



High rates of sexual assault kit submission and the important role of place

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1. Introduction

Over the past two decades in the United States, the popular press, advocacy organizations, and social scientists have been documenting and reporting on large piles of unsubmitted sexual assault kits in jurisdictions across the country (see [Campbell, Feeney, Fehler-Cabral, Shaw, & Horsford, 2017](#) for a review). Sexual assault kits are used by medical providers to collect and preserve potential evidence of a sexual assault to aid in the criminal investigation and prosecution of this crime. In order for the contents of the sexual assault kit to be used in this way, the kit must be transported from the facility in which it was collected to a crime laboratory for analysis. Unsubmitted sexual assault kits are those kits that have been collected by a medical provider, but that have not been submitted to a crime lab for analysis. Unsubmitted sexual assault kits are a problem in and of themselves, as a failure to submit and analyze them prevents their contents from being used in criminal proceedings. Unsubmitted sexual assault kits also serve as tangible evidence of a broader problem: the less-than-thorough criminal justice system response to sexual assault. In recent years, initiatives at state and federal levels have funneled resources into tackling the national problem of unsubmitted sexual assault kits (e.g., see [Bettinger-Lopez, 2016](#); [National Institute of Justice, 2017](#)). Still, to combat this problem, we need to know more about the practice of submitting and analyzing sexual assault kits. Specifically, we need to know more about the scope of the problem by documenting rates of kit submission in locales that are currently unaware of the extent of the problem in their communities. We need to know more about what contributes to this problem so we can develop viable solutions. And we need to determine if there are communities that demonstrate high rates of kit submission (or low rates of unsubmitted kits) that can be further studied to identify factors that support their success. Accordingly, the purpose of the present study is threefold. First, we aim to document for the first time the rates of sexual assault kit submission across one entire state. Second, we aim to examine what predicts sexual assault kit submission as a means to identify potential leverage points for change. Third, we aim to determine if there are communities anywhere in the focal state with relatively better rates of kit submission from which we can learn.

1.1. The role of the sexual assault kit in the criminal justice system

Following a sexual assault, victims may choose to undergo a medical forensic exam, complete with a sexual assault kit. The sexual assault kit is collected by a medical provider and consists of taking a medical forensic history; collecting the patient's clothing, underwear, and any foreign material present on the body; documenting injuries through diagrams, descriptions, and photographs; collecting hair samples; and taking oral, vaginal, penile, anal, and body swabs ([U.S. Department of Justice Office on Violence Against Women, 2013](#)). Ideally, the kit is collected by a sexual assault nurse examiner (SANE). SANEs are medical providers who have completed extensive training in the medical first response to sexual assault ([Shaw, Campbell, & Day, 2017](#)). Regardless of if the kit is collected by a SANE or non-SANE medical provider, the process is invasive and can take several hours. Still, victims often consent to a sexual assault kit because they believe the kit will provide evidence of the assault, help identify the offender in cases of stranger assault, and provide a means for holding the offender accountable for their actions ([Du Mont, White, & McGregor, 2009](#); [Patterson & Campbell, 2010](#); [Tofte, 2010](#)).

Once the kit has been collected, it must be transported to a crime laboratory for analysis. In the vast majority of communities, the police department with jurisdiction over the locale in which the assault occurred is responsible for picking up the kit and transporting it to the crime lab ([Hendrix, Strom, Parish, Melton, & Young, 2019](#)). Once at the laboratory, the kit undergoes a multistage process that involves biological screening and DNA analysis that may result in a DNA profile ([U.S. Department of Justice Office on Violence Against Women, 2013](#)). DNA profiles that meet the requirements for entry into the Combined DNA Index System (CODIS) may be uploaded, and may generate investigative leads by providing information on the identity of the offender, or other crimes committed by the same offender ([Campbell et al., 2017](#); [Federal Bureau of Investigation, 2020](#)). This information can then be combined with other investigatory information to identify or eliminate suspects and move the case forward. The investigative insight gained from the kit findings may help prepare a case for successful prosecution and prevent criminal charges from being filed in error. Such information can also help inform other cases and identify

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serial offenders (e.g., see Campbell et al., 2019; Lovell et al., 2017).

1.2. The problem of unsubmitted sexual assault kits

Though forensic testing of sexual assault kits is required in order for kit contents to aid in criminal investigations, all too often sexual assault kits are never submitted to a crime laboratory for analysis. Indeed, stockpiles of unsubmitted sexual assault kits have been found in jurisdictions across the country (Campbell et al., 2017; Campbell, Shaw, & Fehler-Cabral, 2015; Human Rights Watch, 2010; Lovell, Luminai, Flannery, Bell, & Kyker, 2018; Peterson, Johnson, Herz, Graziano, & Oehler, 2012; Reilly, 2015; Sacco & James, 2015; Tofte, 2009b). New York City, Los Angeles, Illinois, and Detroit were among the first locales reported to have piles of unsubmitted kits (Peterson et al., 2012; Tofte, 2009a, 2009b, 2010). Many other communities across the United States were to soon follow, each reporting somewhere between 200 and 16,000 unsubmitted kits (Campbell et al., 2017). In 2010, Strom and Hickman employed a nationally representative survey of local and state police agencies in an attempt to understand better the full scope of the problem of unsubmitted forensic evidence. Based on survey responses, Strom and Hickman estimated that from 2003 to 2007, 18% of unsolved rape cases in the United States had forensic evidence that had never been submitted to a crime lab for analysis. Five years later, USA Today (Reilly, 2015) released the findings of an investigative reporting project: they counted more than 70,000 unsubmitted sexual assault kits across 1000 police agencies. It was noted, though, that the count included only a “fraction of the nation’s 18,000 police departments, suggesting the number of untested rape kits reaches into the hundreds of thousands” (Reilly, 2015). However, the full scope of the problem is yet to be determined, as many locales are unaware of the extent to which this national problem manifests in their own communities.

The discovery and documentation of unsubmitted sexual assault kits within specific communities provides a raw count of the number of unsubmitted kits within those communities. However, the rate of submission (i.e., the proportion of kits submitted out of the total number of kits collected), and an understanding of what predicts submission of some kits over others, remains unknown in these settings. To produce rates and predictors of rape kit submission, it is necessary to include in the sample both unsubmitted and submitted sexual assault kits. Only then can rates and predictors of sexual assault kit submission be explored. This has been done in just a handful of studies. In examining rates and predictors of sexual assault kit submission among kits completed by SANEs for adult patients from 1999 to 2005 in one Midwestern county, Patterson and Campbell (2012) found a kit submission rate of 58.6%. The researchers found that kits were more likely to be submitted to the crime lab when there were documented physical injuries and when the responding police agency had a higher level of engagement with the SANE program. Kits were less likely to be submitted when the victim washed or bathed after the assault. In examining adolescent (13–17 years old) sexual assault cases completed by SANEs in two Midwestern communities between 1998 and 2007, Shaw and Campbell (2013) reported that 59.3% of the kits had been submitted for analysis. Cases involving “non-White” victims, victims under the age of consent, and a greater number of assaultive acts were more likely to be submitted to the crime lab whereas cases that involved multiple offenders were less likely to be submitted.

In a third study, Valentine et al. (2019) examined rates and predictors of sexual assault kit submission from 2010 to 2013 across four SANE sites in one Western state. Three sites consisted of a single county served by a county SANE team, while the fourth site consisted of four counties served by a single SANE team. The four sites included rural, midsized, and urban communities; represented 40% of the state’s law enforcement agencies; and covered 65% of the state’s population. Only 38.2% of the kits included in the study were submitted to the crime lab for analysis. Kits were more likely to be submitted if the cases involved male victims, and if it was a suspected drug-facilitated sexual assault.

Kits were less likely to be submitted if the victim was using drugs near the time of the assault, bathed or showered following the assault, knew the suspect (i.e., not a stranger assault), or had physical or mental impairments. Valentine and colleagues highlighted the importance of not just submitting the kit, but submitting soon after the assault so that kit contents could readily inform the investigation. Accordingly, in addition to examining what predicted kit submission overall, they also examined what predicted kit submission within one month of the kit being collected. They found that cases involving stranger assaults were more likely to be submitted to the crime lab within one month. Cases involving multiple offenders and in which more time had passed between the time of the assault and time of the exam were less likely to be submitted to the lab for analysis within the first month. Beyond these individual case variables, though, site location (i.e., at which SANE program site the kit was collected) was found to be the most significant predictor of kit submission in this study.

Taken together, these three studies suggest that victim characteristics (i.e., age, race, gender, disability status), assault characteristics (i.e., injuries sustained, victim-offender relationship, number of offenders, drug use), and post-assault actions (i.e., bathing or showering post-assault, time between the exam and assault) may impact kit submission. However, these studies also call attention to the important role of specific characteristics of the responding agencies (i.e., the level of engagement between the responding agency and the SANE program providing medical care) and other yet-to-be-investigated characteristics associated with place (i.e., between sites in the Valentine study and between studies conducted in the Midwest versus a Western state). Additional studies that cover greater geographic areas and allow for comparisons to be made across communities could provide greater insight into the factors that influence kit submission.

1.3. The promise of submitted sexual assault kits

Before presenting the current study, it is important to present an alternative framing for the examination of rape kit submission. National discussions and empirical studies to date have largely discussed the problem of unsubmitted sexual assault kits. This is appropriate given that the pattern observed across U.S. communities time and again is that sexual assault kits are *not being submitted* to crime laboratories for analysis. However, it is possible that there are communities in which the majority of sexual assault kits *are submitted* for analysis. Just as large piles and high rates of unsubmitted kits are used to indicate a problematic criminal justice system response to sexual assault, high rates of submitted kits could be used to indicate a criminal justice system operating as it should. If such communities exist, their identification could be critical in improving the criminal justice system response to sexual assault, as these communities could be assessed to determine the factors that support their relative success. A strengths-based approach that focuses on learning from communities and celebrates ecological validity by identifying and investigating promising community practices (see Miller & Shinn, 2005) may be particularly helpful in developing, implementing, and sustaining strategies to promote an appropriate, thorough criminal justice system response to sexual assault.

1.4. The current study

The purpose of the current study was threefold. First, we set out to document rates of sexual assault kit submission across one entire state: Massachusetts. Prior to this study, Massachusetts had not conducted a systematic examination of rape kit submission for the entire state. Indeed, this is the first known study that examines rates of kit submission for an entire U.S. state. The second purpose of the current study was to examine empirically what predicts sexual assault kit submission. In examining kit submission across an entire state, we were able to investigate the significance of individual case level variables (i.e., victim, assault, and case characteristics) as well as the significance of

place (i.e., the city in which the assault occurred). The third and final purpose of the study was to determine if there are communities within the focal state with a relatively better rate of kit submission. Examining kit submission across all communities in an entire state provides the opportunity to identify those that perform relatively well. This lays the groundwork for future work to investigate factors that support their success, thus informing the development and implementation of strategies to improve the criminal justice system response to sexual assault.

Massachusetts was the site for the current study because of an unprecedented state database. In Massachusetts, state statute requires medical providers to report all cases of rape and sexual assault in which the victim sought medical treatment, whether or not the case was reported to police (Mass. Gen. Laws Ann. ch. 112 § 12A1/2). Medical providers fulfill this requirement by completing a Provider Sexual Crime Reporting form (PSCR). PSCRs collect unidentifiable information on the patient (e.g., patient gender, race, age); assailant (e.g., number of assailants, relation to patient); assault (e.g., weapons used, acts described by patient); and case status at the time of the exam (e.g., reporting status, police agency notified for handling of the sexual assault kit). After a PSCR is completed, the medical provider faxes it to a state safety agency. The state safety agency maintains a master database of all PSCR information received from across the Commonwealth. This database, then, should contain information on all sexual assault kits completed by medical providers in Massachusetts from August 15, 1999 on. While this state database is what made this study possible, it is also important to point out that its existence in the first place suggests a state level commitment to understanding the extent of sexual violence across the Commonwealth, and perhaps a relatively improved response to sexual violence as compared to other states. This makes Massachusetts an ideal location to explore the promise of submitted sexual assault kits and if there exist communities with relatively better rates of kit submission from which we can learn.

2. Methods

2.1. Data

This study relied upon data from the state safety agency and the two crime laboratories in Massachusetts that receive and process sexual assault kits. The sample consisted of PSCR data for all PSCR forms received by the state safety agency that (1) corresponded to adult¹ sexual assault kits completed by medical providers in Massachusetts; (2) between January 1, 2011 and December 31, 2015; (3) for sexual assaults that occurred within Massachusetts. The initial request to the state safety agency for these data resulted in a sample of 4399 cases, with 'case' corresponding to a faxed-in PSCR form meeting the criteria listed above, and complete with a sexual assault kit number. The crime laboratories provided lists of sexual assault kit numbers corresponding to all kits received by their laboratories from January 1, 2011 through December 31, 2016. An additional year of data was requested and received from the crime laboratories to provide a one-year window for sexual assault kits to be submitted to the crime laboratories after they were completed by a medical provider.

Of the 4399 cases included in the dataset from the state safety agency, 88 cases (2.0%) did not identify a single city in which the assault occurred (i.e., the nesting variable) and thus were excluded from analysis. This included cases that listed no city, as well as cases in which multiple cities were noted. Cases in which the medical provider

¹ Massachusetts has both adult and pediatric sexual assault kits, with the former used primarily in cases involving adolescent and adult victims 12 years or older, and the latter used primarily in cases involving children under the age of 12 years old. Provider sexual crime reporting forms for the adult and pediatric sexual assault kits collect very different information, thus the current study is limited to only the adult sexual assault kits.

indicated on the PSCR that no kit was completed were also excluded from analysis ($n = 107$; 2.4% of sample). The exclusions brought the final total analytic sample to $n = 4204$.

2.2. Measures

The dependent variable for all analyses was whether the kit was submitted to a crime lab, based on data provided by the crime labs. All other variables were coded based on data received from the state safety agency. This included the city in which the assault occurred, as well as a series of independent variables related to characteristics of the victim, characteristics of the assault, and post-assault action (i.e., case characteristics). It is important to note that the responding medical provider is responsible for completing the PSCR, thus all data that come from the PSCR are based on the medical providers' documentation of victim, assault, and case characteristics.

2.2.1. Victim characteristics: victim age

Cases involved victims ranging in age from 6 to 99 years old ($M = 27.29$, $SD = 12.38$), based on what was recorded by the medical provider. Age was treated as a categorical variable, with victims aged 0–15 years old as the reference category as they cannot legally consent to sex in Massachusetts and may be handled differently than older victims ($n = 421$; 10.0%). The remaining age categories were created based on practical and statistical considerations (i.e., the distribution of the data) and consisted of 16–17 year olds ($n = 314$; 7.5%; can legally consent to sex, but still minors); 18–24 year olds ($n = 1516$; 36.1%; can legally consent to sex, but still considered adolescents from a developmental standpoint); 25–29 year olds ($n = 591$; 14.1%; remainder of victims in their twenties); 30–39 year olds ($n = 620$; 14.7%; victims in their thirties); 40–49 year olds ($n = 411$; 9.8%; victims in their forties); 50–59 year olds ($n = 193$; 4.6%; victims in their fifties); and 60+ year olds ($n = 73$; 1.7%; elder protective services investigate reported elder abuse in Massachusetts starting at age 60). Age was missing on the remaining 65 cases (1.5%), and was modeled as an additional category for this variable rather than using imputation or a form of deletion. We elected to model missingness because missing data might predict kit handling as cases in which less information was gathered may be treated differently than cases in which all information is recorded.

2.2.2. Victim characteristics: victim gender

Victim gender was treated as a nominal variable, with female ($n = 3865$; 91.9%), male ($n = 190$; 4.5%), transgender ($n = 65$; 1.5%), and missing ($n = 84$; 2.0%) as predictor categories. The response option provided to medical providers on the PSCR to indicate a transgender patient changed over the study time period. Prior to 2012, only one response option indicating "transgender" was provided. Post-2012, medical providers could indicate "male to female" or "female to male." For analysis, "transgender," "male to female," and "female to male" were combined into a single transgender category. Like age, missingness was also modeled as a predictor. Female was used as the reference category for gender because sexual violence is a gender-based crime largely impacting women and girls.

2.2.3. Victim characteristics: victim race

Race was treated as a nominal variable and was based on the categories provided for medical providers to check off on the PSCR. This included White, non-Hispanic (reference category; $n = 2703$; 64.3%); Black, non-Hispanic ($n = 512$; 12.2%); Hispanic/Latino ($n = 618$; 14.7%); Asian/Pacific Islander ($n = 98$; 2.3%); American Indian/Alaska Native ($n = 18$; 0.4%); and other ($n = 160$; 3.8%). Like other victim characteristic variables, race missingness was modeled as a predictor ($n = 95$; 2.3%).

2.2.4. Assault characteristics: multi-day assault

A binary variable was used to indicate if it was noted that the assault

took place over multiple days or not ($n = 221$; 5.3% with multi-day assaults). This was indicated on the PSCR form by the medical provider documenting a different assault start and end date. It is important to note that the reference category on this variable does not confirm that the assault took place on only one day, but rather that the medical provider did not make any note that it was a multi-day assault. Thus, there was no missingness on this variable.

2.2.5. Assault characteristics: multiple offenders

A binary variable was used to indicate if it was noted that the assault involved multiple offenders or not ($n = 514$; 12.2% with multiple offenders). This was indicated on the PSCR form by the medical provider documenting the number of offenders involved in the assault. Like the multi-day assault variable, the reference category here does not confirm the assault involved only one offender. Rather, it just means the medical provider did not make a note of there being multiple offenders. With this coding approach, there was no missingness on this variable.

2.2.6. Assault characteristics: victim-offender relation

The relationship between the victim and offender was treated as a nominal variable with the creation of four categories based on the PSCR information provided. On the PSCR form, the medical provider completes a matrix indicating the specific nature of the relationship between the victim and the offender, with a total of thirteen potential relationships to choose from (e.g., parent/step-parent; spouse/live-in partner; stranger; date, etc.), inclusive of a write-in option. Specific relationships were coded into one of four created categories: stranger (reference category; $n = 1291$; 30.7%); family member ($n = 155$; 3.7%); current or former intimate partner ($n = 486$; 11.6%); and acquaintance ($n = 1941$; 46.2%). In cases with multiple offenders of varying relations to the victim, the case was categorized based on the most intimate or familiar relation. For example, a case involving a family member and a stranger would be coded as familial. Acquaintance was treated as more intimate or familiar than stranger, and both familial and intimate partner were treated as more intimate or familiar than acquaintance. No cases involved both a family member and intimate partner. Like the victim characteristics, missingness on victim-offender relationship was modeled as a predictor ($n = 331$; 7.9%).

2.2.7. Assault characteristics: non-male offender(s)

Offender gender was included as a binary variable to indicate if all of the offenders involved in an assault were male, or if any of the offenders were a gender other than male ($n = 45$; 1.1% with at least one non-male offender(s)). Sexual violence is a gender-based crime, primarily perpetrated by men, thus any deviation from this norm was noted. This was indicated on the PSCR form on an offender matrix indicating the offender gender and relation of the offender to the victim. Like other assault variables described here, the reference category does not confirm the offender(s) was (were) only male. Instead, it just means the medical provider did not indicate any non-male offender(s). With this coding approach, there was no missingness on this variable.

2.2.8. Assault characteristics: offender tactics

The PSCR form asks the medical provider to document different means of force and other tactics employed by the offender during the assault by providing a checklist of possible weapons/force and a write-in space. The checklist items and qualitative data provided were grouped into a series of categories, and each case was coded as to if the medical provider documented use of the tactic or not. A total of four binary variables were created: (1) physical force, which included the offender strangling, biting, holding down, and hitting the victim, and other ways in which the offender's body was used as a weapon or force against the victim ($n = 2339$; 55.6%); (2) substance, which included the offender targeting victims who had ingested, or were made to ingest, alcohol, drugs, or other substances ($n = 354$; 8.4%); (3) object, which included the offender using guns, knives, blunt objects,

restraints, chemicals to cause chemical burns, and any other items other than the offender's body or ingested substances as a weapon ($n = 504$; 12.0%); and (4) verbal threat, which included any verbal threats made by the offender to the victim ($n = 569$; 13.5%). Like many of the other assault characteristics included in the study, the absence of documentation of one of these tactics does not mean the tactic was not used, only that it was not indicated on the PSCR by the medical provider. With this coding approach, there was no missingness on this variable.

2.2.9. Assault characteristics: penetrative acts

The PSCR form asks the medical provider to document attempted and completed anal, oral, and vaginal penetration (yes, no, unsure, attempt, n/a). The number of attempted or completed penetrative acts was summed and treated as a count variable ranging from zero (no penetration, only fondling) to three (attempted or completed penetration of the anus, mouth, and vagina). Most cases had a single act of attempted or completed penetration ($n = 1656$; 39.4%) with a quarter of the cases involving two acts of penetration ($n = 1071$; 25.5%); a quarter of the cases involving only fondling ($n = 1082$; 25.7%); and the remaining cases involving three acts of penetration ($n = 395$; 9.4%). Like other variables, absence of documentation of penetrative acts does not mean they did not occur, only that they were not indicated on the PSCR by the medical provider. With this coding approach, there was no missingness on this variable.

2.2.10. Assault characteristics: ejaculation and condom use

The PSCR form asks the medical provider to document if ejaculation occurred and if a condom was used during the assault (yes, no, unsure, n/a). Two binary variables were created for indication of ejaculation ($n = 1224$; 29.1%) and indication of condom use ($n = 388$; 9.2%), where indication only included cases with the 'yes' box checked, and all other response options or lack of documentation treated as no indication. With this coding approach, there was no missingness on this variable.

2.2.11. Assault characteristics: bleeding injuries

The PSCR form asks medical providers to indicate if any injuries to the victim and offender resulted in bleeding. The medical provider is to indicate this using a checkbox (yes, no, unsure) and is also provided a write-in space to describe the injury. Two binary variables were created for indication of victim injury that resulted in bleeding ($n = 989$; 23.5%), and indication of offender injury that resulted in bleeding ($n = 112$; 2.7%). Only cases with definitive documentation of bleeding resulting from injury were coded as indicated; unsure (e.g., medical provider unsure if vaginal bleeding was due to injury or menstruation) or incomplete information was coded as not indicated. With this coding approach, there was no missingness on this variable.

2.2.12. Case characteristics: days between assault and exam

The number of days between the assault and exam was calculated based on the last date of the assault and date of the exam, as recorded by the medical provider. Each case was then coded into a series of categories (i.e., this was a nominal variable) for if the assault and exam took place on the same day (reference category; $n = 1807$; 43.0%); there was 1 day between ($n = 1351$; 32.1%); 2 days between ($n = 469$; 11.2%); 3 days between ($n = 259$; 6.2%); 4 days between ($n = 133$; 3.2%); or 5 or more days between the assault and exam ($n = 92$; 2.2%). If the date of the assault or exam was missing on the PSCR or presented impossible values (i.e., the date of exam was recorded as prior to the assault), this was coded as missing and entered into the model as a predictor ($n = 93$; 2.2%).

2.2.13. Case characteristics: SANE exam

A binary variable was included to indicate if it was noted that the exam was conducted by a SANE or not ($n = 2956$; 70.3%). In

Table 1
Kit submission rates by number of cases.

Number of cases in sample	Number of cities	Number of kits from these cities	Number of kits submitted (%)	Submission rate range	Submission rate mean	Submission rate median	Submission rate SD
1–10	202	747	618 (82.7%)	0.0–100.0%	82.8%	100.0%	28.4%
11–20	27	398	356 (89.4%)	23.5–100.0%	89.9%	93.3%	12.5%
21–30	14	370	336 (90.8%)	71.4–100.0%	90.2%	94.4%	9.0%
31–40	4	135	128 (94.8%)	86.1–100.0%	95.1%	97.0%	6.1%
41–50	6	274	257 (93.8%)	84.0–100.0%	94.0%	94.5%	6.5%
51–60	3	169	165 (97.6%)	96.3–100.0%	97.6%	96.4%	2.1%
61–70	1	68	61 (89.7%)	89.7%	89.7%	89.7%	n/a
71–80	2	153	152 (99.3%)	98.8–100.0%	99.4%	99.4%	0.8%
81–90	3	230	177 (77.0%)	63.1%–100.0%	87.7%	100.0%	21.3%
91–100	0	0	n/a	n/a	n/a	n/a	n/a
101+	5	1629	1485 (91.2%)	88.0–97.1%	94.1%	95.4%	3.7%

Massachusetts, nurses with expert training in forensic evidence collection and how to respond to patients reporting sexual assaults (i.e., SANEs) are available in many, though not all hospitals. The medical provider is to indicate if a SANE or non-SANE medical provider conducted the medical forensic exam with a checkbox (MA SANE, SANE-A, other). Only cases with documentation of a SANE were coded as indication of SANE; the remaining cases (i.e., documented as non-SANE or with this information missing) were coded as no indication. There was no missingness on this variable with this approach.

2.2.14. Case characteristics: toxicology kit

A binary variable was included to indicate if it was noted that a toxicology kit was completed at the time of the medical forensic exam or not ($n = 1190$; 28.3%). Toxicology kits may be completed if the medical provider or patient suspects that a drug was used to facilitate the sexual assault. The medical provider is to indicate if a toxicology kit was completed or not with a checkbox (yes, no). Only cases with ‘yes’ checked were coded as toxicology kit indicated; all other cases were coded as no indication of a toxicology kit. With this approach, there was no missingness on this variable.

2.2.15. Case characteristics: police and child protective services involvement at exam

The PSCR form asks the medical provider to indicate if the sexual assault case was reported to police at the time of the exam (yes, no) and if child protective services was involved at the time of the exam (yes, no). Two binary variables were created for indication of a police report ($n = 2920$; 69.4%) and indication of child protective services involvement ($n = 426$; 10.1%), where indication only included cases with the ‘yes’ box checked, and all other response options or lack of documentation treated as no indication. With this coding approach, there was no missingness on this variable.

2.2.16. Case characteristics: mandatory reports made

The PSCR form asks the medical provider to indicate if the medical provider made any of a series of possible mandatory reports in Massachusetts. Using a checkbox format (yes, no), the medical provider is to indicate if they made an elder abuse report ($n = 53$; 1.3%), child abuse report ($n = 668$; 15.9%), disabled persons report ($n = 146$; 3.5%), or weapon report ($n = 82$; 2.0%). Four binary variables were created for indication of completing these mandatory reports, where indication only included cases with the ‘yes’ box checked, and all other response options or lack of documentation treated as no indication. With this coding approach, there was no missingness on this variable.

2.3. Analysis

The current data set consisted of PSCR data for all PSCR forms received by the state safety agency that correspond to adult sexual assault kits completed by medical providers in Massachusetts for sexual

assaults that occurred in Massachusetts between January 1, 2011 and December 31, 2015. Sexual assault cases are handled by the police agency with jurisdiction over the geographic area in which the assault occurred. This includes handling of the sexual assault kit. It is likely that sexual assaults occurring in the same jurisdiction were handled more similarly than those across jurisdictions (e.g., as a result of individual policy agency policy, culture, or other characteristics). Because individual cases are nested within cities and those cities often correspond to a specific jurisdiction, a logistic mixed model with a random intercept was used to examine predictors of rape kit submission. The dichotomous dependent variable and the series of victim, assault, and case characteristics were modeled as Level 1 variables, while the city in which the assault occurred was modeled at Level 2. Separate models were examined for each set of variables (i.e., victim model, assault model, and case characteristics model) in addition to the final, combined model, inclusive of all predictor variables. All analyses were performed using Mplus 7.31.

3. Results

3.1. Rate of kit submission

Of the 4204 sexual assault kits included in the sample, 90.1% ($n = 3788$) were submitted to the crime lab for analysis. Sexual assault kits corresponded to sexual assaults committed across 267 different cities. Cities varied in the number of cases that occurred in each city during the study period, ranging from just one case to 893 cases. The rate of submission also varied significantly based on the city in which the assault occurred, ranging from 0 to 100%. In a null model with no covariates, the intra-class correlation coefficient for the nesting variable of city was 0.428, indicating that nearly 43% of the variance in the dependent variable was explained by the city in which the assault occurred (see Nakagawa, Johnson, & Schielzeth, 2017 for the calculation to generate intra-class correlations for logistic outcomes). Table 1 provides the rates of kit submission by the number of cases that occurred in each city. Though only descriptive, the table illustrates variation in submission rates across cities of varying size.

3.2. Models

Table 2 presents the results of the logistic mixed models examining predictors of kit submission to the crime lab for analysis. Only three variables significantly predicted rape kit submission in the full model: victim age; missing victim race; and verbal threat. Cases involving victims who were 18–24 years old (full model OR = 0.43 [95% confidence interval (CI): 0.25, 0.74]); or 40–49 years old (full model OR = 0.45 [95% confidence interval (CI): 0.23, 0.85]) were nearly half as likely to have their kit submitted to the crime lab for analysis as compared to cases involving victims under the age of consent (0–15 years old). Cases involving victims 25–29, 30–39, and

Table 2
Model results.

	Victim model		Assault model		Case model		Full model	
	OR (95%CI)	p	OR (95%CI)	p	OR (95%CI)	p	OR (95%CI)	p
Victim characteristics								
Age: 0–15 years old	-						-	
16–17 years old	1.20 (0.73, 1.98)	0.479					1.11 (0.66, 1.87)	0.699
18–24 years old	0.64 (0.45, 0.93)	0.019					0.43 (0.25, 0.74)	0.002
25–29 years old	0.82 (0.53, 1.27)	0.371					0.60 (0.34, 1.05)	0.073
30–39 years old	0.74 (0.49, 1.13)	0.17					0.53 (0.27, 1.05)	0.068
40–49 years old	0.60 (0.40, 0.88)	0.009					0.45 (0.23, 0.85)	0.013
50–59 years old	0.71 (0.44, 1.14)	0.158					0.56 (0.28, 1.12)	0.099
60+ years old	1.09 (0.47, 2.53)	0.839					0.89 (0.29, 2.74)	0.841
Missing	0.81 (0.29, 2.30)	0.693					0.60 (0.17, 2.09)	0.419
Gender: Female	-						-	
Male	0.78 (0.52, 1.17)	0.225					0.77 (0.51, 1.18)	0.23
Transgender	2.39 (0.90, 6.34)	0.081					2.57 (0.94, 7.02)	0.065
Missing	1.49 (0.49, 4.53)	0.482					1.56 (0.47, 5.21)	0.468
Race: White, non-Hispanic	-						-	
Black, non-Hispanic	0.94 (0.73, 1.20)	0.618					0.99 (0.79, 1.24)	0.922
Hispanic/Latino	0.91 (0.64, 1.29)	0.594					0.98 (0.71, 1.36)	0.914
Asian/Pacific Islander	0.79 (0.34, 1.86)	0.591					0.75 (0.33, 1.68)	0.476
American Indian/Alaska Native	1.28 (0.13, 12.72)	0.836					1.26 (0.10, 15.29)	0.855
Other	1.59 (0.88, 2.88)	0.122					1.62 (0.89, 3.07)	0.137
Missing	0.44 (0.25, 0.79)	0.006					0.47 (0.27, 0.83)	0.008
Assault characteristics								
Multi-day assault			0.69 (0.47, 1.02)	0.065			0.68 (0.46, 1.02)	0.059
Multiple offender			1.15 (0.86, 1.53)	0.349			1.13 (0.85, 1.51)	0.393
Relation: Stranger			-				-	
Family member			1.26 (0.72, 2.20)	0.414			1.18 (0.64, 2.17)	0.595
Intimate partner			0.78 (0.57, 1.08)	0.132			0.82 (0.58, 1.16)	0.272
Acquaintance			1.22 (0.97, 1.53)	0.087			1.19 (0.94, 1.51)	0.156
Missing			1.03 (0.58, 1.82)	0.928			1.00 (0.57, 1.73)	0.989
Non-male offender			0.84 (0.33, 2.15)	0.713			0.69 (0.27, 1.73)	0.426
Physical force			0.77 (0.62, 0.97)	0.024			0.80 (0.63, 1.02)	0.068
Substance			1.52 (1.05, 2.21)	0.028			1.41 (0.96, 2.09)	0.083
Object			1.13 (0.78, 1.63)	0.526			1.13 (0.79, 1.60)	0.512
Verbal threat			1.45 (1.04, 2.02)	0.029			1.49 (1.11, 2.01)	0.008
Penetrative acts			1.10 (0.96, 1.26)	0.157			1.11 (0.97, 1.28)	0.135
Ejaculation			1.06 (0.87, 1.31)	0.553			1.10 (0.89, 1.35)	0.375
Condom use			1.11 (0.83, 1.50)	0.478			1.09 (0.80, 1.48)	0.577
Victim bleeding injuries			0.97 (0.73, 1.29)	0.833			0.99 (0.74, 1.33)	0.948
Offender bleeding injuries			0.92 (0.52, 1.64)	0.779			0.96 (0.51, 1.80)	0.891
Case characteristics								
Days assault exam: same day							-	
One day					0.95 (0.75, 1.19)	0.635	0.90 (0.71, 1.13)	0.355
2 days					1.29 (0.93, 1.80)	0.124	1.26 (0.91, 1.76)	0.161
3 days					1.17 (0.72, 1.92)	0.522	1.06 (0.63, 1.77)	0.836
4 days					1.29 (0.68, 2.44)	0.435	1.25 (0.65, 2.40)	0.513
5+ days					1.13 (0.57, 2.25)	0.721	1.01 (0.51, 1.97)	0.984
Missing					0.86 (0.40, 1.86)	0.696	0.83 (0.41, 1.70)	0.61
SANE exam					0.92 (0.70, 1.22)	0.559	0.94 (0.70, 1.26)	0.685
Toxicology kit					1.14 (0.92, 1.40)	0.242	1.14 (0.91, 1.44)	0.249
Police report					0.75 (0.40, 1.40)	0.36	0.73 (0.41, 1.29)	0.27
Child protective services					1.22 (0.74, 2.01)	0.44	1.05 (0.64, 1.73)	0.835
Elder abuse report					1.34 (0.46, 3.86)	0.592	1.05 (0.32, 3.43)	0.94
Child abuse report					1.08 (0.73, 1.60)	0.695	0.61 (0.32, 1.19)	0.15
Disabled persons report					0.74 (0.43, 1.27)	0.272	0.71 (0.41, 1.23)	0.227
Weapon report					0.96 (0.43, 2.12)	0.919	0.90 (0.42, 1.94)	0.789

50–59 years old had similar odds ratios (full model ORs = 0.60; 0.53; 0.56, respectively), but they did not quite reach statistical significance ($p = .073$; 0.068; 0.099, respectively). Cases in which the race of the victim was missing were also nearly half as likely to have their kit submitted to the crime lab for analysis (full model OR = 0.47 [95% confidence interval (CI): 0.27, 0.83]).

Cases in which the medical provider documented verbal threat(s) were used by the offender in the assault were more likely to have their kit submitted to the crime lab for analysis (full model OR = 1.49 [95% confidence interval (CI): 1.11, 2.01]). Two additional offender tactics, physical force (assault model OR = 0.77 [95% confidence interval (CI): 0.62, 0.97]) and substance use (assault model OR = 1.52 [95%

confidence interval (CI): 1.05, 2.21]), were significant predictors of rape kit submission in the assault characteristics model, but fell below the threshold for statistical significance in the full model.

4. Discussion and conclusion

Countless jurisdictions across the United States have been identified as having piles of unsubmitted sexual assault kits. This is problematic in that it prevents kit contents from being used in the criminal investigation and prosecution of sexual assault crimes. Unsubmitted sexual assault kits also serve as tangible evidence of the less-than-thorough criminal justice system response to sexual assault and serve as

a representation of the “justice denied” to sexual assault victims (Strom & Hickman, 2010, p. 382). To combat the problem of unsubmitted sexual assault kits across the country, it is essential to document rates of sexual assault kit submission in communities that have yet to determine if they, too, have piles of unsubmitted sexual assault kits; understand what predicts sexual assault kit submission as a means to identify leverage points for change; and determine if there are communities with high rates of kit submission from which we can learn what works. This study did just that by examining rates and predictors of sexual assault kit submission for the entire state of Massachusetts.

In comparison to the few other studies that have examined rates of sexual assault kit submission, Massachusetts has a much higher rate of kit submission. Other studies have reported sexual assault kit submission rates of 38–59% (Patterson & Campbell, 2012; Shaw & Campbell, 2013; Valentine et al., 2019); we found a kit submission rate of 90%. Ninety percent is not perfect, as it means that 416 sexual assault kits from this sample were never submitted to the crime lab for analysis. However, given the patterns observed in other areas across the country, this is a relatively high rate of sexual assault kit submission.

While we did not empirically investigate what specific factors might explain this substantially higher rate of kit submission, key events and ongoing practices in the state of Massachusetts over the past 25 years provide insight in what may contribute to this substantially higher rate of kit submission. In 1995, the Massachusetts SANE program began operating out of the Massachusetts Department of Public Health. Massachusetts is one of the few states, if not the only state, that has a statewide SANE program supported through their state budget. That the program is centralized and supported in this way positions it to help coordinate and work to improve the response to sexual assault across a wide range of state and community agencies. As previously discussed, the PSCR and accompanying database maintained by the state safety agency came online in 1999. In 2007, the PSCR form was revised to include a place to document the sexual assault kit number, allowing for a means to link PSCR forms to their sexual assault kits. Additionally, the PSCR form was made available inside the kit alongside other kit forms so as to promote completion of the PSCR every time a kit was collected. In 2008, the state safety agency sent a memo to police chiefs across the Commonwealth explaining that police agencies were expected to pick up and transport all sexual assault kits to the crime lab for analysis within a reasonable amount of time, whether the sexual assaults were reported to police or not. In the memo, police chiefs were encouraged to incorporate the information provided therein into their departments' policy and procedure manuals, and were informed that the state safety agency would track agency's compliance with the protocol. However, the memo did not mandate adoption of the protocol. Indeed, it was not until 2020 that an official, legislated statewide tracking system was implemented in Massachusetts (Szaniszló, 2020). Then, in 2013, the Massachusetts Senate Committee on Post Audit and Oversight produced a report on the handling, transportation, and testing of sexual assault kits in Massachusetts. Due to the reports across the country about the less-than-timely handling of sexual assault kits, state concerns about delays in the delivery of sexual assault kits to the lab for processing, and the lack of a statewide tracking system for sexual assault kits in Massachusetts, the Committee sought to examine each step in how kits were handled in the Commonwealth and determine “what legal, procedural, administrative, and/or logistical changes might reduce [any] existing delays” (Senate Committee on Post Audit and Oversight, 2013, p. 2). Beyond these key events, Massachusetts also has a “Kit Committee” co-chaired by the statewide SANE program and the state safety agency. This multidisciplinary group meets annually to review and make revisions to the sexual assault kit as needed (Commonwealth of Massachusetts, 2020b). Finally, the state also has a Governor's Council to Address Sexual Assault and Domestic Violence. The Council is chaired by the Lieutenant Governor and acts as an advisory council to the governor on issues related to sexual assault and domestic violence (Commonwealth of Massachusetts, 2020a). This series of events and

ongoing activities in Massachusetts related to the response to sexual assault, and more specifically related to the handling of sexual assault kits, may help explain the high rate of sexual assault kit submission found in the current study.

However, it is important to note that this rate may be inflated or underestimated as a result of the data employed to produce it. The sample for this study came from the PSCR database maintained by a state safety agency. This database is populated by PSCR forms that are sent in to the state safety agency. State statute requires that all medical providers complete a PSCR for all cases of rape and sexual assault in which the victim sought medical treatment. However, this law is difficult to enforce and it is possible that not all PSCRs are sent to the state safety agency. Thus, while the sample in this study was conceptualized as a census of all sexual assault kits completed in Massachusetts between January 1, 2011 and December 31, 2015, it is more accurately described as a census of all sexual assault kits completed in Massachusetts for which the state safety agency received a PSCR between January 1, 2011 and December 31, 2015. It is possible that the sexual assault kits that are missing from the state safety agency database because a PSCR form was never sent in are also less likely to be submitted to the crime lab for analysis. If this is the case, the rate of sexual assault kit submission reported here would be inflated. Unfortunately, given available databases, it is not possible to determine just how many PSCRs may be missing and if they are systematically different from those that are submitted.

It is also possible, though, that the rate of kit submission is underestimated. The data used in this study were completely de-identified. Data from the state safety agency (providing the independent and nesting variables) and the crime labs (providing the dependent variable) were linked using only the sexual assault kit numbers. A matching kit number across these two datasets was indicative of a kit that had been submitted to the crime lab for analysis. However, if there were any errors made in recording the 4–5 digit kit number by the state safety agency or a crime lab, it would be impossible to link a case from the state safety agency data to its corresponding kit in the crime lab data. Any cases unable to be linked across the two datasets were determined to be unsubmitted kits. Thus, any errors in recording of the kit number drive down the rate of sexual assault kit submission.

Because the sample did include some kits that were not submitted to the crime lab for analysis, we were able to investigate what predicted sexual assault kit submission. The predictive value of individual case variables paled in comparison to the predictive value of the city in which the assault occurred; 43% of the variance in the dependent variable was explained by the nesting variable of city. This incredibly high intra-class correlation indicates that place—where the assault occurred—plays a very significant role in if the sexual assault kit is submitted for analysis. This finding aligns with Valentine et al.'s study (2019) that found site to be the main determinant of sexual assault kit submission.

Cities, or sites, may vary considerably in terms of available resources, policies, and practices related directly to the criminal justice system response to sexual assault. For example, cities differ from one another in their response to sexual assault in that they fall into different law enforcement agencies' jurisdictions. Different agencies have different numbers of sworn officers; different organizational charts that may or may not include a unit dedicated to responding to sex crimes; different explicit or implicit policies in regards to sexual assault kit handling; different leadership that emphasizes different values and priorities; and even different distances to drive in order to transport a sexual assault kit to the crime lab for analysis. Beyond these police agencies, cities also vary in terms of their access to SANE services; rape crisis centers; specialized units within prosecutor's offices dedicated to responding to sex crimes; and other sexual assault victim service providers. A thorough, timely response to sexual assault may be prioritized less in communities with fewer services, as there are no champions to advocate for such a response. And, of course, looking beyond the

criminal justice system and related systems' responses to sexual assault, cities vary in population size, crime rates, and levels of financial resources and stability. Unfortunately, it was beyond the scope of this study to examine empirically the specific factors that may have contributed to the variation in sexual assault kit submission rates across cities. Still, this finding is important as it reminds us that while it is not possible to alter the victim or assault characteristics of a given sexual assault, it is possible to target and change organizational and setting-level norms, policies, and practices. This finding demonstrates that in doing so it is possible to have a significant impact on sexual assault kit submission.

4.1. Future directions

In observing national trends and in consideration of this study, there is clearly more work to do to improve the criminal justice system response to sexual assault, including and beyond the problem of unsubmitted sexual assault kits. First, this study provided an example of a state, and specific communities within it, with relatively high rates of sexual assault kit submission; some cities were found to have submitted 100% of their sexual assault kits. To make full use of these findings, future research should examine distinguishing features of Massachusetts as a whole, as well as the communities within it, in order to identify the factors that support their relative success. While we have discussed potential contributors to the state rate of sexual assault kit submission, this should be explored further through empirical means. Specifically, future work should examine empirically state- and community-level factors that may promote higher rates of sexual assault kit submission.

In addition to examining factors that promote kit submission, future work should investigate how long it takes for kits to be submitted to the crime lab for analysis. The data used for the current study did not consistently include the dates that each sexual assault kit was collected (i.e., the date of the medical forensic exam) as well as the date each sexual assault kit was submitted to the crime lab for analysis. Valentine et al. (2019) found that different variables significantly predicted sexual assault kit submission within the first month after a kit was collected as compared to the set of variables that predicted sexual assault kit submission at any time (i.e., including and beyond the first month after kit collection). This is important, as submitting the kit in a timely manner means that the findings from forensic analysis that can inform criminal investigation and prosecution are available sooner. Additionally, examining the time between kit collection and submission would help to identify if there are specific police agencies responsible for transporting kits from select areas that hold onto kits for a longer time, perhaps in order to make fewer visits to the crime laboratory. For example, cities located farther away from their crime labs may not transport each kit as soon as it arrives in police custody, but instead may wait until they have a group of kits to transport them all at once. While this may be helpful to the police agency, it can create a bottleneck for crime labs as they receive larger quantities of kits for processing at unpredictable intervals. Many locales, including Massachusetts, are already on their way to be able to know how long kits spend in transit with the development and implementation of sexual assault kit tracking systems (Szaniszló, 2020). Such systems can help to identify if and where kits are delayed, and provide more accurate rates of sexual assault kit submission as each kit is tracked, thus informing remedies for identified kit handling and processing problems.

Finally, submitting the sexual assault kit to the crime lab for analysis is but one step in responding to criminal sexual assault. Submitted sexual assault kits must also be tested; the findings must be communicated back to criminal investigators and prosecutors; investigators and prosecutors must treat the findings as one piece of their larger criminal investigation; investigations must lead to criminal charges (when appropriate); and charges must be pursued (when appropriate). In this manuscript, we have argued for considering a high rate of sexual

assault kit submission as an indication of the criminal justice system operating as it should. However, we refer to this as a "promising" practice, as high rates of sexual assault kit submission alone do not guarantee an improved response to sexual assault. If we focus only on sexual assault kit submission, it is possible that we are moving the ball down the field, but still not achieving our intended goal. Instead of a pile of unsubmitted sexual assault kits, we may progress to a pile of submitted but yet to be tested kits. If we test those kits, we may arrive at a pile of cases with tested kits but that have not been fully investigated, and so on. Future work should examine if higher rates of sexual assault kit submission correspond to higher rates of successful sexual assault case progress in the criminal justice system. In order to improve the criminal justice system response to sexual assault, we must conceptualize it as just that: a system. We must consider it in its entirety if we wish to make the changes necessary to provide justice to all crime victims.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-project sectors.

Declaration of Competing Interest

None.

Acknowledgement

We would like to thank Joan Meunier-Sham for her willingness to review and provide feedback on this manuscript.

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