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Connecting the Dots: Identifying Suspected Serial Sexual Offenders Through Forensic DNA Evidence

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Introduction: Most sexual assaults that are reported to the criminal justice system will not be prosecuted. Researchers and policymakers have expressed concern that this long-standing practice allows offenders to commit additional sexual assaults. Determining whether reported sex offenders commit other sexual assaults requires establishing reliable linkages between two (or more) cases. Typically, criminal history records are used to identify repeat sexual offenders, but biological evidence in sexual assault kits (SAKs; also termed *rape kits*) provides an another way to study how often reported sexual offenders commit additional sexual assaults by linking DNA across multiple cases to the same perpetrator. ***Method:*** This study examined the forensic DNA testing results from a large sample of SAKs from Detroit, Michigan ($N = 7{,}287$). We assessed how many SAKs yielded a DNA match to a reference sample in the federal criminal database CODIS (Combined DNA Index System). We then ascertained whether the matching case was related to another sexual assault incident documented by state criminal history records. ***Results:*** Approximately one third (35.7%) of the unique perpetrators in this sample had two or more sexual assaults linked via DNA, which is higher than what is typically documented in recidivism studies using court records (8–15%). Three case studies are presented that highlight how forensic DNA evidence can link multiple sexual assaults to the same perpetrator. ***Conclusion:*** Forensic DNA testing of SAKs reveals a more complete picture of the scope of offenders' sexual perpetration behaviors than what is documented in criminal history records alone.

Keywords: sexual assault, rape, serial sexual offending, forensic DNA, sexual assault kits

When sexual assault victims report to the police, more often than not, their perpetrators will not be held accountable, as only 3–26% of reported cases result in a conviction (Lonsway & Archambault, 2012). Research on case attrition in the criminal justice system consistently finds that the vast majority of reported sexual assaults are never referred by the police to prosecutors for arrest warrants and charges (Campbell et al., 2014; Spohn & Tellis, 2012a), and most cases are closed by the police, often with minimal or no investigation (Campbell, Bybee, Kelley, Dworkin, & Patterson, 2012; Shaw, Campbell, & Cain, 2016; Shaw, Campbell, Cain, & Feeney, 2017; Tasca, Rodriguez, Spohn, & Koss, 2013; Venema, 2016). What are the potential *consequences* of this long-standing practice of systemic inaction? What happens when sexual assaults are reported, but offenders are not investigated, arrested, or adjudicated? The White House Council on Women and Girls (2014) cautioned that offenders might go on to commit additional sexual assault crimes: "Across all demographics, rapists and sex offenders are too often not made to pay for their crimes, and remain free to assault again" (p. 5).

Determining whether reported sex offenders do indeed go on to commit other sexual assaults is challenging, as it requires establishing reliable linkages between two (or more) cases. Police records could provide such information (e.g., perpetrator name could be used to match cases), but, as noted previously, such records are often incomplete because reported incidents are closed without much investigation (i.e., perpetrator's name may not be documented). Another method for establishing these linkages is forensic DNA matches across cases. In many sexual assaults, biological evidence is left by the perpetrator (e.g., semen, saliva), which can be collected by medical professionals in standardized sexual assault kits (SAKs; colloquially referred to as *rape kits*) and analyzed for DNA. A suspect's DNA profile can be uploaded to the federal criminal DNA database, CODIS (Combined DNA Index System), and searched against other DNA profiles. Matching DNA profiles can link multiple reported crimes to the same perpetrator, potentially revealing or confirming an offender's identity (Butler, 2015; Doleac, 2017). Forensic DNA evidence will not find all sexual assaults a perpetrator has committed because only 21–43% of sexual assault victims seek postassault medical care and therefore have access to SAK collection (Campbell, Wasco, Ahrens, Sefl, & Barnes, 2001; Resnick, Acierno, Holmes,

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Dammeyer, & Kilpatrick, 2000; Zinzow et al., 2012). Furthermore, SAKs may not be collected in all types of sexual assaults, typically just those involving penetration (Ledray, 1999; United States Department of Justice, Office on Violence Against Women, 2013).[1] Although SAK forensic DNA evidence may underestimate how many offenders have committed multiple sexual assaults, it is a reliable way of linking many assaults that were reported to the criminal justice system.

In this study, we examined the forensic DNA testing results from a large sample of SAKs from Detroit, Michigan ($N = 7{,}287$), that spanned about 30 years (1980–2009). Consistent with common practices for medical forensic exams during that time, these sexual assaults were typically penetrative acts (of any orifice), committed without consent, by the use of force, threat of force, or when a person was unable to provide consent. Victims reported these assaults to the police, had an SAK collected in a hospital emergency department, and released the kit for forensic testing, but the police did not test the forensic evidence. Instead, law enforcement put these SAKs in storage, untested, and the cases went inactive (see Campbell, Feeney, Fehler-Cabral, Shaw, & Horsford, 2017, for a review on the national scope of untested SAKs). When these kits were discovered in 2009, Detroit officials began a long process of inventorying and testing all kits (Campbell et al., 2015), which provided an opportunity to study DNA matches across cases and explore how many offenders were associated with multiple sexual assaults. To set the stage for this study, we will begin by reviewing how "repeat" or "serial" sexual perpetration is traditionally defined in the literature, focusing on sexual assaults that are reported to the criminal justice system and tracked in police and court records. We acknowledge there is a robust literature on the prevalence of repeat perpetration using self-report methods, primarily assessed with college student samples, but because the vast majority of campus sexual assaults are *not* reported to the police (see Sabina & Ho, 2014, for a review), we will not delve into that literature, as it represents fundamentally different subpopulations of offenders and assaults. Given that our focus is incidents that are reported to the criminal justice system, we will review how forensic DNA evidence can complement traditional court records to identify perpetrators who may have committed multiple sexual assaults.

Studying Sexual Assault Perpetration Through Court Records

In research focusing on sexual assaults that have been reported to the criminal justice system, reperpetration is typically referred to as *recidivism* or *serial sexual offending*, and is measured by assessing how many convicted sex offenders are later rearrested/reconvicted. Two meta-analyses of recidivism research from the 1940s to late 1990s/early 2000s found that on average, 13% of perpetrators reoffended over a mean follow-up period of 5–6 years (Hanson & Bussière, 1998; Hanson & Morton-Bourgon, 2005). More recent studies published after these reviews have documented similar recidivism rates: rearrest rates of 7–24% (Freeman, 2012; Zgoba & Levenson, 2008), recharge rates of 8–15% (Daly, Bouhours, Broadhurst, & Loh, 2013; Lasher, McGrath, & Cumming, 2015; Lehmann, Goodwill, Hanson, & Dahle, 2016), and reconviction rates of 8–16% (Abracen, Looman, Ferguson, Harkins, & Mailloux, 2011; Lehmann et al., 2016; Zgoba & Levenson, 2008). Recidivism researchers acknowledge that these rates underestimate the true scope of serial sexual offending because this method can only capture incidents that are reported to—and acted upon by—the criminal justice system to generate records of arrests, charges, and convictions that can be counted for research (Hanson & Morton-Bourgon, 2005; Lussier & Davies, 2011).

Studying Sexual Assault Perpetration Through Forensic DNA Evidence

Forensic DNA evidence offers another way to study sexual assault reperpetration for cases that have been reported to the criminal justice system. This approach relies on biological evidence of a reported crime, so it is critical to emphasize that an SAK is not *de facto* proof that a crime occurred. However, as a type of crime scene evidence, SAKs are unique for their level of oversight and regulation. For a DNA profile to be uploaded to CODIS, it must meet biological quality standards (number of core loci), and there must be accompanying documentation to verify that the sample was collected from a crime scene (i.e., a police report) and that the sample is from the probable perpetrator of the crime. If a sample meets these criteria, it can be uploaded to CODIS, and if that profile matches a reference sample in CODIS, the probability that the reference is the source of the SAK DNA sample is 99% or higher (United States Department of Justice, Federal Bureau of Investigation, 2000). Thus, SAKs are a rigorous and reliable data source for identifying criminal suspects, and emerging research suggests DNA profiling can curb recidivism, as offenders may be less likely to commit additional crimes because the criminal justice system has their DNA profile (Tegner, Doleac, & Landersö, 2017).

CODIS consists of two indexing systems, and the data in these systems can identify offenders associated with multiple sexual assaults. First, the offender index contains known DNA profiles from arrestees/convicted offenders, obtained at their qualifying offense (i.e., a previous criminal offense that met federal requirements for CODIS entry). When a new DNA profile is entered into CODIS, there may be an "offender hit," such that the new profile matches the DNA of a known offender profile already in the system. For example, if the DNA in an SAK matches an offender whose qualifying offense was a sexual assault, then that CODIS Hit links two separate sexual assault crimes, establishing a pattern of suspected serial sexual offending. Second, the forensic index contains unknown DNA profiles obtained at crime scenes; matches to these samples are termed *forensic hits*. If the DNA in an SAK matches a forensic sample from a previous sexual assault, that hit links two separate sexual assault crimes, establishing suspected serial sexual perpetration. Suspected serial sexual offending can also be identified when large batches of SAKs are tested *en masse* and the kits hit to each other once their profiles are uploaded to CODIS, which are often termed *case-to-case associations*. Matches within and across these index systems can link multiple cases to the same reported offender over decades.

[1] The current United States Department of Justice, Office on Violence Against Women (2013) protocol for sexual assault medical forensic exams stipulates that evidence can be collected in nonpenetrative sexual assaults given new advances in DNA technology, but historically, kits have been, and continue to be in many jurisdictions, collected only for penetrative assaults in which there is the possibility of foreign bodily fluid recovery.

Emerging research suggests that forensic DNA testing is a viable method for identifying suspected serial sexual offending. Campbell and colleagues (2015) tested a stratified random sample of $N = 1{,}595$ previously untested SAKs from Detroit, Michigan, and nearly half yielded a CODIS-eligible DNA profile ($n = 785$; 49%). When these profiles were uploaded to CODIS, they produced $n = 455$ CODIS Hits (58% of the profiles entered), and $n = 127$ hits (28% of the CODIS Hits) were to a reference sample in CODIS from another sexual assault crime and/or the match was to another SAK, revealing a pattern of suspected serial sexual offending. Lovell et al. (2017) studied a sample $N = 433$ SAKs in Cleveland, Ohio, of which $n = 245$ (56%) were connected to a suspected serial sexual offender, defined as a DNA match to another SAK or to a previous arrest for a sexual assault documented in an offender's criminal history record. The differences in the documented rates between these studies highlights the needs for research that compares rates of suspected serial sexual offending based on varying data sources and operational definitions employed.

Current Study

Although it has been well-documented that most reported sexual assaults are not adjudicated, the impact of that practice on public safety has not been widely studied. This is a challenging problem to study because it is nearly impossible to document "what happens next" for all offenders who were once reported to the criminal justice system. However, for cases with biological evidence from an SAK, forensic DNA testing can establish case associations of repeat perpetration across long periods of time. In this study, we reviewed the forensic DNA testing results from $N = 7{,}287$ SAKs from Detroit, Michigan, to answer four research questions. First, how many SAKs yielded a CODIS Hit and how many of those SAKs had a CODIS Hit in which the DNA match was to a reference sample in the offender or forensic index from a separate sexual assault case? Second, how many unique perpetrators were associated with these CODIS Hits and suspected serial sexual assaults? We expect that this number will be lower than the number of SAKs that yielded a CODIS Hit, as some offenders may be associated with multiple kits. Not all of these unique perpetrators may be identifiable, though. If the CODIS Hits were to reference samples in the forensic index of CODIS, the offender's identity is not yet known. Therefore, our third question was how many unique *and identifiable* perpetrators were documented in this sample? For identifiable offenders, it is possible to obtain their criminal history record to explore what other crimes they have committed, including other sexual assault arrests, charges, and convictions. Our fourth research question was how does adding criminal history record data change the number of unique and identifiable suspected serial sexual offenders and how many assaults were linked to each offender?

Method

Sample

The sample for this study was drawn from the population of untested SAKs in Detroit, Michigan, that was discovered in a police property storage facility in August, 2009 (see Campbell et al., 2015). A census of all SAKs in police property was conducted, current to November 1, 2009, which revealed that there were 11,219 SAKs in police storage, of which only 1,932 had been tested for DNA (Campbell et al., 2015). From 2010 to 2014, $n = 2{,}000$ SAKs were outsourced for testing for pilot research projects (Campbell et al., 2015; Pierce & Zhang, 2011), and our goal in this current project was to examine the forensic DNA testing outcomes of the *remaining* $N = 7{,}287$ SAKs from the original inventory. We did not have detailed victim, assailant, and case characteristics for these cases because, as we discovered in a pilot study, those records are not computerized, centralized, or easily linked via a common identification number (Campbell et al., 2015). However, in that pilot study, a random sample of $N = 400$ SAKs was pulled from the population of all kits discovered in August, 2009 and complete records were assembled for review, which revealed that 62.5% of the kits were associated with non–stranger-perpetrated sexual assault, and 37.5% were associated with stranger-perpetrated assaults (Pierce & Zhang, 2011). These rates are consistent with multiple epidemiological studies that indicate victims are more likely to be sexually assaulted by someone known to them (Breiding et al., 2014; Jones, Rossman, Wynn, Dunnuck, & Schwartz, 2003; Morgan & Kena, 2018; Spohn & Tellis, 2012b).

Procedures and Measures: Forensic DNA Testing Data

Testing SAKs is a multistage process and the outcomes at each stage can be quantified for statistical analysis. At Stage 0, SAKs are screened for biological evidence (e.g., semen) that can be analyzed for DNA and the probability that a kit will pass from Stage 0 to Stage I is the DNA testing rate. In this study, all SAKs were associated with a male perpetrator/male DNA. In Stage I, forensic scientists attempt to extract the DNA from the sample cells. If the resulting DNA profile has the requisite number of core loci for that specimen type, and there is reasonable belief that the sample is from the person who committed the reported crime, then in Stage II, the profile can be uploaded into CODIS (Butler, 2015). The probability that a kit will pass from Stage I to Stage II is the CODIS entry rate. Once a DNA profile is uploaded to CODIS, it is compared with all other DNA samples that have been previously entered into the indexing systems (i.e., the offender index and the forensic index). If the DNA matches to an existing profile, it is termed a CODIS Hit (Stage III) and the probability that a DNA profile will pass from Stage II to Stage III is the CODIS hit rate, which is the primary variable for answering Research Question 1. Finally, for each SAK that had a CODIS Hit, we checked what the hit was "hitting to," specifically, whether the hit was to the same DNA profile from another, separate sexual assault case (i.e., a CODIS Serial Sexual Assault Hit). The probability that a SAK will pass from Stage III to Stage IV is the CODIS serial sexual assault hit rate, which is the outcome variable for Research Question 2.

The forensic testing data are at the *SAK-level of analysis*, meaning these variables reflect how many SAKs progressed to DNA testing, yielded a CODIS-eligible profile, produced a CODIS Hit, and a CODIS Serial Sexual Assault Hit. We also constructed variables at the *perpetrator-level of analysis* to capture how many unique perpetrators were associated with these assaults. To identify the number of Unique Perpetrators, we reviewed the CODIS Hit data to find all instances when the same DNA profile yielded

two or more CODIS Hits to "de-duplicate" the data. For example, if five SAKs produced CODIS hits, but two kits contained the same DNA (e.g., they hit to each other), then there are only four Unique Perpetrators associated with those hits. Likewise, to identify the number of Unique Serial Sexual Assault Perpetrators, we reviewed the CODIS Serial Sexual Assault Hit data to identify all instances when the same DNA profile was associated with multiple sexual assault cases.

We further refined the perpetrator-level variables by distinguishing whether the forensic testing data provided information as to the perpetrator's identity. If the CODIS Hit is to an existing reference sample in the offender index, then the perpetrator is identifiable and it is possible to obtain criminal history record data to check whether there are other sexual assaults in that person's criminal career. To identify the number of Unique and Identifiable Perpetrators, we reviewed the list of Unique Perpetrators (defined above) to determine how many perpetrators had identifying information in CODIS. Similarly, to identify the number of Unique and Identifiable Serial Sexual Assault Perpetrators, we reviewed the list of Unique Serial Sexual Assault Perpetrators (defined above) to determine how many perpetrators had identifying information in CODIS. These variables assess Research Question 3.

Procedures and Measures: Criminal History Records Data

We obtained the Michigan adult criminal history records for the Unique and Identifiable Perpetrators and Unique and Identifiable Serial Sexual Assault Perpetrators who were revealed through CODIS offender index hits. The Michigan State Police Forensic Science Division submitted a list of those individuals (based on an identifying state-issued ID number) directly to the Michigan State Police Criminal History Record Division to obtain their criminal histories as of April 15, 2016. Those data were compiled and perpetrators were assigned a unique, anonymized research ID number; the research team never had access to the perpetrators' names, state-issued ID numbers, or DNA profiles. The criminal history records list every Michigan-based criminal incident associated with each offender, since age 16, by one of 449 crime code types. To address Research Question 4, we examined whether each Unique and Identifiable Perpetrator and each Unique and Identifiable Serial Sexual Assault Perpetrator had any criminal incident records (arrest, charge, or prosecution) for the Criminal Sexual Conduct codes, which are the Michigan legal codes for sexual assault. For each sexual assault incident identified, we cross-referenced the forensic testing data with the criminal history data to check whether they were potentially the same incident. When the two dates were less than 45 days apart, we considered them to be linked (i.e., likely the same sexual assault incident) and noted that as an overlap in the two data sources. These data collection procedures (for the forensic DNA testing data, described earlier, and the criminal history data, described here) were reviewed (under full board review protocol) and approved by the institutional review board for the ethical protection of human subjects in research at Michigan State University.

Data Analytic Plan

For the variables at the *SAK-level of analysis*, we counted how many SAKs progressed through each stage of forensic DNA testing and conducted continuation-ratio modeling to obtain unconditional and conditional rate estimates, as well as their 95% confidence intervals (CIs; Agresti, 2002; Hosmer, Lemeshow, & Sturdivant, 2013). Continuation-ratio models are useful statistical models for examining sequential selection processes and in this application, we included main effects for testing stage while omitting the intercept term; this allowed us to provide estimates for the DNA Testing (Stage I), CODIS Entry (Stage II), CODIS Hit (Stage III), and CODIS Serial Sexual Assault Hit Rates (Stage IV), as well as their 95% CIs. All continuation-ratio model analyses were implemented using R software, Version 3.4.1 (R Development Core Team, 2017). For the variables at the *perpetrator-level of analysis*, we counted how many sexual assaults each offender was suspected of committing, based on the number of unique SAKs that were linked to his DNA, and when applicable, the number of sexual assault incidents documented in his criminal history records. These variables were used to obtain the mean, standard deviation, and range for the number of suspected sexual assaults committed. All data files, analysis scripts, raw statistical output, and other documentation required to reproduce the analyses were deposited in the National Archive of Criminal Justice Data.

To add context to these descriptive counts, we selected three case study examples to highlight how forensic DNA testing identified suspected serial sexual assault perpetrators: one Unique Serial Sexual Perpetrator, one Unique and Identifiable Serial Sexual Perpetrator (based only on information available in CODIS), and one Unique and Identifiable Serial Sexual Perpetrator (based on information available in CODIS and criminal history records). Case study selection methods vary depending on whether the researcher seeks to present common effects and/or delineate the boundaries by highlighting extreme cases (Emmel, 2013). Approximately 95% of the sample of identifiable perpetrators had five or fewer assaults linked to their DNA, so we selected two case studies within this bound, and for the third case study, we selected a case to illustrate the upper end of the distribution. We do not have much information about victim demographics or assault characteristics because the data sources we had access to did not consistently provide this information (again, these were reported assaults that law enforcement closed without much investigation), but we do know all victims are female and the vast majority are African American. We present as much information as we have about each victim in each case study. We also note that we do not have data on the final legal disposition of these cases, as most were still under review at the prosecutor's office at the time this project concluded.

Results

Question 1: How Many SAKs Yielded a CODIS Hit and a CODIS Serial Sexual Assault Hit?

Figure 1 summarizes the forensic testing outcomes of the $N = 7,287$ SAKs that comprise this study's sample. All $N = 7,287$ were submitted for testing and screened for DNA, and $n = 5,048$ SAKs progressed to DNA testing (69.3% unconditional DNA Testing

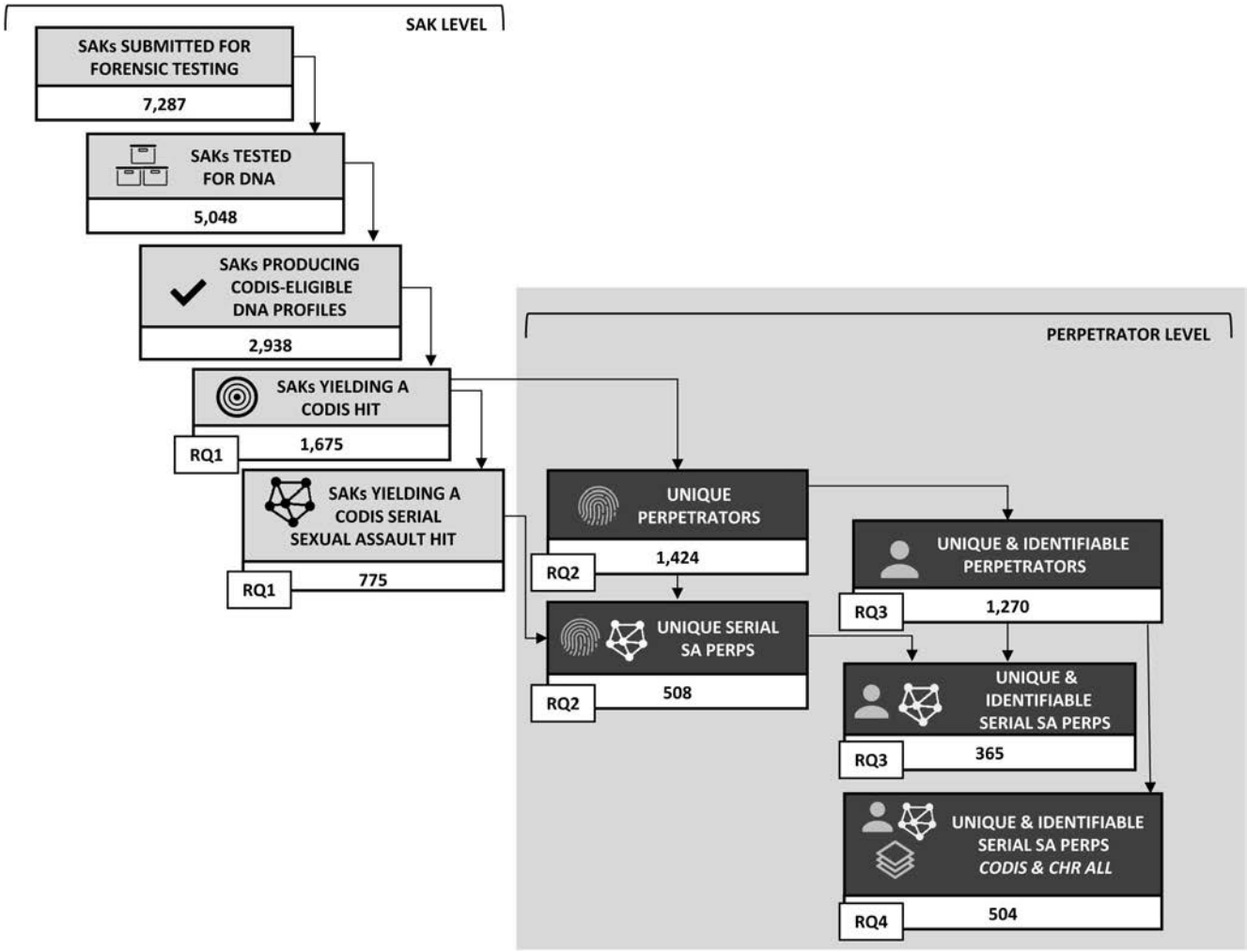

Figure 1. Forensic testing outcomes from $N = 7{,}287$ sexual assault kits (SAKs).

Rate, 95% CI [68.2%, 70.3%]).[2] A total of $n = 2{,}938$ SAKs had a DNA profile that met eligibility for upload into CODIS (40.3% unconditional CODIS Entry Rate, 95% CI [39.2%, 41.4%]), and $n = 1{,}675$ SAKs yielded a CODIS Hit (22.9% unconditional CODIS Hit Rate, 95% CI [22.0%, 24.0%]). When reviewing the forensic testing data, we noticed that some SAKs produced more than one CODIS Hit. Typically, there is a one-to-one ratio, such that a kit will produce, at most, one hit: a single-perpetrator sexual assault in which one unique DNA profile is extracted and uploaded into CODIS, and matched an existing reference sample in CODIS. However, in multiple-perpetrator assaults (i.e., gang sexual assaults), more than one unique DNA profile may be extracted from a single SAK. If multiple DNA profiles are uploaded to CODIS (one for each perpetrator), they might hit to different reference samples in CODIS, and thus, in multiple-perpetrator assaults, one SAK could produce multiple CODIS Hits (i.e., hits to two or more separate offenders). In this data set, there were $n = 15$ SAKs that produced more than one CODIS Hit: $n = 14$ SAKs produced two hits (i.e., two perpetrators committed the assault) and $n = 1$ SAK produced three hits (i.e., three perpetrators committed the assault). Thus, the total number of CODIS Hits was $n = 1{,}691$ from $N = 7{,}287$ SAKs tested (23.2% unconditional CODIS Hit Rate, 95% CI [22.2%, 24.2%]).

For each SAK that had a CODIS Hit, we checked whether the hit was to another sexual assault case and, in this study, $n = 775$ SAKs produced a CODIS Serial Sexual Assault Hit (10.6% unconditional CODIS Serial Sexual Assault Hit Rate, 95% CI [9.9%, 11.4%]). The total number of CODIS Serial Sexual Assault Hits did not change when we took into consideration the $n = 15$ SAKs that produced more than one CODIS Hit (see above). A sizable number of these CODIS Serial Sexual Assault Hits were a hit to an existing reference sample in the offender index of CODIS for which the qualifying offense was a different sexual assault ($n = 169$, 21.8%, 95% CI [19.0%, 24.9%]). Similarly, there were many CODIS Serial Sexual Assault Hits to an existing reference sample in the forensic index of CODIS for which the forensic sample was

[2] Unconditional rates use the total number of SAKs submitted for testing ($N = 7{,}287$) as the denominator for the proportion.

collected from another/different sexual assault crime scene (n = 170, 21.9%, 95% CI [19.1%, 25.0%]). However, most CODIS Serial Sexual Assault Hits were case-to-case associations of SAKs tested in this project matching to other SAKs also in this project *that also hit to* existing forensic samples in CODIS from other sexual assault crime scenes (n = 292; 37.7%, 95% CI [34.3%, 41.2%]).

We used continuation ratio modeling to obtain plausible ranges for conditional testing rates (DNA Testing Rate, CODIS Entry Rate, CODIS Hit Rate, CODIS Serial Sexual Assault Hit Rate). Only the first stage of this process, DNA Testing Rate, is an *unconditional* rate, where the denominator is the total number of SAKs tested; thereafter, conditional rates can be computed.[3] The *unconditional* DNA Testing Rate was 69.3% (95% CI [68.2%, 70.3%]) and of the SAKs that progressed to the stage of DNA testing, 58.2% produced a CODIS-eligible DNA profile (*conditional* CODIS Entry Rate; 95% CI [56.8%, 59.6%]). Of the SAKs that had a DNA profile uploaded into CODIS, 57.0% produced a CODIS Hit (*conditional* CODIS Hit Rate; 95% CI [55.2%, 58.8%]). Of the SAKs that produced a CODIS Hit, 46.3% matched to another sexual assault documented in CODIS (conditional CODIS Serial Sexual Assault Hit Rate; 95% CI [43.9%, 48.7%]). A post hoc power analysis was conducted in PASS (2018, Version 16) to solve for sample size requirements for the rates from the continuation-ratio model. The power analysis estimated that for a 95% CI for a proportion with a defined precision level (CI width) of 0.05 and using the most conservative proportion of 0.5, the sample size required was n = 1,533.

Question 2: How Many Unique Perpetrators Were Associated With These CODIS Hits and CODIS Serial Sexual Assault Hits?

Figure 1 also depicts the transition from the SAK-level variables to the perpetrator-level variables, which reflect how many individuals committed these sexual assaults. There were n = 1,424 Unique Perpetrators associated with the n = 1,675 SAKs that produced a CODIS Hit. Furthermore, there were n = 508 Unique Serial Sexual Assault Perpetrators associated with the n = 775 Serial Sexual Assault CODIS Hits. Table 1 (first column) presents the frequency distribution of the number of suspected sexual assaults committed by these n = 508 offenders. Most of these perpetrators (n = 358 of 508, 70%) had two sexual assaults documented via forensic DNA/CODIS, but a sizable percentage (30%) had DNA evidence linking them to more than two sexual assaults: M = 2.64 sexual assaults documented in DNA/CODIS (SD = 1.37), range 2 to 12 sexual assaults.

Each of the 508 Unique Serial Sexual Assault Perpetrators represents an offender who had sexually assaulted multiple women. Figure 2 presents a case study example of one of these histories (Case A). In November 1993, a 19-year-old African American woman was walking home from a local store when an unknown man grabbed her by the neck and forced her into an alley and sexually assaulted her. The next day, she went to a hospital emergency department to have a sexual assault kit collected. She signed the release to have the kit submitted for testing and reported the assault to the police. The police did not submit the kit for DNA testing and instead put the untested SAK in storage. One month later, another woman was sexually assaulted by a stranger; she too reported the assault to the police and consented to the collection of an SAK, but the police put the untested kit in storage. A year later, a 13-year-old African American girl was walking home from a local store when an unknown man grabbed her, pulled her into an abandoned building, and sexually assaulted her. The next morning, she went to the hospital for SAK collection and to file a police report. Her kit was also placed in storage, untested. Seven years later, another woman was sexually assaulted by a stranger; she had an SAK collected and reported to the police. Law enforcement personnel submitted this last kit for forensic DNA testing and a profile was uploaded to the forensic index of CODIS. There were no matches to that sample when it was uploaded and the case remained unsolved for years. In April 2015, a batch of kits found in that police storage facility were tested and a single perpetrator was associated with all four reported sexual assaults.

Question 3: How Many Unique and Identifiable Perpetrators Were Associated With These CODIS Hits and CODIS Serial Sexual Assault Hits?

We reviewed the CODIS Hits associated with Unique Perpetrators and Unique Serial Sexual Assault Perpetrators to determine how many offenders were identifiable because of hits to reference samples in the offender index of CODIS. A substantial number of the n = 1,424 Unique Perpetrators were identifiable, as we documented n = 1,270 Unique and identifiable Perpetrators in this sample. Likewise, many of the n = 508 Unique Serial Sexual Assault Perpetrators were identifiable, as n = 365 were Unique and Identifiable Serial Sexual Assault Perpetrators. Most of these suspected serial sexual perpetrators (n = 256 of 365, 71%) had two sexual assaults documented via forensic DNA/CODIS, though some committed many more: M = 2.67 sexual assaults documented in DNA/CODIS (SD = 1.47), range 2 to 12 sexual assaults (see Table 1, second column, for frequency distribution).

Figure 3 presents a case study example of one of 365 Unique and Identifiable Serial Sexual Assault Perpetrators (Case B). In 1989, a woman was sexually assaulted, had an SAK collected and reported to the assault to the police; there are no records indicating that the suspect was identified or arrested, and the untested SAK was placed in storage. Three years later, another woman was sexually assaulted, and she reported the crime to the police and had an SAK collected, but no arrest was made nor was the kit tested. One year thereafter, a 17-year-old woman was sexually assaulted and had an SAK collected. She reported to the police, but the SAK was not tested and it does not appear that the case was investigated. In 2015, these kits were pulled from storage and submitted for forensic DNA testing, and their profiles hit to each other and to a reference sample in the offender index, which revealed the identity of the offender. The qualifying offense for that reference sample was another/different sexual assault case, indicat-

[3] They are conditional on having reached a specific stage of testing, so the denominator for each of these rates is the number of SAKs that passed all previous stages of testing. The first rate in the set is unconditional only because it corresponds to the first-stage transition (it is only conditional on being submitted for testing).

Table 1
Number of Suspected Sexual Assaults Committed by the Subsample of Unique Serial Sexual Assault Perpetrators and the Subsample of Unique and Identifiable Serial Sexual Assault Perpetrators, by Data Source

No. of sexual assaults suspected of committing	No. of unique serial sexual assault perpetrators, based on DNA testing/CODIS (n = 508) (%)	No. of unique and identifiable serial sexual assault perpetrators, based on DNA testing/CODIS (n = 365) (%)	No. of unique and identifiable serial sexual assault perpetrators, based on DNA testing/CODIS and criminal history records (n = 504)
2	358 (70.5)	256 (71.0)	249 (49.4)
3	79 (15.6)	52 (14.2)	125 (24.8)
4	31 (6.1)	24 (6.6)	51 (10.1)
5	15 (3.0)	11 (3.0)	22 (4.4)
6	10 (2.0)	7 (1.9)	18 (3.6)
7	5 (1.0)	2 (0.5)	5 (1.0)
8	4 (0.8)	4 (1.1)	15 (3.0)
9	3 (0.6)	3 (0.8)	6 (1.2)
10	1 (0.2)	1 (0.3)	6 (1.2)
11	1 (0.2)	1 (0.3)	4 (0.8)
12	1 (0.2)	1 (0.3)	1 (0.2)
13	0 (0)	0 (0)	1 (0.2)
14	0 (0)	0 (0)	0 (0)
15	0 (0)	0 (0)	1 (0.2)
Total	508 (100.0)	365 (100.0)	504 (100.0)

Note. CODIS = Combined DNA Index System.

ing that four sexual assaults were linked to the same, now known, perpetrator.

Question 4: Do Criminal History Record Data Change the Number of Unique and Identifiable Suspected Serial Sexual Offenders and How Many Assaults Were Linked to Each Offender?

Thus far, we have presented results based *only* on forensic DNA testing results and matches via CODIS. We also obtained the Michigan adult criminal history records for all identifiable offenders to determine if there were other documented sexual assaults in their criminal histories. As noted previously, we checked whether the sexual assaults documented in the criminal history records could plausibly be the same incidents as the SAKs/CODIS hits (and therefore, should not be counted as an additional sexual assault incident). Indeed, there were 223 criminal sexual conduct incidents (associated with 203 perpetrators) in the criminal history records that may have overlapped with CODIS hits we had already documented. To ensure that these incidents were not double counted, we noted that it was an incident documented through both CODIS and through criminal history records (and only counted it once).

The examination of the criminal history records, however, revealed many more criminal sexual conduct incidents that were *not* documented in CODIS, meaning that many perpetrators had other sexual assault arrests, charges, or convictions. These data shift not only how many people could be classified as a suspected serial sexual perpetrator, but also the number of assaults committed. For example, if an identifiable perpetrator was associated with only one SAK, and the CODIS Hit associated with that SAK did *not* hit to another sexual assault case, then that individual would have been classified as a Unique and Identifiable Perpetrator, but not as a Unique and Identifiable Serial Sexual Assault Perpetrator because, based solely on the forensic DNA testing/CODIS information, there was no indication that person was suspected of committing another sexual assault. However, if that offender's criminal history records revealed another sexual assault (different from the assault associated with the SAK), then the classification would change to suspected serial sexual assault perpetrator (and thus, number of Unique and Identifiable Serial Sexual Assault Perpetrators would increase). As shown in Figure 1, that number did indeed increase from n = 365 to n = 504 when we included criminal history record data. Thus, of the 1,270 Unique and Identifiable Perpetrators in this sample, n = 504 (39.7%) had a record of two or more sexual assaults, when drawing information from both CODIS and criminal history records. Based only on data available in CODIS, 28.7% of the subsample of Unique and Identifiable Perpetrators were suspected sexual serial assault offenders, but a fuller review of their criminal histories revealed that 39.7% were suspected of committing multiple sexual assaults. These n = 504 perpetrators committed on average three sexual assaults: M = 3.27 (SD = 2.02), range 2 to 15 sexual assaults (see Table 1, third column for frequency distribution).

Figure 4 presents a case study example of one of these 504 Unique and Identifiable Serial Sexual Assault Perpetrators, identified by both forensic DNA testing/CODIS and criminal history records data (Case C). From 1993 to 1995, eight women were sexually assaulted by the same unknown (stranger) offender: Each had an SAK collected, each reported to the police, and each SAK was placed in storage, untested. From 1995 to 2002, four additional women were sexually assaulted by the same unknown offender. These women also reported to the police, but did not have SAKs collected. In those cases, the police did investigate, and through other evidence, they were able to identify the perpetrator, who was convicted four different times for criminal sexual conduct. In the first of these four convictions, there was no evidence the perpetrator had committed a previous sexual assault, as none of the SAKs from the previous cases had been tested. For his subsequent convictions, his previous criminal sexual conduct convic-

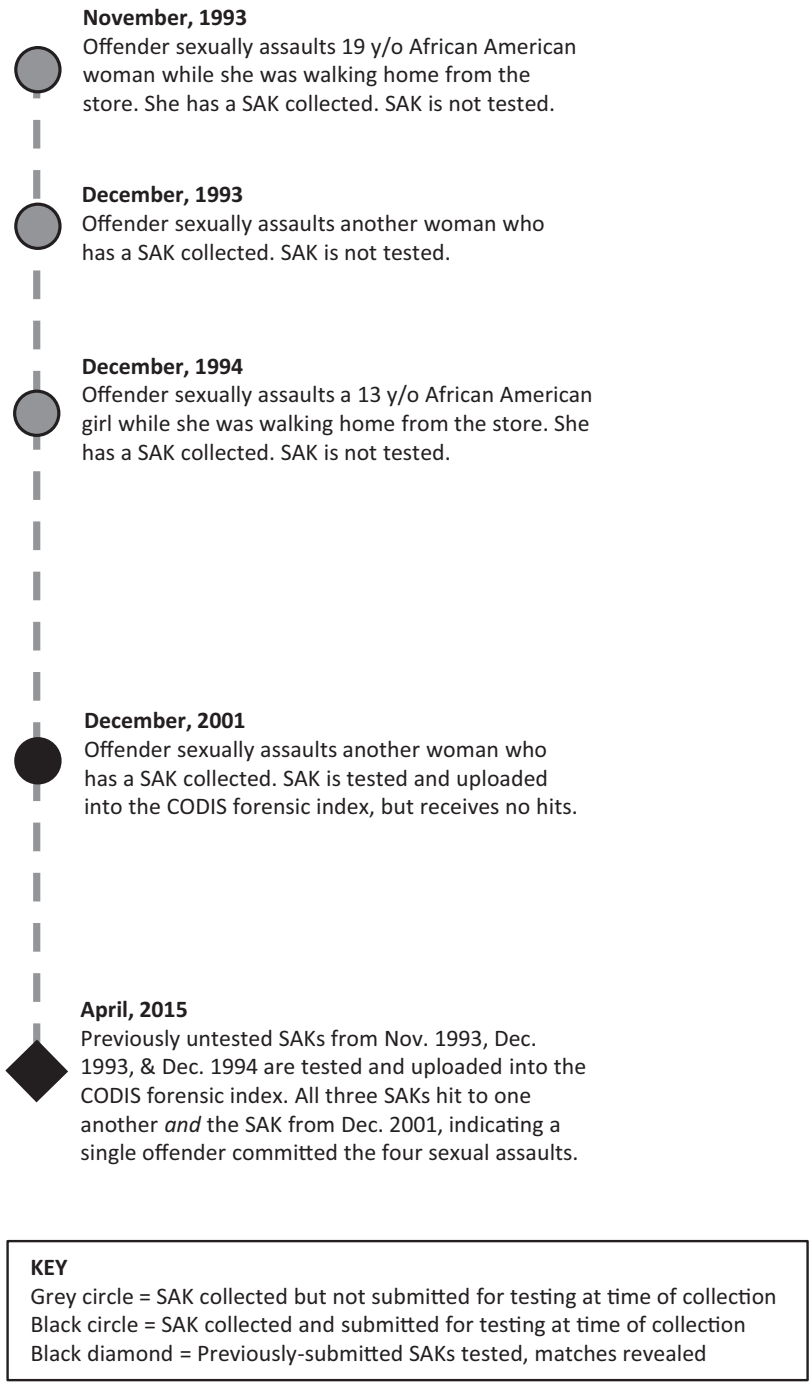

Figure 2. Case Study A: A Unique Serial Sexual Assault Perpetrator identified through CODIS forensic index hits. SAKS = sexual assault kits.

tions were documented, but no information from the SAKs was available because eight SAKs remained untested in storage. In 2015, all of these previously untested SAKs were finally submitted for forensic DNA analysis, and they all hit to each other and to a reference sample in the offender index, for which the qualifying offense was another/different sexual assault case. Taken together, 13 sexual assaults linked to this perpetrator.

Discussion

Only a small proportion of sexual assaults that are reported to the criminal justice system result in a conviction (Lonsway & Archambault, 2012), so many perpetrators are free to reoffend. However, the most commonly used data source to study repeat sexual offending—criminal justice records—are limited in their

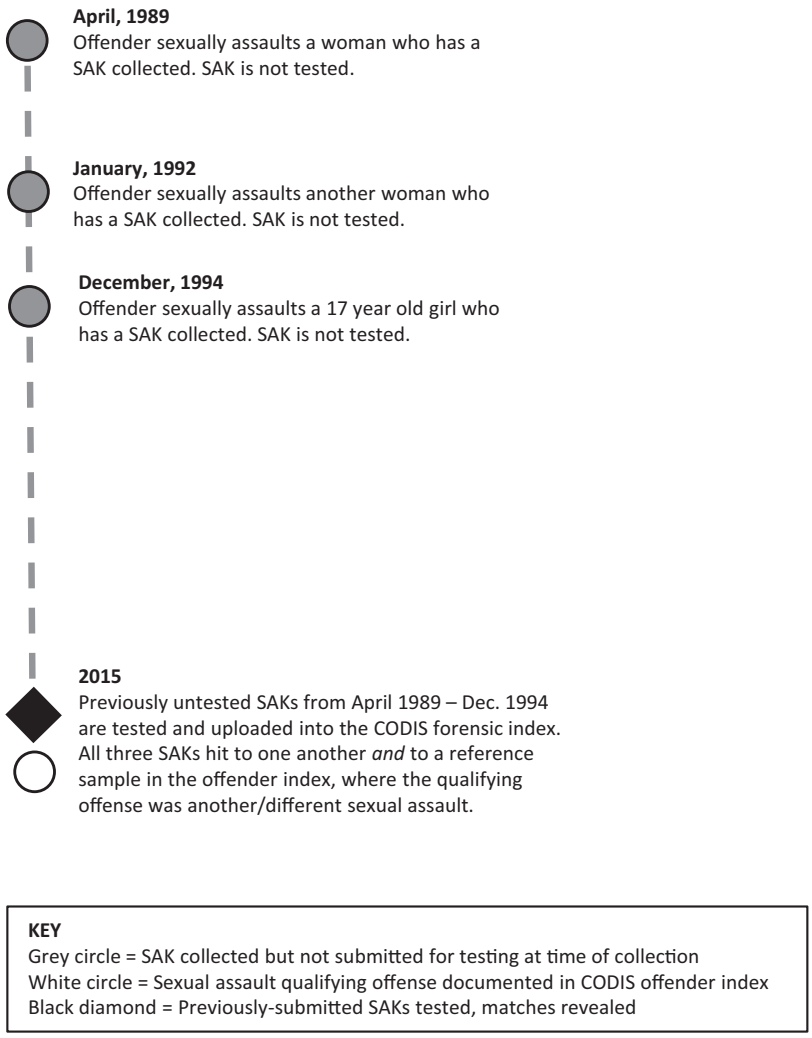

Figure 3. Case Study B: A Unique and Identifiable Serial Sexual Assault Perpetrator identified through CODIS offender and forensic index hits. SAKS = sexual assault kits.

ability to illustrate how frequently offenders who are reported to law enforcement for a sexual assault are able to "slip through the cracks" and perpetrate additional assaults. Because criminal justice data typically select participants based on a sexual assault conviction or incarceration, their conviction status places them in the small minority of sexual assault perpetrators and therefore may limit the generalizability of their perpetration patterns. Data from previously untested SAKs extend the utility of criminal history records by identifying instances when a fuller investigation of a reported sexual assault could have impacted the resolution, or even occurrence, of a later assault. Testing previously unsubmitted SAKs offers the opportunity to see what reported perpetrators do when they are not apprehended, and can provide unique insight on rates of suspected serial sexual offending.

We explored this issue with a sample of $N = 7{,}287$ previously untested SAKs from Detroit, Michigan, and found that 23% of the SAKs yielded a CODIS Hit and 10% yielded a CODIS Serial Sexual Assault Hit (unconditional rates, Research Question 1). The forensic DNA testing results indicated that more than one third (35.7%) of Unique Perpetrators were suspected serial sex offenders (Research Question 2) and just less than one third (28.7%) of Unique and Identifiable Perpetrators were suspected serial sex offenders based only on information available via DNA testing/CODIS (Research Question 3). When criminal history data were included in our analysis, the percentage of *identifiable* suspected serial sexual offenders increased to 39.7% (Research Question 4). This operational definition includes previously untested SAKs and CODIS entry offenses, and also other arrests, charges, or convictions for sexual assault that had not involved CODIS entry. As expected, the suspected serial sexual perpetration rate identified in this study is substantially higher than what has been found in recidivism studies (typically 8–15%), which supports our key concern that criminal history data underestimate the scope of this problem. In comparison with other studies that have used forensic DNA evidence to identify suspected serial sexual offenders, the rates in this study are higher than what was reported in Campbell et al. (2015), most likely because we drew upon both DNA evidence and criminal history records; however, these rates are

Figure 4. Case Study C: A Unique and Identifiable Serial Sexual Assault Perpetrator identified through CODIS offender index hit and criminal history records data. SAKS = sexual assault kits.

lower than what was documented in Lovell et al. (2017), which also used both data sources. There are key setting-level (e.g., city) and methodological (e.g., sampling) variations between these studies, and future research is needed to clarify how these differences affect documented rates of suspected serial sexual perpetration.

What do these figures tell us about missed opportunities for law enforcement intervention? Most strikingly, they indicate that nearly four out of 10 sexual offenders in our sample were reported to law enforcement for a sexual assault, a report that was most often ignored rather than thoroughly investigated, and they were

able to sexually offend again. In Case Study A (Research Question 2), three women were victimized by the same perpetrator from 1993 to 1994 (i.e., a Unique Perpetrator). All three women had SAKs collected, but the kits were never tested and the connection between the three assaults was unknown until they were uploaded to CODIS in 2015 and hit to each other, as well as to a fourth case that had been entered into CODIS in 2001. Because there was no reference sample for the perpetrator in CODIS, testing the SAKs would not have resolved the identity of the perpetrator, but it would have alerted law enforcement to the existence of a suspected serial sexual perpetrator, one who victimized three women in a 13-month period. It is difficult to gauge whether this knowledge would have increased the investigative effort to identify the offender, and equally difficult to say whether this knowledge could have facilitated his apprehension before the 2001 assault. It is likely, however, that these connections would have been of interest to the law enforcement officers tasked with investigating these cases.

Case Study B (Research Question 3) illustrates a different type of missed opportunity, one in which SAK testing can identify an offender (i.e., a Unique and Identifiable Perpetrator). In this case study, three women were sexually assaulted from 1989 to 1994, and all three consented to medical forensic evidence collection. Similar to the case study above, the three SAKs were not tested until 2015, at which time the connection between the kits was discovered. The DNA profile from these SAKs also hit to a reference sample in the offender index of CODIS, thereby identifying the likely perpetrator of these three previously unsolved sexual assaults. Without knowing the date that the reference sample was entered into the offender index, we cannot know at what point in the offense series this perpetrator could have been identified. What we do know is that had the 1989–1994 SAKs continued to sit in police property storage, the perpetrator of these crimes would likely have remained unknown, withholding closure from the victims and important contextual information from the criminal justice system that could inform this offender's sentencing for later crimes.

The final case study (Case C, Research Question 4) highlights yet another scenario of missed opportunities, one in which the possibility for earlier apprehension of the perpetrator is even more striking due to multiple SAKs and criminal history records that were associated with this Unique and Identifiable Perpetrator. Though eight separate SAKs had been submitted to law enforcement from this perpetrator's victims from 1993 to 1995, the perpetrator appears not to have been investigated or apprehended until he was convicted for an additional sexual assault perpetrated in 1995, a case in which no SAK was collected. When the perpetrator was convicted for that 1995 assault, there was no record of previous assaults and although we do not have access to his sentencing information, his ability to commit three subsequent assaults before 2002 suggests that he was not incarcerated for more than a few years, if at all. When he was convicted for the three subsequent sexual assaults, there was the record of his 1995 conviction, but no indication of the eight additional assaults committed from 1993 to 1995. These assaults were not linked until the eight previously untested SAKs were analyzed in 2015, at which time the perpetrator's full pattern of offending became clear. In this case, the response of the criminal justice system was based on incomplete information and encourages reflection on what the response might have been if the information from the 1993–1995 SAKs had been readily available.

It may be tempting to believe that individual reports of sexual assault can somehow indicate to us who is most likely to reoffend, and that law enforcement officers are able to recognize and prioritize those cases. However, the SAKs included in this sample represent victim reports that were overwhelmingly ignored and the finding that nearly 40% of the perpetrators identified through these SAKs went on to reoffend suggests that future serial offenders are not apprehended the first, or even second, time they are reported to the police. Victims are impacted by these missed opportunities not only by wondering whether their assault could have been prevented, but also by the absence of closure that might have come from perpetrator identification and arrest. The general public is impacted as well, not only by the possibility of increased violence, but also by the institutional betrayal of knowing that young women and girls, in this case mostly young, poor, African American women and girls, were routinely ignored by a system meant to protect them. Underresourced police departments often cite the cost of SAK testing as prohibitive, but we must not forget that there is also a cost to *not* testing SAKs.

Limitations

As with any study, there are limitations to these findings. This research was carried out in Detroit, a city that is racially unique compared with other U.S. cities (82% African American in the 2000 Census, 83% in the 2010 Census) and that experiences an unusually high rate of violent crime (second highest violent crime rate in the United States based on the 2000 FBI Uniform Crime Report [UCR], highest violent crime rate in the United States based on the 2010 UCR). These dynamics may have affected the police response to sexual assault in ways that are difficult to quantify and may therefore impact the generalizability of our data. Furthermore, this study examined the experiences of select subpopulations of sexual assault survivors and offenders. All victims had an SAK collected and reported their assaults to the criminal justice system, and previous research indicates that most survivors do *not* seek these formal help sources (Ullman, 2010). Although these actions are less typical for survivors, it is no less important to understand what happened to those who did seek this help in effort to improve the community response to sexual assault. Likewise, the offenders we studied are atypical in that most are never reported to the criminal justice system, and those who are reported probably do not have DNA profiles in CODIS. The national problem of untested SAKs means that hundreds of thousands of DNA profiles have not been entered into CODIS (Campbell et al., 2017), and in this study, a substantial proportion of our SAKs did *not* yield a CODIS hit (77% unconditional rate). Federal efforts to improve SAK evidence collection techniques and storage (SAFER Act of 2017) and DNA testing (Bureau of Justice Assistance [BJA], 2018) could increase rates of CODIS eligible profiles, CODIS Hits, and CODIS Serial Sexual Assault Hits in the future, and evaluations of these initiatives are warranted.

We also acknowledge that the data sources we drew upon for this study did not provide extensive information about victim, offender, and assault characteristics, as this information is not stored with the SAKs and is not feasibly accessible (i.e., not computerized, not centrally stored, not consistently linked by a

unique identification number). As such, our case studies do not provide the level of rich detail typical in qualitative work, but what we could piece together substantiates concerns that when offenders are not held accountable, many will go on to commit additional sexual assaults. We also note that because we had access only to adult criminal history records within the state of Michigan, we do not have information about crimes committed as juveniles, crimes committed in other states, or crimes committed in federal jurisdiction, so our results may also underestimate the true rate of suspected serial sexual offending.

Implications for Research and Criminal Justice Practice

With these limitations in mind, the results of this study indicate that SAK testing can help connect the dots to reveal a more complete picture of perpetrators' behavior than what is documented in criminal history records alone. For future research, this means that forensic DNA evidence is an important data source to consider in the study of repeat sexual assault perpetration. Our findings emphasize the importance of using both forensic DNA evidence and criminal history records, as either alone will underestimate reoffending rates. To date, this approach to documenting repeat perpetration has been used only in large, urban cities with high crime rates, and replication of these findings is sorely needed in other jurisdictions of varying sizes and lower overall levels of criminal activity. For criminal justice practice, these results emphasize the utility of testing SAKs for forensic DNA evidence, as even older SAKs can still provide probative leads. The sizable number of suspected serial sexual offenders identified in our study should encourage law enforcement officers to approach investigations as suspected serial, rather than isolated incidents, and conduct criminal history record checks for identified offenders. Our findings invite reflection on the crimes that *could* have been prevented with earlier identification and apprehension of the perpetrator, but that is not to say all of them *would* have been prevented. What is clear is that the failure to investigate sexual assault reports and test SAKs creates opportunities for perpetrators to slip through the cracks and reoffend.

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