimize bias, peer reviewed publications were selected. It was assumed that internal validity, external validity, originality and ethics would have been assessed in the peer review process. There was a total of 131 papers examined (see the list in Appendix A). To be included in the systematic literature review, each study had to address at least one of the three (3) research questions. This was the inclusion-exclusion criteria. Articles that were excluded fell outside the scope of the study; they were in fields of psychology, sociology medicine and unrelated to policing; or they considered smart technologies for applications outside of policing, e.g. wildlife conservation, military applications, or soil analysis. Twenty papers were excluded from the 131 that were returned by the database search, leaving 111 papers (Appendix A).

This electronic search was evaluated against the Sampson (2008) seven (7) key criteria for assessing search quality: "(1) accurate translation of the research question into search concepts; (2) correct choice of Boolean operators; (3) accurate line numbers and absence of spelling errors; (4) an appropriate

text word search; (5) inclusion of relevant subject headings; (6) correct use of limits and filters; and (7) search strategy adaptations". In 2016, the seventh of the key criteria was removed as a highly recommended criterion and is now required at the search strategist's discretion [88].

The final articles included in the analysis were dated from 1994 to August 8, 2020, when the search was performed. The number of studies that focus on Smart Policing has steadily increased since (Fig. 2). While earlier papers focused on Smart technologies such as CCTV and data analysis in policing, the total number of articles published on Smart Policing increased after 2014, the year a bystander recorded the death of Eric Garner on video [89, 90].
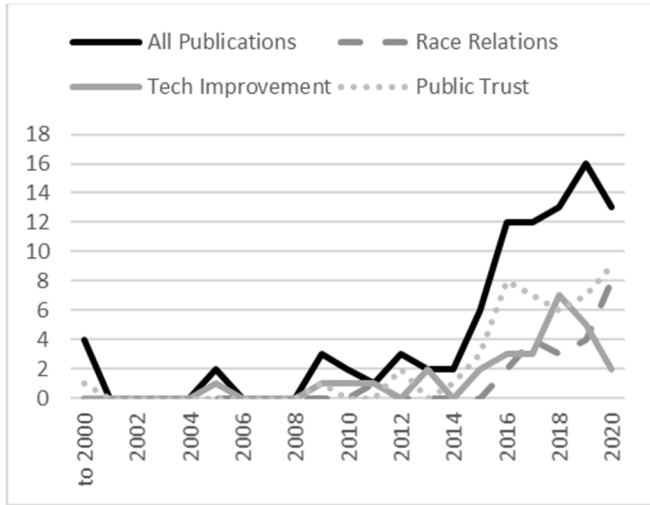

Fig. 2.   Number of Publications by Year

III.   FINDINGS

The papers were analyzed to understand the topics that are covered to ascertain whether and how Smart Policing was being studied. First, we reviewed the frequency that technologies are mentioned in the dataset (Fig. 3). The most studied technologies are surveillance technologies, i.e. video cameras, body-worn cameras, and CCTV. These technologies are the earliest technologies that have been implemented and also the earliest studied.
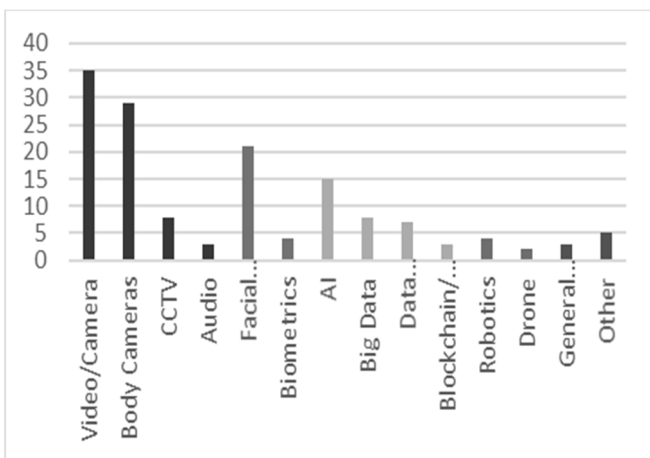

Fig. 3.   Technology Focus Frequency

More recent studies have shifted towards more advanced technologies, i.e. biometrics, especially facial recognition and Big Data analysis. Facial recognition studies focus on improving technological accuracy for identification of criminals that have committed a crime. Big Data studies are also focused on analysis stage of policing, usually finding technological improvements to make policing more efficient.

The focus of technology is not the only aspect that is considered in the studies. Each paper was also analyzed to see what topic the research was interested in and categorized (Fig. 4). One of the most popular topics is public trust in the police. Many of these considered different aspects of civilian-police interaction including police bias and race relations. Many studies on surveillance footage usually considered the source of bias, either from the police or from the observer, e.g. camera-perspective bias. Otherwise, studies focused on technological improvements or the policy response to those improvements. A few other studies considered outside perspectives such as the psychological, sociological, or philosophical aspects of Smart Policing.
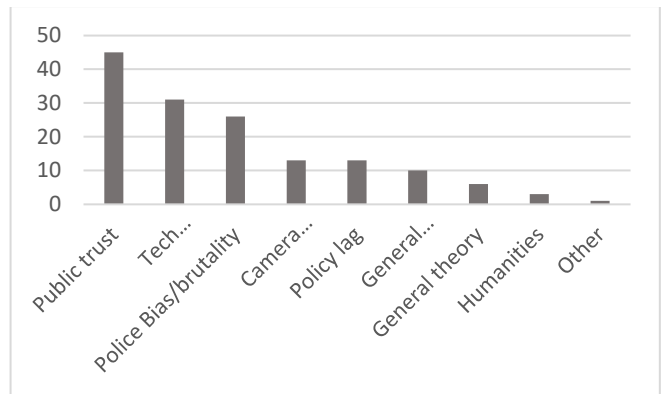

Fig. 4.   Topic Frequency

Some of the main topical drivers of research on Smart Policing that relate to ethics are technological improvement and race relations. The intersection of these two, however, is small. There are only four papers that mention these issues together. They directly attempt to improve technological objectivity through Smart Policing. Two of them involve the use of sensors and cameras to administer traffic citations. Another considers the application of Smart technology to mugshot lineups to remove inherent observer bias, and the fourth examines body-worn camera perspective bias. Otherwise, most papers (fifteen of the twenty-three) that examine race relations consider it through a lens of police bias.

The papers were then analyzed according to whether they focused on specific types of crimes (Fig. 5). Privacy was a common issue that was raised without direct connection to laws, usually attempting to understand how these laws should be written. Few of the studies specified the type of crime. With respect to ethics, although not always explicitly mentioned, police misconduct is implied when examining police bias. Otherwise, specific crimes mentioned in the studies are cybercrime, traffic statutes, regulatory enforcement (in the financial sector), or other crime. Studies on cybercrime focused on how to define and detect new forms of crime. Traffic and

regulatory enforcement studies examine how to apply new technologies to policing. The difference with traffic enforcement through new surveillance and sensor technologies, however, is that automated traffic enforcement replaces most civilian-police interactions.
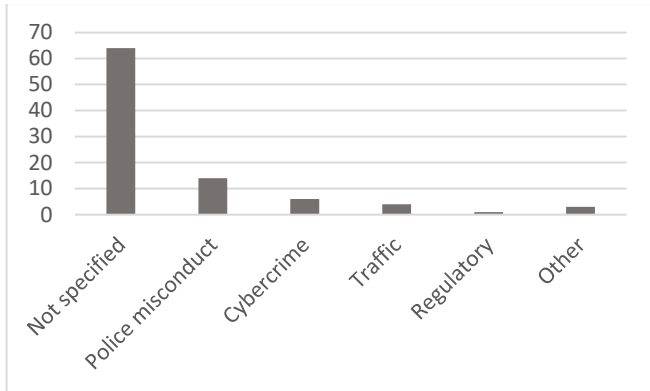

Fig. 5.   Crime Focus Frequency

Another aspect of the research that is examined is related to the phase of community policing (Fig. 6). The majority of studies looked at criminal investigation after the crime has been committed, i.e. analysis. Surveillance technologies were generally assumed to scan for crimes being perpetrated, but since they rarely specified a crime, the assumption failed to define how the crime was to be detected. Traffic enforcement is the exception, clearly defining what law enforcement the Smart technology is being applied to. Those studies that were most broad in (not) specifying a technology or crime, implied that assessment of policing was or could be performed using the methodologies introduced in the study. Few papers addressed the response to crime, directly.
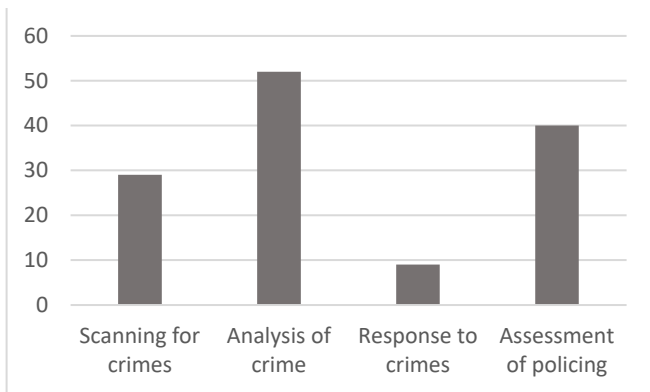

Fig. 6.   SARA Focus Frequency

The types of new Smart technologies were associated with the phase of policing stages (SARA) (Table II). Despite the "Smart" label, many of the surveillance technologies relied on more traditional detection of crimes, e.g. CCTV. Facial recognition technology studies usually attempted to improve the ability to identify a person in an image.

Current capabilities of Smart technology limits the applications for which traditional policing might be replaced, e.g. arrests. The main technology that is capable of substituting

traditional use of policing is traffic enforcement—the main face-to-face interaction that civilians have with police.

TABLE II.   INTERACTIONS IN COMMUNITY POLICING SARA STAGES

Stage of Interaction	Human Policing	Smart Technology-enabled Policing
Scanning	Traffic violation Assault/dispute Loitering	CCTV Traffic cameras/ sensors
Analysis	Investigation/ Evidence gathering	Surveillance technology Facial recognition Predictive analytic (Big Data) Forensic sensors
Response	Fines/Summons/ Arrests	Summons/Fines
Assessment	Oversight organizations	Big Data analysis Data review and oversight

IV. CONCLUSION

Although there have only been a small number of studies that examine Smart Policing, the topics that researchers have chosen to focus on become clearer. This study classified articles between 1994 and August 2020. The classifications include technology, social issues, phase of community policing and crime. The number of articles published on Smart Policing increased after 2014, the year a bystander recorded the death of Eric Garner on video. While tech improvement research appears to be declining, studies on race relations and public trust are increasing. Although media coverage has focused on robotics use in Smart Policing, we found that research focused on surveillance technology and facial recognition are the most popular technology topics. With regard to topic frequency, public trust is the most common. Many of the studies on public trust considered different aspects of civilian-police interaction including police bias and race relations. Several studies find that police interactions with individuals that lead to violent incidents have racial disparities [55, 57, 91].

Although most studies do not specify a crime, the most frequent topic is police bias/misconduct. The US DOJ Community Policing Problem-solving Model, SARA (Scanning, Analysis, Response and Assessment), was also considered when analyzing the studies. The most frequent was analysis of crime. The second most frequent was assessment of policing.

While studies involving surveillance, technologies were important for analysis of crimes, the Smart applications are still rather limited. CCTV and other surveillance provided addition "sets of eyes" for scanning but rarely used to stop crimes from actually being committed. The other common application is to analyze crime scenes to identify perpetrators and collect other evidence. For instance, Robocops have limited capabilities; they are primarily used as surveillance technology. Technological capabilities, policy lags and ethical considerations limit the implementation of Robocops to a fuller extent.

The American science fiction author Isaac Asimov's 75-year old 'Three Laws of Robotics' follows:

    1.   A robot may not injure a human being or, through inaction, allow a human being to come to harm;

2. A robot must obey orders given it by human beings except where such orders would conflict with the First Law; and

3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law [4].

Based on this systematic literature review, what should Smart Policing or new public safety system look like? More immediate concerns raised are how technology and policies need to adjust to meet the needs of existing technologies.

As Smart technologies continue to advance, questions regarding ethics must consider Laws of Robotics.

1. The primary ethical questions with the use of robots, drones and telebots for smart policing include, but is not limited to: If a robot's actions result in someone being imprisoned, does this violate Asimov's First and/or Second Laws?

2. Can a robot act upon criminal suspects safely?

3. How can a city be sure that the robot will not injure people?

4. Since machines are not responsible for mistakes, how can it be punished or sanctioned for wrongdoings? Will the city be held accountable and vicariously liable? [28]

With respect to Foucault's Boomerang:

5. Will reliance on automated machine processes 'deskill' officers cultivated sense of morality and field training in ethical decision making and ethical restraint (esp. the use of force)?

6. Will the use of automated machine processes promote a disconnection from reality, lack of concern for applicable laws and sense of immunity from legal reprisal? [43, 92, 93]

7. Generally, what are the appropriate organizational structures to achieve sustained ethical technological solutions? [94]

With regard to public trust, one of the problems with the "Broken Window theory" is that it encourages police-civilian interaction to find criminals without probable cause. Investigation of crimes precedes a crime being committed. Police use misdemeanors as the rationale to create dragnets to find criminals. Moreover, officer performance is incentivized to increase these interactions.

Bias is neither precluded from technology nor inherent to it. It must be designed to prevent bias. Smart policing offers opportunities to increase transparency. IoT offers the ability to increase citizen engagement, which also encourages transparency.

Technology is not a panacea. Policing institutions and policies determine how the technology is managed or even initiated. Police departments have denied access to data in the past, despite oversight mechanisms being put in place [95]. With respect to Big Data and ethics, algorithmic policing is not without its problems. Bias in the behavior of policing can introduce "dirty data" that reinforce bias. CompStat was seen as a means to prevent major crimes by deterring minor infractions, known as the now discredited Broken Window Theory [96]. Smart technology, however, offers another tool in the arsenal to improve policing outcomes by enabling standardization, oversight transparency, and algorithmically defined objectivity.

By reducing civilian-police interaction through Smart Policing technology, such as ATES in South Korea, the potential for escalation of minor crimes into fatalities would potentially be reduced. Given the share of face-to-face interactions that occur through traffic encounters, these measures would have a large effect on saving lives that are lost to police error or misconduct.

Smart Policing allows knowledge gained to be incorporated into the other stages of interaction. Whereas, police officers are trained individually and thus have variable behaviors; Smart Policing offers the ability to correct policing behavior in a standardized manner. The research-focused aspect of Smart Policing can be enforced through technology.

One of the initial problems of defining Smart Policing is that the definition was arbitrarily, narrowly constrained to violent crimes committed by civilian offenders. This study argues that the definition needs to be expanded to include all aspects of policing, which lends itself towards Smart Justice.

While innovation does not always come from academic research, innovation does require research and development efforts. The protests against police violence and other misconduct are not unfounded. Several studies find that police interactions with individuals that lead to violent incidents have racial disparities [55-57]. The protests represent public demand or desire for policing reform. The technological trajectories of Smart Policing are such that efficiencies tend to be pursued rather than previously unmet demand, i.e. the ethical reform of policing. Our systematic review suggests that the boundary line of the literature—scientific effort—falls well behind the curve of the needs of those communities— demand—most directly affected by police brutality and can thus benefit from improved Smart Policing and Smart Justice.

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APPENDIX A
List of 111 studies

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