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Refining Measurement of Substance Use Disorders among Women of Child-bearing Age Using Hospital Records: The Development of the Explicit-Mention Substance Abuse Need for Treatment in Women (EMSANT-W) Algorithm

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Abstract

Substance use disorder (SUD) in women of reproductive age is associated with adverse health consequences for both women and their offspring. US states need a feasible population-based, case-identification tool to generate better approximations of SUD prevalence, treatment use, and treatment outcomes among women. This article presents the development of the Explicit Mention Substance Abuse Need for Treatment in Women (EMSANT-W), a gender-tailored tool based upon existing International Classification of Diseases, 9th Edition, Clinical Modification diagnostic code-based groupers that can be applied to hospital administrative data. Gender-tailoring entailed the addition of codes related to infants, pregnancy, and prescription drug abuse, as well as the creation of inclusion/exclusion rules based on other conditions present in the diagnostic record. Among 1,728,027 women and associated infants who accessed hospital care from January 1, 2002 to December 31, 2008 in Massachusetts, EMSANT-W identified 103,059 women with probable SUD. EMSANT-W identified 4,116 women who were not identified by the widely used Clinical Classifications Software for Mental Health and Substance Abuse (CCS-MHSA) and did not capture 853 women identified by CCS-MHSA. Content and approach innovations in EMSANT-W address potential limitations of the Clinical Classifications Software, and create a methodologically sound, gender-tailored and feasible population-based tool for identifying women of reproductive age in need of further evaluation for SUD treatment. Rapid changes in health care service infrastructure, delivery systems and policies require tools such as

the EMSANT-W that provide more precise identification methods for sub-populations and can serve as the foundation for analyses of treatment use and outcomes.

Substance use disorder (SUD) is widely recognized as a complex, chronic disease (1). While 2013 estimates of current illicit drugs use and current alcohol use among persons aged 12 and older are higher for men (11.5% and 57.1%, respectively) than for women (7.3% and 45.7%, respectively) (2), research indicates women progress more rapidly to problem use (3, 4). Moreover, SUD is not only associated with adverse health outcomes for the woman, but also with adverse obstetric and health outcomes for her offspring (5-11). Because screening for SUD among women in primary or prenatal care is not universal (12, 13), opportunities are likely missed to identify women in need of SUD evaluation and treatment referral.

Methods currently used to obtain population-level prevalence estimates of women in need of SUD treatment are gender neutral. They include medical record review, national self-report surveys, and retrospective analysis of administrative data from intervention research (8, 14-19). These may not provide adequate estimates among both genders. States need better approximations of SUD treatment need, use, and outcomes by gender to support compliance with new quality and cost monitoring measures mandated under the Patient Protection and Affordable Health Care Act (20). Recent studies have demonstrated that the prevalence of drug use during pregnancy can be estimated by analyzing diagnostic codes in hospital administrative data (21-23). This type of method is currently the only one that states could feasibly apply at the population-level outside of a research context to identify those in need of SUD treatment, and suggests an avenue to tailor the method to identify women in particular.

The Clinical Classifications Software for Mental Health and Substance Abuse (CCS-MHSA) (24) is widely used to group hospital administrative records with substance-related and mental health disorder diagnoses (18, 25-27); and it is gender neutral. However, the CCS-MHSA does not distinguish SUDs from co-occurring mental health disorders or from legitimate substance use associated with health disorders. Because mental health disorders are more common among women than among men (28), a mental health diagnosis may have poorer specificity in identifying SUD among women than among men. Moreover, the CCS-MHSA does not include substance-related poisoning codes and therefore may miss individuals with an SUD who receive a substance-related poisoning code but no accompanying abuse or dependence code (29). For example, there may be a poisoning code for Naloxone (970.1), which is not itself a drug of abuse but is administered solely as an antidote to opioid overdose, with no accompanying abuse or dependence code (30). Furthermore, tailoring to known differences in SUD patterns between men and women requires attention to differences in reasons for seeking health care. Women of reproductive age primarily see obstetrician-gynecologists, and the inclusion of information gleaned from records of pregnancy and delivery complications are essential for identification of women with SUD. Women are particularly reluctant to disclose substance use because in 16 states, substance abuse during pregnancy is considered child maltreatment (31), and SUD at any time may result in reports to child protective services which may lead to loss of custody. In the absence of free disclosure, evidence of use garnered from pregnancy complications and

conditions of the neonate in hospital, birth and fetal death records will support identification of treatment need among mothers. Lack of inclusion of this evidence is a critical gap in existing algorithms.

The aim of this study was to develop a theoretically sound and woman-specific, population-based SUD identification tool to be used by researchers, public health planners and policy makers who wish to analyze patterns of and outcomes related to substance use disorders in their states. Our approach was guided by three criteria: 1) the tool would be sensitive enough to capture discharge diagnoses strongly suggestive of an SUD in need of further assessment, with or without dependence; 2) the tool would be specific enough to distinguish SUD from background mental health conditions; and 3) the tool would be tailored to women of reproductive age using indirect sources of information about substance use that are not usually included in gender-neutral grouping algorithms.

The foundation for the Explicit Mention Substance Abuse Need for Treatment in Women (EMSANT-W) was a methodologically rigorous measure of interstate variations in the rates of substance abuse/dependence and unmet treatment need among the general population, the Substance Need Index (SNI), developed by McAuliffe and colleagues using multiple years of inpatient hospital discharge data, mortality data, and arrest records (32-34). The SNI's algorithm for hospital data was a major step forward from the CCS-MHSA in that it only used International Classification of Diseases, 9th Edition, Clinical Modification (ICD-9-CM) diagnostic codes directly associated with substance use (so-called "explicit mention" measures that had 100% alcohol- and drug-attributed fractions) and excluded diagnoses associated with drugs that had minimal potential for causing drug use disorders (e.g., tricyclic antidepressants, antibiotics) and drug poisonings coded as self-inflicted (i.e., suicide attempts), adverse effects of therapeutic use, or assault.

We describe the EMSANT-W algorithm, an adaptation of the SNI that identifies women of reproductive age who have indicators of possible SUD that merit treatment, broadly defined as evaluation and further referral for needed treatment or post-treatment monitoring. EMSANT-W uses women's own diagnosed health conditions and those of their neonates to capture evidence for SUD. In this study we 1) describe EMSANT-W as an example of tailoring an SUD identification algorithm to a specific population, in this case women of reproductive age; 2) compare the number of SUD cases identified by EMSANT-W with those identified by the most commonly used grouping tool, the CCS-MHSA; and 3) evaluate differences across the two algorithms in SUD prevalence by type of substance used.

METHODS

Data sources and Sample

This investigation used two major data sources: 1) statewide hospital discharge data from the Massachusetts Center for Health Information and Analysis (CHIA), which provided diagnostic codes for inpatient, observational stay, and emergency department discharges from all Massachusetts hospitals for women aged 15-49, and 2) the population-based Massachusetts Pregnancy to Early Life Longitudinal (PELL) data system, which links Massachusetts birth and death certificates for infants to CHIA delivery discharge data for the

infants and their mothers aged 15-49 . This study was approved by the Boston University Medical Campus and Massachusetts Department of Public Health Institutional Review Boards.

The study sample included 1,728,027 women who received inpatient, observational stay, or emergency department services in Massachusetts hospitals between January 1, 2002 to December 31, 2008, and their infants (live and stillborn) delivered in Massachusetts from January 1, 2003 to December 31, 2007.

Data linkage

A multi-step data linkage was developed for this study to identify individual women in the CHIA dataset from incident-level data. We also linked women to any associated births contained in the PELL data system for the study period.

Step 1: Cleaning of data elements in incident-level CHIA data in order to aggregate records to the woman-level—The CHIA episodic-level hospital use data contained 6,347,310 total records from 2002-2008. The elements used for linkage of multiple records belonging to an individual woman included the universal hospital identification number (UHIN; an encryption of the patient's social security number), birth date, and hospital medical record number (MRN). UHINs, the strongest linkage element, were present for 5,904,323 records (93%) of the hospital discharge records. Records were linked in 3 steps: 1) exact match on UHIN; 2) match on 7 of the 9 UHIN digits plus exact match on MRN and birth date; and 3) exact match on MRN and birthdate. Most women (82.7%) were matched in steps 1 and 2.

Step 2: Linkage to the PELL data system—PELL includes mothers with inpatient delivery records and links 99% of Massachusetts birth/fetal death certificates with maternal and infant delivery records in an eight-step linkage algorithm, detailed elsewhere (35, 36). Birth certificate and hospital data on infants contained in PELL are longitudinally linked to maternal hospital data in CHIA using the mother's UHIN.

Development of the EMSANT-W Algorithm

The EMSANT-W algorithm was developed using an iterative process. First, a list of ICD-9-CM codes indicators of likely/presumptive SUD was formed. Next, inclusion/exclusion rules were developed based on the presence of specific codes in the other diagnosis fields. We then assessed the internal validity and factor structure of how these indicators clustered and refined the list and inclusion/exclusion rules accordingly (see next section).

The indicator list—We began with a combined list of ICD-9-CM diagnostic and emergency codes from the CCS-MHSA and SNI lists. The CCS-MHSA uniquely contributed conditions affecting pregnancy or fetuses/newborns; and the SNI uniquely contributed poisoning-related codes. We added some additional poisoning-related codes, described below, and toxicology screen results from the “abnormal conditions of newborn” section of the Massachusetts birth/fetal death certificates (Table 1).

Inclusion/exclusion rules development—The CCS-MHSA includes all codes regardless of what is contained in other diagnosis and emergency code fields for an individual record, and therefore lacks precision in separating SUDs from drug-induced disorders with other causes (e.g., anesthetic complications of labor and delivery). To address this limitation, we adopted the SNI's more methodologically rigorous approach of applying inclusion/exclusion rules based on combinations of the nature of the poisoning (i.e., diagnostic code for type of substance) and the emergency (E-code) indicating the manner in which the poisoning occurred (accidental overdose; adverse effects of therapeutic use; self-inflicted/suicide attempt; assault; or undetermined). With few exceptions, the SNI includes records with a nature code by itself, a nature code in conjunction with an accidental E-code for that specific drug, or the accidental E-code by itself. To create the rules for EMSANT-W, we performed a code-by-code examination of the SNI inclusion/exclusion rules. Adaptations were made which both broadened and narrowed the SNI rules as needed. Rules were broadened to include undetermined cause poisoning E-codes because of the known reluctance among clinicians to specify SUD among women due to legal repercussions, such as the removal of children from the home (37). Adaptations narrowed the SNI rules to exclude poisoning codes occurring along with conditions managed through prescribed medication, based on the possibility of a coding omission or error in assigning the appropriate adverse effects of therapeutic use E-code. For example, a record with the “poisoning by methadone” code (965.02) was excluded if another diagnosis code field indicated that the woman had cancer (140.xx-208.xx; the “x” represents any number in that decimal place). See Table 1 for specific inclusion and exclusion decisions.

Codes were grouped into two categories. Those explicitly mentioning abuse or dependence (explicit dependence codes, EDC) were used as a marker for SUD regardless of what other codes co-occurred in other diagnosis fields for that record. All of the dependence 303.xx/304.xx and abuse 305.xx series codes were considered to be EDC codes (with the exclusion of 305.1x, tobacco use disorder, and 305.8x, antidepressant abuse). Other codes that specifically mentioned controlled substances on the Drug Enforcement Agency schedules I and II were also categorized as EDC codes (see <http://www.deadiversion.usdoj.gov/schedules/index.html#define>). Codes less directly associated with dependence were specified as likely dependence codes (LDC). These LDC codes were subject to inclusion/exclusion rules based on the co-occurring ICD-9-CM codes in the other diagnosis fields for that record. LDC codes included poisoning codes and pregnancy and fetal/newborn related codes other than those specifying schedule I or II controlled substances.

Analysis of factor structure—Because individual ICD-9-CM codes are part of larger condition types, the EDC and LDC categories were further subdivided into the following five condition types: abuse/dependence (EDC), drug-induced disorder – EDC, drug-induced disorder – LDC, poisoning – EDC, and poisoning – LDC. These five groups were run in a factor analysis to determine how the EDC and LDC groups clustered together in order to consider whether modifications to the indicator list or inclusion/exclusion rules were needed. Low factor loadings for the LDC drug disorder category and the need to examine the LDC poisoning codes that were not on the SNI or CCS-MHSA lists prompted examination of the co-occurrence of LDC drug disorder and poisoning codes with EDC

codes at the woman level (i.e., not necessarily in the same hospital record, but occurring for the same woman across hospital records). A co-occurrence threshold of 67% was set for inclusion, which resulted in the deletion of some codes.

The factor analysis revealed one factor with an Eigenvalue of 1.34. Four of the five condition type groups had factor-one loadings of 0.30 or greater. The factor loading of 0.27 for the poisoning – EDC category was acceptable given the large sample size, although it loaded equally on a second factor.

We were concerned that inclusion of the drug-induced psychosis codes in the CCS-MHSA that were not associated with drug withdrawal (drug-induced disorder – LDC codes 292.1x, 292.2x, and 292.8x) would weaken the specificity of the index by identifying women who might have a medically induced psychosis or a condition related to therapeutic drug use. The 292.1x code had only 60.3% co-occurrence with EDC codes, which did not meet our inclusion criterion of 67%, while the other two codes (292.2x and 292.8x) had 67% agreement. We re-ran the factor analysis without 292.1x, 292.2x, and 292.8x, and found a poorer factor structure (factor one Eigenvalue = 1.18; the drug-induced disorder – LDC did not have a significant factor loading). Therefore, we elected to keep these three codes as indicators. We retained codes for major tranquilizers (e.g. 969.3x) as indicators, even though they are not themselves drugs of abuse and dependence because their 75% rate of co-occurrence with dependence was far higher than the proportion of women with a co-occurring mental health disorder would suggest (19).

Statistical analyses

Data linkages and analyses were performed using SAS 9.2 (SAS Institute, Inc., Cary, NC). The EMSANT-W and CCS-MHSA identification algorithms were both conducted to determine the numbers and percentages of women who would be classified as having an SUD by each method. Counts were created using the substance identified by the diagnosis codes, and percentages with 95% confidence intervals (95%CI) were compared across EMSANT-W and CCS-MHSA for alcohol; cocaine; opiates; sedatives, barbiturates, hypnotics, and anesthetics; cannabis; hallucinogens; amphetamines/sympathomimetics; tranquilizers; other psychotropics, analeptics, other central nervous system stimulants, dietetics, parasympatholytics; analgesics/antipyretics; and other/mixed/unspecified drugs that met inclusion criteria.

RESULTS

The EMSANT-W algorithm identified 103,059 (6.0%, 95%CI: 5.9, 6.0) women as having an SUD, and the CCS-MHSA identified 99,796 (5.8%, 95%CI: 5.7, 5.8) women; 98,843 women were identified by both methods (Table 2).

EMSANT-W identified 4,116 women who were not identified through the CCS-MHSA and did not identify 853 women whom the CCS-MHSA did identify. Table 2 presents examples of differences in capture rates for single codes that were the largest contributors to the differences between the algorithms. Factors responsible for the majority of the additions were inclusion of E-codes and expansion of the list of SUD-related poisonings, and those

responsible for the majority of deletions were the use of inclusion/exclusion rules and excluding mental health conditions not necessarily related to SUD.

Table 3 presents the number of women identified by each algorithm with SUD by types of drugs used. Using EMSANT-W, the substance types identified for the highest percentage of women were alcohol (66.1%, 95%CI: 65.8, 66.4), other/mixed/unspecified drugs (38.6%, 95%CI: 38.3, 38.9), and opiates (25.2%, 95%CI: 24.9, 25.5). The CCS-MHSA identified fewer women with alcohol (62.8%, 95%CI: 62.5, 63.1) and other/mixed/unspecified drugs (34.8%, 95%CI: 34.5, 35.1) codes, and more women with opiate codes (28.2%, 95%CI: 27.9, 28.5).

Moreover, EMSANT-W identified 4,724 (4.6%; 95%CI 4.5, 4.7) women through affected babies, a substantially higher percentage than was identified through CCS-MHSA (3,707, 3.7%: 95%CI 3.6, 3.8) (Table 3). For women identified solely through pregnancy/infant codes, the capture rate was almost double for EMSANT-W (418, 0.4%: 95%CI 0.4, 0.4) compared to CCS-MHSA 228, 0.2%: 95%CI 0.2, 0.2).

DISCUSSION

In this sample of women who used Massachusetts hospital services, EMSANT-W identified 103,059 (6.0%) with indicators of SUD that should initiate diagnostic assessment and treatment or post-treatment monitoring if needed. EMSANT-W likely has greater specificity than the CCS-MHSA in that it excludes mental health conditions not directly related to SUD, and it is inclusive in that it captures a larger number of SUD-related diagnostic codes for conditions of pregnancy, delivery and neonates, in addition to general conditions.

The proportion of women identified with SUD through EMSANT-W is comparable to that of women in the National Survey on Drug Use and Health (8). EMSANT-W identified 4,116 (4.1%) more women with a likely SUD in comparison to the CCS-MHSA, in large part due to expanding the ICD-9-CM indicator list, an adaptation based on the methodologically rigorous SNI, in order to capture prescription and other drug abuse. The CCS-MHSA identified 853 women with SUD that EMSANT-W did not, largely due to the latter's exclusion of records with co-occurring diagnoses for mental health or physical conditions that lack specificity in relation to SUD, particularly conditions that are more common or only occur in women, such as rheumatoid arthritis (36) and anesthetic complications of labor and delivery, respectively. This adaptation from the SNI was intended to reduce false positives likely captured by the CCS-MHSA, which does not distinguish substance abuse and mental health disorders, or physical health disorders that require medication by drugs with abuse potential. (Some of these latter enhancements might also be applicable for future efforts to enhance men's SUD estimations methods using the CCS-MHSA.)

The gender tailoring in EMSANT-W has the potential to improve specificity of SUD identification in women. General population data is always an appropriate starting point, but tailoring to specific groups may be more desirable when there is an established basis for difference between the groups. The prevalence of SUD, types of drugs used, patterns of entry into treatment and health outcomes associated with SUD are known to differ by gender

(38). From the perspective of life course theory, women of reproductive age have unique trajectories, transitions, and points of vulnerability; the emergence of SUD and associated conditions and consequences may be missed by a more general approach.

National Survey on Drug Use and Health state prevalence estimates are carefully constructed and widely cited, but limited by the nature of representational polling. In Massachusetts, for example, estimates are constructed from a sample of 1,000 persons; fewer than 500 will be women, and approximately 10% of those will report current use of illicit drugs (19). EMSANT-W provides states with an epidemiological research tool that can provide better prevalence estimates than national representative surveys. It may have greater sensitivity than the CCS-MHSA for identifying women of reproductive age with need for SUD treatment or follow-up monitoring, a hypothesis which requires testing in a validation study that was beyond this project's scope. As states build linkages across vital records, health, and social service data systems, opportunities to further examine the properties of EMSANT-W will increase. The process used to develop the EMSANT-W is not dependent on the ICD-9-CM indicator codes used and is adaptable to the 10th edition of ICD codes. As a public health tool, EMSANT-W could be used by local, regional, or state entities to estimate need for treatment and to identify gaps in access to care.

Although EMSANT-W was designed to capture substance abuse that has clinical consequences, there are some important limitations to consider. Several factors may contribute to overestimation of the total sample size and number with SUD, including data linkage across multiple hospitals for women without a UHIN, clinicians' continuation of SUD related diagnostic codes for women who are currently abstinent, and our inclusion of poisoning by drugs that are not themselves substances of abuse. Our criterion of 67% co-occurrence between LDC and EDC may limit this source over-identification, but further examination by varying that criterion would allow better characterization of the appropriateness of these codes. The convergence of our prevalence findings with national survey data provides some reassurance that these issues are not major confounders.

Furthermore, this study is limited to women whose contact with hospital services generated an ICD-9-CM code, so it does not include other types of indicators such as outpatient doctor visits, or participation in Alcoholics or Narcotics Anonymous. In particular, all algorithms may under-identify prescription drug abusers, because of difficulty defining abuse of prescription drugs. On the other hand, inclusion of unspecified poisonings may have cast the net too widely. Our decision rules reflect an attempt at a balancing process—an effort to assure specificity without losing significant numbers of women with indicators of the need for a comprehensive SUD evaluation. This article documents the initial development of an SUD grouping algorithm by a multi-disciplinary team. We recommend continued discussion and refinement of inclusion and exclusion criteria by the field, especially as all-payer claims data become available.

This study demonstrates the utility to states of creating longitudinal and cross-system linkages to enhance capacity for population health research that states can use to improve health care. EMSANT-W creates an internally valid and feasible population-based tool for SUD identification among women of reproductive age through tailoring of existing medical

diagnostic code groupers to a specific clinical definition and a particular population. It provides a robust method to use hospital data available in all states to provide estimates for assessing state-specific needs for treatment. The data system linkage conducted for this study could be reproduced in other states to identify women in need of SUD treatment. Future uses include tracking outcomes that affect the health of women of reproductive age and their offspring.

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Table 1
Comparison of Substance Use Disorder Indicator Codes in EMSANT-W and CCS-MHSA

Substance Type	Indicator Code ^a	Indicator Label	Factor Analysis Group ^b	EMSANT-W	CCS-MHSA
Alcohol	291xx	Alcoholic psychoses	Drug-induced disorder – EDC	✓	✓
	303xx	Alcohol dependence syndrome	Abuse/Dependence – EDC	✓	✓
	3050x	Nondependent abuse of alcohol	Abuse/Dependence – EDC	✓	✓
	3575	Alcoholic polyneuropathy	Drug-induced disorder – EDC	✓	✓
	4255	Alcoholic cardiomyopathy	Drug-induced disorder – EDC	✓	✓
	5353	Alcoholic gastritis	Drug-induced disorder – EDC	✓	✓
	5710	Alcoholic fatty liver	Drug-induced disorder – EDC	✓	✓
	5711	Acute alcoholic hepatitis	Drug-induced disorder – EDC	✓	✓
	5712	Alcoholic cirrhosis of the liver	Drug-induced disorder – EDC	✓	✓
	5713	Alcoholic liver damage, unspecified	Drug-induced disorder – EDC	✓	✓
	76071	Fetal Alcohol Syndrome	Drug-induced disorder – EDC	✓	✓
	7903	Excessive blood level of alcohol	Drug-induced disorder – EDC	✓	✓
	9800	Poisoning by alcohol	Poisoning – LDC	✓	✓
	E8600	Accidental alcohol poisoning (alcoholic beverages)	Poisoning – LDC	✓	
	E8601	Accidental alcohol poisoning (other/unspecified ethyl alcohol & its products)	Poisoning – LDC	✓	
	E9809	Undetermined cause alcohol poisoning	Poisoning – LDC	✓	
	3042x	Cocaine dependence	Abuse/Dependence – EDC	✓	✓
Cocaine	3056x	Cocaine abuse	Abuse/Dependence – EDC	✓	✓
	76075	Cocaine - noxious influences affecting fetus or newborn via placenta or breast milk	Drug-induced disorder – EDC	✓	✓
	9685x	Poisoning by surface (topical) and infiltration anesthetics (e.g., cocaine)	Poisoning – EDC	✓	
	E8552	Accidental poisoning by local anesthetics (e.g., cocaine)	Poisoning – LDC	✓	
	E9804	Undetermined cause poisoning by other specified drugs & medicinal substances	Poisoning – LDC	✓	
Opiates	3040x	Opioid type dependence	Abuse/Dependence – EDC	✓	✓
	3047x	Combinations of opioid with any other dependence	Abuse/Dependence – EDC	✓	✓
	3055x	Opioid abuse	Abuse/Dependence – EDC	✓	✓

Substance Type	Indicator Code ^a	Indicator Label	Factor Analysis Group ^b	EMSANT-W	CCS-MHSA
Sedatives, Barbiturates, Hypnotics, Anesthetics	76072	Narcotics - noxious influences affecting fetus or newborn via placenta or breast milk	Drug-induced disorder – LDC	✓	✓
	96500	Poisoning by opium (alkaloids), unspecified	Poisoning – LDC	✓	✓
	96501	Poisoning by heroin	Poisoning – EDC	✓	✓
	96502	Poisoning by methadone	Poisoning – LDC	✓	✓
	96509	Poisoning by other opiates (e.g., morphine)	Poisoning – LDC	✓	✓
	9701x	Poisoning by opiate antagonists	Poisoning – LDC	✓	
	E8500	Accidental poisoning by heroin	Poisoning – EDC	✓	
	E8501	Accidental poisoning by methadone	Poisoning – LDC	✓	
	E8502	Accidental poisoning by other opiates and related narcotics (e.g., codeine)	Poisoning – LDC	✓	
	E9350	Heroin - adverse effects of therapeutic use	Poisoning – EDC	✓	
	E9800	Undetermined cause poisoning by opiates (analgesics, antipyretics, and antirheumatics)	Poisoning – LDC	✓	
	3041x	Sedative, hypnotic or anxiolytic dependence	Abuse/Dependence – EDC	✓	✓
	3054x	Barbiturate, sedative, and hypnotic abuse	Abuse/Dependence – EDC	✓	✓
	9670x	Poisoning by barbiturates	Poisoning – LDC	✓	
	9671x	Poisoning by chloral hydrate group	Poisoning – LDC	✓	
	9672x	Poisoning by paraldehyde	Poisoning – LDC	✓	
	9673x	Poisoning by bromine compounds	Poisoning – LDC	✓	
	9674x	Poisoning by methaqualone compounds	Poisoning – LDC	✓	
	9675x	Poisoning by glutethimide group	Poisoning – LDC	✓	
	9676x	Poisoning by mixed sedatives, not elsewhere classified	Poisoning – LDC	✓	
	9678x	Poisoning by other sedatives & hypnotics	Poisoning – LDC	✓	
	9679x	Poisoning by unspecified sedative or hypnotic	Poisoning – LDC	✓	
	9682x	Poisoning by other gaseous anesthetics (e.g., nitrous)	Poisoning – LDC	✓	
	9683x	Poisoning by intravenous anesthetics	Poisoning – LDC	✓	
	E851x	Accidental poisoning by barbiturates	Poisoning – LDC	✓	
	E852x	Accidental poisoning by other sedatives & hypnotics	Poisoning – LDC	✓	
	E8551	Accidental poisoning by anesthetics (other central nervous system depressants, e.g. nitrous)	Poisoning – LDC	✓	
Cannabis	E9801	Undetermined cause poisoning by barbiturates	Poisoning – LDC	✓	
	3043x	Cannabis dependence	Abuse/Dependence – EDC	✓	✓

Substance Type	Indicator Code ^a	Indicator Label	Factor Analysis Group ^b	EMSANT-W	CCS-MHSA
Hallucinogens	3052x	Cannabis abuse	Abuse/Dependence – EDC	✓	✓
	E8541	Accidental poisoning by psychodysleptics (hallucinogens, e.g. cannabis, LSD)	Poisoning – LDC	✓	
	3045x	Hallucinogen dependence	Abuse/Dependence – EDC	✓	✓
	3053x	Hallucinogen abuse	Abuse/Dependence – EDC	✓	✓
	76073	Hallucinogenic agents - noxious influences affecting fetus or newborn via placenta or breast milk	Drug-induced disorder – EDC	✓	✓
Amphetamines, Sympathomimetics	9696x	Poisoning by psychodysleptics (hallucinogens)	Poisoning – LDC	✓	
	E8541	Accidental poisoning by psychodysleptics (hallucinogens, e.g. cannabis, LSD)	Poisoning – LDC	✓	
	3044x	Amphetamine and other psychostimulant dependence	Abuse/Dependence – EDC	✓	✓
	3057x	Amphetamines and sympathomimetic abuse	Abuse/Dependence – EDC	✓	✓
	9697x	Poisoning by psychostimulants (e.g., amphetamine)	Poisoning – LDC	✓	
Tranquilizers	E8542	Accidental poisoning by psychostimulants	Poisoning – LDC	✓	
	3041x	Sedative, hypnotic or anxiolytic dependence	Abuse/Dependence – EDC	✓	✓
	9693	Poisoning by psychotropic agents - other antipsychotics, neuroleptics, and major tranquilizers	Poisoning – LDC	✓	
	9694	Poisoning by benzodiazepine-based tranquilizers	Poisoning – LDC	✓	
	9695	Poisoning by other tranquilizers	Poisoning – LDC	✓	
Other psychotropics	E8532	Accidental poisoning by benzodiazepine-based tranquilizers	Poisoning – LDC	✓	
	E8538	Accidental poisoning by other specified tranquilizers	Poisoning – LDC	✓	
	E8539	Accidental poisoning by unspecified tranquilizer	Poisoning – LDC	✓	
	E9803	Undetermined cause poisoning by tranquilizers and other psychotropic agents	Poisoning – LDC	✓	
	9698x	Poisoning by other specified psychotropic agents	Poisoning – LDC	✓	
Analeptics, Other CNS Stimulants	9699x	Poisoning by unspecified psychotropic agents	Poisoning – LDC	✓	
	9701x	Poisoning by opiate antagonists	Poisoning – LDC	✓	
	9708x	Poisoning by other specified CNS stimulants	Poisoning – LDC	✓	
	9770	Poisoning by dietetics	Poisoning – LDC	✓	
	9711	Poisoning by parasymphatholytics (anticholinergics, antimuscarinics) and spasmolytics	Poisoning – LDC	✓	
	E8543	Accidental poisoning by central nervous system stimulants	Poisoning – LDC	✓	
	E8554	Accidental poisoning by parasymphatholytics (anticholinergics, antimuscarinics) and spasmolytics	Poisoning – LDC	✓	

Substance Type	Indicator Code ^a	Indicator Label	Factor Analysis Group ^b	EMSANT-W	CCS-MHSA
Analgesics, Antipyretics	E8588	Accidental other specified drugs (central appetite depressants)	Poisoning – LDC	✓	
	9658x	Poisoning by other specified analgesics and antipyretics	Poisoning – LDC	✓	
	E8508	Accidental poisoning by other specified analgesics and antipyretics (pentazocine)	Poisoning – LDC	✓	
Other, Mixed, Unspecified	BC + Tox	Positive toxicology screen (on birth certificate)	Drug-induced disorder – EDC	✓	
	2920	Drug withdrawal	Drug-induced disorder – EDC	✓	✓
	2921x	Drug-induced psychotic disorders	Drug-induced disorder – LDC	✓	✓
	2922	Pathological drug intoxication	Drug-induced disorder – LDC	✓	✓
	2928x	Other specified drug-induced mental disorders	Drug-induced disorder – LDC	✓	✓
	2929	Unspecified drug-induced mental disorder	Drug-induced disorder – LDC	✓	✓
	3046x	Other specified drug dependence	Abuse/Dependence – EDC	✓	✓
	3048x	Combinations of drug dependence excluding opioids	Abuse/Dependence – EDC	✓	✓
	3049x	Unspecified drug dependence	Abuse/Dependence – EDC (Not included in factor anal.)	✓	✓
	3058x	Antidepressant abuse			✓
	3059x	Other, mixed, or unspecified drug abuse	Abuse/Dependence – EDC	✓	✓
	64830	Drug dependence complicating pregnancy - pregnancy status unspecified	Abuse/Dependence – EDC	✓	✓
	64831	Drug dependence complicating pregnancy - delivered	Abuse/Dependence – EDC	✓	✓
	64832	Drug dependence complicating pregnancy - delivered with postpartum complication	Abuse/Dependence – EDC	✓	✓
	64833	Drug dependence complicating pregnancy - antepartum	Abuse/Dependence – EDC	✓	✓
	64834	Drug dependence complicating pregnancy - postpartum	Abuse/Dependence – EDC	✓	✓
	65550	Suspected damage to fetus from drugs - pregnancy status unspecified	Drug-induced disorder – LDC	✓	✓
	65551	Suspected damage to fetus from drugs - delivered	Drug-induced disorder – LDC	✓	✓
	65553	Suspected damage to fetus from drugs - antepartum	Drug-induced disorder – LDC	✓	✓
	7795x	Drug withdrawal syndrome in newborn	Drug-induced disorder – EDC	✓	✓
	E9804	Undetermined cause poisoning by other specified drugs & medicinal substances	Poisoning – LDC	✓	
	V6542	Seeking consultation - counseling on substance use/abuse	Abuse/Dependence – EDC	✓	✓

Abbreviations: BC Pos. Tox. – birth certificate positive toxicology screen; CCS-MHSA – Clinical Classifications Software for Mental Health and Substance Abuse; EMSANT-W – Explicit Mention Substance Abuse Need for Treatment in Woman; EDC – explicit dependence code; LDC – likely dependence code.

^a *International Classification of Diseases, 9th Edition, Clinical Modification* diagnostic codes are presented without the decimal point following the third digit. The “x” at the end of codes represents any number in that decimal position. Boldface codes are included in more than one type of substance.

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b Condition type – categorization as explicit dependence code (EDC) or likely dependence code (LDC).

Table 2

Differences in Capture Rate for Identification of Women with Likely Substance Use Disorders: A Comparison of EMSANT-W and CCS-MHSA, Massachusetts, United States, 2002-2008

Increase/Decrease and Contributing Factors	Examples of Contributing Indicators ^a	Sample Size by Method				Decision Rules Responsible for Increase/Decrease
		EMSANT-W		CCS-MHSA		
		<i>b</i> n	%	<i>b</i> n	%	
Total Women Identified with an SUD		103,059	100	99,796	100	
Increase						
Inclusion of poisoning E codes	E8500 (accidental opioids)	1,521	1.5	--	--	CCS-MHSA does not include E codes.
	E8600 (accidental alcohol)	965	0.9	--	--	
	E9803 (undetermined tranquilizers)	2,023	2.0	--	--	
	E9809 (undetermined alcohol)	1,324	1.3	--	--	
Range of drugs	9678x (poisoning by other sedatives, hypnotics)	694	0.7	--	--	CCS-MHSA does not include poisoning codes other than for alcohol and opiates
	9679x (poisoning by unspecified sedative, hypnotic)	640	0.6	--	--	
	9693 (poisoning by other antipsychotics, neuroleptics, major tranquilizers)	1,643	1.6	--	--	
	9694 (poisoning by benzodiazepine-based tranquilizers)	5,210	5.1	--	--	
	9697x (poisoning by psychostimulants)	681	0.7	--	--	
Decrease						
Application of exclusion rules	96509 (poisoning by opioids other than heroin and methadone)	1,594	1.6	--	--	CCS-MHSA has no exclusion rules based on what other codes are in a record that suggest this code is not for SUD
	9800 (poisoning other alcohol)	2,528	2.5	2,961	3.0	
	2928 (drug induced mental disorders)	4,410	4.3	4,501	4.5	
Code exclusion for greater specificity in SUD-positive sample	2929x (unspecified drug induced disorders)	--	--	335	0.3	CCS-MHSA includes non-SUD explicit codes regardless of low co-occurrence with explicit codes.

Abbreviations: CCS-MHSA – Clinical Classifications Software for Mental Health and Substance Abuse; EMSANT-W – Explicit Mention Substance Abuse Need for Treatment in Women.

^a *International Classification of Diseases, 9th Edition, Clinical Modification* code examples do not provide an exhaustive list for that contributing factor category. The decimal point following the third digit has been dropped. The “x” at the end of codes represents any number in that decimal position.

^b Counts are not mutually exclusive across rows.

Table 3

Comparison of EMSANT-W and CCS-MHSA Algorithms for Identifying Women with Substance Use Disorders by Type of Substance, Massachusetts, United States, 2002-2008

Substance Type and Specific Codes	EMSANT-W			CCS-MHSA ^a		
	n	%	(95% CI)	n	%	(95% CI)
Alcohol	68,110	66.1	(65.8-66.4)	62,665	62.8	(62.5-63.1)
Crack/cocaine	21,576	20.9	(20.7-21.2)	20,693	20.7	(20.5-30.0)
Heroin, opiates, methadone	26,018	25.2	(24.9-25.5)	28,146	28.2	(27.9-28.5)
Sedatives, barbs, hypnotics, anesthetics	8,107	7.9	(7.7-8.1)	5,858	5.9	(5.8-6.1)
Cannabis	15,363	14.9	(14.7-15.1)	15,224	15.3	(15.0-15.5)
Hallucinogens	782	0.8	(0.8-0.9)	283	0.3	(0.3-0.3)
Amphetamines, sympathomimetics	1,872	1.8	(1.7-1.9)	1,130	1.1	(1.0-1.2)
Minor tranquilizers	24,006	22.8	(22.5-23.1)	3,143	3.2	(3.1-3.3)
Other psychotropics	640	0.6	(0.6-0.7)	0	0	--
Analeptics, other CNS stimulants, dietetics, parasympatholytics	2,555	2.5	(2.4-2.6)	0	0	--
Analgesics/antipyretics	462	0.4	(0.4-0.4)	0	0	--
Other/mixed/unspecified	39,764	38.6	(38.3-38.9)	34,750	34.8	(34.5-35.1)
Affected babies	4,724	4.6	(4.5-4.7)	3,707	3.7	(3.6-3.8)
Identified solely through pregnancy/infant codes	418	0.4	(0.4-0.4)	228	0.2	(0.2-0.2)

Bolded figures indicate significantly different percentages at $P < .05$. Abbreviations: CCS-MHSA – Clinical Classifications Software for Mental Health and Substance Abuse tool; EMSANT-W – Explicit Mention Substance Abuse Need for Treatment in Women.

^aOnly codes related to substances were included.