Online supplementary material

Predictive value of indicators for identifying child maltreatment and intimate partner violence in coded electronic health records: a systematic review and meta-analysis

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Table S1. Review deviations from the original PROSPERO protocol

1. Given the limited amount of eligible studies, we decided not to conduct bivariate random-effects models to measure the pooled sensitivity and specificity of coded indicators to account for the variation of underlying prevalences between studies on family violence. Whilst some studies reported sensitivity, the high volume of eligible patients presenting to healthcare combined with the rare occurrence and underreporting of all family violence limits the feasibility to apply a reference standard to non-coded cases to ascertain false negatives. Reliable measures on sensitivity are therefore unlikely to be obtained without a bivariate random-effects model. We therefore decided to focus the review solely on positive predictive values.

2. We decided to include studies without specific code lists given that the study met all other criteria, and reported on a specific coding system and coding terms adequately enough to classify indicators into relevant categories. This posthoc decision was made to allow for inclusion of studies assessing broader indicators of family violence such as combinations of multiple codes for adversity.

Table S2. Search strategy used in this systematic review and meta-analysis

1. Sources:

We searched the following sources from 1970 to inception:

Electronic databases: MEDLINE, EMBASE, PsychINFO, Maternity & Infant Care Database, AMED, Global Health Archives, Web of Science (Ovid), PubMed, CINAHL Plus, Child Development & Adolescent Studies, British Education Index, Web of Science, SCOPUS, ERIC, Proquest Central, Science Citation Index, Cochrane library (Wiley), DARE.

***Trial registers*:** EU-CTR, ISRCTN, ClinicalTrials.gov

Grey literature: Google Scholar, Open Grey, ProQuest Dissertations & Theses Global and web links from relevant organisational websites including WHO Global Health Library.

References of screened literature reviews and/or annotated bibliographies: Clinical Practice Research Datalink biography [1], CM, IPV, alcohol misuse [2-4], drug misuse [5-9], family dysfunction [10-13], mental health problems [14-17], suicide and self-harm, [18-21], physical injuries [22-24], violent injuries [25-27], multiple adversities [28,29], and www.apps.who.int/violence-info.

Journals: JAMA, JAMA Psychiatry, JAMA Paediatrics, the Lancet, the Lancet Psychiatry, Lancet Public Health, The Lancet Child & Adolescent Health, Traumatology, BJPsych, Psychiatric services, BMJ Injury Prevention and the BMC journals.

Code repositories:

- https://clinicalcodes.rss.mhs.man.ac.uk/
- https://www.caliberresearch.org/portal/phenotypes
- https://www.phpc.cam.ac.uk/pcu/cprd_cam/codelists/
- https://data.bris.ac.uk/data/organization/health-sciences-org?q=cprd&sort=score+desc%2C+metadata_modified+desc
- https://www.rcgp.org.uk/clinical-and-research/resources/toolkits
- https://nccd.cdc.gov/dph_ardi/info/icdcodes.aspx

Expert recommendations: Prominent researchers, policy experts and clinicians within the field with at least one contact from each of the five WHO defined continents.

2. Search terms:

The following search terms were applied across sources using the PICO structure and combined using Boolean operators and MESH terms:

CM and IPV*: (abuse* OR maltreat* OR neglect* OR malnutriti* OR violen* OR mistreat* OR trauma* OR adversity* OR "adverse childhood*" OR assault* OR fight OR mutilate* OR mutiliation* OR fgm OR battering OR battered OR exploitation OR crushed OR rape OR strike* OR struck OR stabb* OR drown* OR homicide* OR murder* OR molest* OR hardship OR tragedy OR harass* OR stalk OR "lack$of" OR street* OR shelt* OR "looked after" OR "child in care" OR "outofhome$care" OR "child in need" OR "child protect*" OR "foster care" OR "foster family" OR "substitute family" OR "vulnerable child" OR "act 1989" OR "act 1995" OR "order 1995" OR orphan OR asylum OR unwanted OR refugee OR displaced OR escape* OR fugitive OR exile OR "at$risk" OR "neonatal abstinen*" OR NAS OR "substance withdrawal" or "opiod misuse*" OR "maternal substance*" OR "substance-exposed newborn" OR "neonatal drug withdrawal" OR "opioid dependency" OR "perinatal substance" OR "antenatal substance"* OR *"prenatal* drug" OR "pre-natal* drug expos*" OR embryopath* OR "neurodevelopmental* disorder*" OR "birth defect*" OR arnd OR arbd OR "fetal$alcohol*" OR "foetal$alcohol*" OR fae OR fas OR fasd OR "fetal alcohol spectrum disorder*" OR "alcohol syndrome*" OR "prenatal* alcohol" OR "pre-natal* alcohol expos*").[ti,ab]*

Design*: AND (*"electronic$health$record*" OR "electronic$medical$record*" OR "routine$data" OR "administrative$data" OR "registry" OR "electronic$data" OR "registery*" OR "icd* or "read$code" OR "codes").*[ti,ab]*

Outcome*: AND* (specifici* OR accura* OR sensi* OR reliabilit* OR valid* OR "chart$review" OR "manual$review" OR "medical$record$review" or "substantiated" or "verifi*" or "confirmed" OR "linked" OR "linkage" OR surveillance*).*[ti,ab]*

*/$ Search term wildcard.

3. Limitations:

All searches were limited to studies published in English, Swedish and German without year restriction.

4. Method for addressing articles published in languages other than English:

Given that study titles were indexed in English, we retrieved all potentially eligible non-English language studies published in German and Swedish. Full texts were uploaded to Google's document translation service for automatic translation. Each document was then checked for accurate translations by either a native Swedish speaker (S.S) or a native German speaker (M.S) and made available to the remaining reviewers.

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Table S3. Eligible sources for obtaining independent reference standards for assessing electronic health records

Independent reference standard
• Independent and blinded manual chart review of full medical, social and/or criminal records (either as extracted or by re-coding charts for direct comparison of codes).
• Non-blinded manual chart review of full medical records (extracted or by re-coding for direct comparison of codes).
• The individual meets criteria defined by a validated instrument (e.g., self-report survey) completed within one-month of the coded-EHR.
• Clinician confirms case via a self-report survey administered to the service.
• Linkage of the same individual to another independent non-health-related database that provides concordance of the diagnosis by a qualified professional (e.g., social worker, police etc.).
• Linkage of the same individual to another healthcare database that provides concordance of the diagnosis (e.g., similar diagnosis recorded in both hospital discharge and general practitioner records).

Eligibility of sources for obtaining reference standards broadly adapted from Nissen et al.[30]

Table S4. Modified version of the Revised Tool for the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) with rankings of reference standard and exclusion made in comparison groups

Description	
The QUADAS-2 provides criterion to assess the quality of validation studies across two overall domains concerning risk of bias: (1) validity methods, and (2) level of applicability and generalisability to practice.	
Risk of bias: validity methods	**Quality rating**
1. Patient selection	
• Population selection criteria clearly described & reported the numbers excluded from the analyses with reason(s) explained, or there were no exclusions.	1 (high)
• Population selection criteria unclear/ did not report the numbers excluded	0 (low)
2. Index test (i.e. indicators/codes)	
• Specific codes (primary vs primary or secondary diagnoses) reported in the main paper or the supplement	1 (high)
• No specific codes reported, but used a recognised coding system and reported on related coding terms.	0 (low)
3. Level of certainty for distinguishing CM/IPV from non-CM/IPV applied by reference standard Quality ratings correspond to the level of certainty that the reference standard is a true measure of CM or IPV. Ratings 1-5 apply to CM, 1-4 apply to NAS and FAS, and 1-3 apply to IPV.	
• CM/IPV confirmed at case conference or family, civil, or criminal court proceedings; admitted by perpetrator; or witnessed abuse AND non-CM actively excluded by stated criteria (e.g., witnessed accidental cause, caused by metabolic bone diseases etc).	5 (high)
• CM/IPV confirmed by stated criteria including multidisciplinary assessment AND non-CM/IPV actively excluded by stated criteria.	4
• CM/IPV defined by stated criteria AND source verifying non-CM/IPV merely stated.	3
• CM/IPV stated, but no supporting detail is given AND source verifying non-CM/IPV merely stated.	2
• Suspected CM/IPV AND no criteria stated for verifying non-CM/IPV.	1 (low)
4. Were the reference standard interpreted without knowledge of the results from the index test (e.g. blinding, did not know which case had positive code)?	
• Blinded chart review (e.g. review of records without knowledge of abuse status) or/and external linkage/independent review.	1 (high)
• The reviewers knew the coded classification or no information provided regarding the reviewer's knowledge.	0 (low)
5. Flow and timing *Alternative option provided for reference standards based on external linkage for verification.	
• The information used in the reference standard was the same as the information used at the time of coding (applicable: chart reviews).	1 (high)
• The period between linkage for verification and the initial diagnosis was short enough (1 year maximum) to be reasonably sure that the target condition did not change relative to the original coding classification? (applicable: studies using external linkage for verification).	1 (high)*
• The information used to make the reference standard diagnosis was not the same as the information used at the time of coding (e.g. extra material gathered from other departments).	0 (low)
• The period between external linkage for verification and the initial diagnosis was more than 1 year.	0 (low)*
• Insufficient published data.	0/U (unclear)
Risk of bias: Applicability and generalisability	**Risk of bias**
6. Patient selection	
• The study included patients diagnosed and treated in a representative mixture of general health settings, and the population was otherwise relatively unselected.	1 (low)
• The study was performed in a selected population (e.g. restricted to patients admitted to a trauma/burn/victim unit, where awareness and coding performance of abuse might be higher)	0 (high)
• Insufficient published information.	0/U (unclear)
7. Index test (indicators)	
• Codes were initially assigned by hospital coders or treating clinicians as part of routine patient care stored in seemingly accessible database management system.	1 (low)
• Reported codes were assigned by surveillance personnel, subject experts or the study authors for the purpose of diagnostic comparison or for use in selected service audits (i.e. where coding methods and performance might be higher).	0 (high)
• Insufficient published information.	0/U (unclear)
8. Reference standard	
• The whole sample/random selection/broader sample (e.g. broad range of injuries/presentations) were assessed with the reference standard, with a reasonably low likelihood of missed cases?	1 (low)
• Some of the samples did not receive the reference standard or the codes formed part of the reference standard (e.g., reference standard only applied to cases with CM/IPV specific-coded diagnoses).	0 (high)
• Insufficient published information.	0/U (unclear)

The QUADAS-2 has been modified for assessing studies of administrative data/electronic health records as in McCormick et al.,[31] and the ratings of CM and IPV were adapted from Maguire et al.[32] Depending on outcome, studies could achieve a maximum total score accordingly: CM=12; NAS & FAS= 11; IPV=10. Abbreviations: CM=Child maltreatment; EHR=Electronic health records; FAS=Fetal alcohol syndrome; NAS=Neonatal abstinence syndrome.

Table S5. Additional information on methods for evaluating coding quality and sources of misclassifications

We examined documentation quality and potential sources of misclassifications by pooling the proportions of coded medical charts (identified using indicator) with missing information required to meet criteria by the independent reference standard:

- For IPV, we pooled the proportion of coded assault indicators with missing data on perpetrator status in the underlying medical charts (No. of assault records with missing perpetrator status/No. of assaults records). Missing perpetrator information prohibits the assignment of IPV specific outcomes by all reference standards, and further assignment of specific ICD codes (e.g. ICD-9-CM=E967.3. Battering by intimate partner; ICD-10= Y07.0. Other maltreatment by spouse or partner).

- For FAS, we included studies that evaluated coded FAS indicators with missing information on maternal alcohol status in the underlying medical charts (o. of coded records with FAS indicator with missing maternal alcohol status/ No. of coded records with FAS indicator). Missing alcohol status was the most frequent reason for not meeting criteria by a reference standard across included studies.

We examined coding misclassifications by pooling the proportion of miscoded indicators for any outcome:

- Misclassifications were defined as the discordance/disagreement between the original codes (i.e. indicator) and the reference standard when adequate information was available in the underlying medical charts or discharge notes to assign a more appropriate code. Estimates were based on studies explicitly stating the proportion of misclassifications (e.g. No. of individuals with wrongly classified codes following re-coding of the data / No. of individuals with originally assigned codes by hospital coder).

All proportions were pooled using a random-effects intercept logistic regression with the logit transformation when at least three studies were available for the same outcome.[33]

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Table S6. Selected study characteristics of included studies by outcome

Source	Indicator	Country, period	D	Setting	No. of centres, data source	N	Mean age years, range	Prev, %	Coding sys	Ref	Definition reference standard/alternative reference standard
Neonatal Abstinence Syndrome (NAS)											
Lind, 2019abcdef[34]	NAS	USA, 2015-2016	C	Inpatient & SURVL	State-wide (New Mexico, Vermont & Illinois), HDDS & birth defects surveillance data & Medicaid data	44-1563	NR	0.003	ICD-9-CM/-10	CR	Verification for meeting NAS CDC case definition (3 criteria, incl. FNAS score >8)
Maalouf, 2019b[35]	NAS	USA, 2009-2011	L	Inpatient	NR, TennCare, Tennessee's Medicaid program	950	25.9[d]	0.77	ICD-9	CR	Verification by two physicians using stated criteria incl. recorded physician diagnosis and/or a FNAS score of >4/ Stricter: + recorded required pharmacological treatment
Lind, 2015[36]	NAS	USA, 2010-2011	C	Inpatient & SURVL	3 hospitals, Florida's discharge data linked to birth certificates & NICUs	413	27.4[d]	1.07	ICD-9	CR	Verification for meeting all three CDC defined NAS criteria /Stricter: FNAS score >8
Phillips-Bell, 2019[37]	NAS	USA, 2015	C	Inpatient	3 hospitals, Linked Florida hospital discharge database to infant records	303	NR	NR	ICD-9-CM	CR	Verification for meeting all three defined criteria of NAS or FNAS >8 /Stricter: only FNAS score >8
Chisamore,[38] 2016	NAS	USA, 2000-2014	C	Inpatient	1 hospital with NICU, St. Joseph's Health Centre	278	24-33§	NR	ICD-10	CR	Verification of maternal opioid exposure through confirmed drug screen and/or self-admitted use/Stricter: Recorded required pharmacological treatment of child
Yam, 2019[39]	NAS	USA, 2000-2006	L	Inpatient & SURVL	1 medical centre, Campbelltown Hospital, Sydney	253	29	1.36	ICD-10	CR	Verification by one researcher for maternal opioid exposure and child required NAS medications/ Stricter: FNAST score ≥8
Patrick, 2015[40]	NAS	USA, 2008-2011	C	Inpatient	3 Hospitals, TennCare, Tennessee's Medicaid program	228	median: 24[d]	0.97	ICD-9-CM	CR	Verification of prescription opioid using recorded drug test or/and "infant history or drug screening"
Maalouf, 2019a[35]	NAS	USA, 2016	C	Inpatient	1 hospital, TennCare, Tennessee's Medicaid program	217	25.9[d]	0.77	ICD-10-CM	CR	As in Maalouf (2019b)[35]
Alsaleem, 2019‡[41]	NAS	USA, 2013-2016	C	Inpatient	2 NICUs/hospitals, Women's/Children's Hospital of hospital & Millard Fillmore Suburban Hospital	110	28[d]	NR	ICD-9	CR	Verification for meeting NAS criteria (incl. modified FNAS sore >8)
Umer, 2019[42]	NAS	USA, 2017	C	Inpatient & SURVL	NR, Western Virginia Surveillance database on all births from all hospitals	79	NR	0.053	ICD-10-CM	CR	Verified by nurse survey for intrauterine exposure to a neuro-active substance, clinical signs of withdrawal, regardless of pharmacological treatment
Huybrechts,[43] 2017	NAS	USA, 2000-2010	C	Inpatient	NR, obstetrical care centres in the Partners HealthCare system	57	Mean: 24.6-28.4[d]	1.23	ICD-9	CRB	Verification of physician diagnosis or recorded required NAS treatment of child
Fetal Alcohol Syndrome (FAS)											
Miller, 2002[44]	FAS	USA, 1995-1997	L	Inpatient & SURVL	NR, FASSNet surveillance registry & hospitals, clinics, early intervention programs & Medicaid Database across Alaska, Arizona, Colorado, NY	1489	NR, babies	0.0004	ICD-9	CR	Verification for FAS using stated criteria/Stricter: Definite/probable
Egeland, 1998[45]	FAS	USA, 1977-1993	C	Inpatient	NR, multiple sources of FAS referral centres in Alaska	630	Median: 0.6	0.0013	ICD-9	CR	Verification for a physician for diagnosis/suspected FAS and/or meeting a defined criterion of FAS/Stricter: meeting all stated criteria
Welty, 1995[46]	FAS	USA, 1981-1991	L	Inpatient & ED	8 Health Services, Aberdeen Area involving Indian Health Services	251	8, 0-31	0.003	ICD-9	CR	Verification for five stated criteria of FAS/Stricter: Meeting all criteria
Miller, 1995[47]	FAS	USA, 1992-1994	L	Inpatient & SURVL	NR, Colorado Registry for Children with Special Needs, birth defects surveillance	173	0-3	0.0003	ICD-9-CM	CR	Verification for FAS using stated criteria of definitive or problem/Stricter: Definite/probable
Harris, 2003[48]	FAS	AU, 1990-2000	L	Inpatient/outpatient	NR, Top End/the Northern Territory	117	0-10	0.0007	ICD-9/10	CR	Verification for meeting ≥1 defined FAS criterion/Stricter: meeting all four stated defined FAS criteria
Allen, 2007[49]	FAS	AU, 1995-2002	L	Inpatient	NR, Victoria and the Victorian Birth Defects Register	117	0 (babies)	0.00001	ICD-9/10	CR	Verification for three classical facial features of FAS using stated criteria.
Fox, 2003[50]	FAS	USA, 1995-1997	L	Inpatient & SURVL	NR, NY Congenital Malformations Registry & FASSNet surveillance registry	57	≤2	0.0004	ICD-9-CM	EL	Verification for confirmed or suspected FAS by uniform CDC criteria

Table S6. Selected study characteristics of included studies by outcome (continued)

Source	Indicator	Country, period	D	Setting	No. of centres, data source	N	Mean age years, range	Prev, %	Coding sys	Ref	Definition reference standard/alternative reference standard
Child maltreatment (CM)											
Gumbs, 2013[51]	CM	USA, 1998-2005	L	Inpatient/outpatient	Nationwide military families, US Defence DoD Birth and Infant Health Registry	676827	≤1	0.0003	ICD-9-CM	EL	Substantiated/probable AHT by positive match in CPS registry 1 week before, or within 60 days of AHT diagnosis
O'Donnell, 2012[52]	CM/A	AU, 2001-2005	L	ED	NR, EDs in Western Australia linked to CPS/Hospital/birth data	657656	≤17	0.03	ICD-10	EL	Positive match for CM substantiation/allegation within 5 years/Stricter: CM substantiation 2 days pre & 5 days post-ED presentation
O'Donnell, 2010[53]	CM/A	AU, 1990-2005	L	Inpatient	NR, All Births in Western Australia eligible linked to CPS/hospital data	397346	0-5	3.43	ICD-10	EL	Positive match for CM notification within 4 days (73%) /Stricter: CM substantiation
Parrish, 2013a[54]	CM	USA, 2005-2010	C	Inpatient & SURVL	24 hospitals, Alaska trauma registry linked to Hospital/Medicaid/Violent Death reporting system	130683	≤2	0.03	ICD-9-CM/10-CM	EL	Positive match for CM across 7 trauma, hospital, claims and death databases using algorithm
Schnitzer, 2004[55]	CM	USA, 2002-2003	C	Inpatient & ED	NR, Missouri Division of Family Services linked to Patient Abstract System	6121	≤9	0.74	ICD-9-CM	CR & EL	Positive match for substantiated CM recording & 10% random sample verified by CR for CM allegation /Stricter: substantiated only
Schnitzer, 2011[55]	CM/COMB/A/RF/BURN/POISN/SF/SDH	USA, 2000	C	Inpatient & ED	NR, Missouri Patient Abstract System of discharges & linked ED visits	2826	≤9/≤9/≤4/≤2/≤4/≤4/≤4/≤4	NR	ICD-9	CR	Verification for carer behaviour with risk of possible CM, with cases discussed at weekly team meeting/ Stricter: Probable CM
Raghavan, 2015[56]	CM/COMB/A	USA, 1999-2002	C	Inpatient	NR, First National Survey of Child and Adolescent Well-Being linked to Medicaid claims from 36 states	2136	≤18	NR	ICD-9-CM	EL	Social caseworker determinations of CM in linked survey
Hooft, 2015[57]	CM/TBI	USA, 2007-2010	C	Inpatient	4 Hospitals, Yale-New Haven, Connecticut, Philadelphia, New York	936	≤3[f]	NR	ICD-9-CM	CR	Verification for evaluation by CM paediatrician
McKenzie, 2012[58]	CM	AU, 2003-2006	C	Inpatient	20 hospitals stratified by size, Queensland	895	8.3, ≤18	NR	ICD-10-AM	EL & CR	Positive CPS match & CR verification by 2 researches for CM cues/Stricter: Recorded CPS event
Krawiec, 2019[59]	CM	USA, 2009-2014	C	Inpatient	1 Institution with CPS referrals, Penn State Children's Hospital	666	0-18	NR	ICD-9-CM/ SNOMED CT	CR	Verification of CM by CPT
Karatekin, 2018[60]	CM	USA, 2011-2015	C	Inpatient & ED	8 hospitals, University of Minnesota's Clinical Data Repository	631	≤21	0.02	ICD-9	CR	Verification/agreement between 11 research assistants for appropriate CM code assignment
Paroskie, 2014[61]	CM	USA, 2007-2012/2009-2012	C	Inpatient & ED	2 Hospitals, billing data from Vanderbilt University & Children's Mercy Hospitals	427	0-14	NR	ICD-9	CR	Bruising & injuries concerning for NAI by the study team
Garza, 2019a[62]	CM/A[e]	USA, 2012-2013	C	Inpatient	1 medical centre, Dell Children's Medical Centre Texas	391	≤18/≤7a	NR	ICD-9	CR	Verification for determination of physical abuse by MCPT/ Stricter: CPT confirmation
Garza, 2019b[62]	CM/A[e]	USA, 2016-2017	C	Inpatient	1 medical centre, Dell Children's Medical Centre Texas	303	≤18/≤7a	NR	ICD-10	CR	Verification for determination of physical abuse by MCPT/ Stricter: CPT confirmation
Wu, 2015[63]	CM/BURN/LLF/ULF/SF/POISN/SDH	Taiwan, 2007-2009	C	Inpatient	1 medical centre, southern Taiwan	247	≤3	5.26	ICD-9-CM	CR	Meeting criteria per the 28-Criteria of Distinguishing Abuse from Accidents by two experts
Berger, 2013[64]	CM	USA, 2006-2012	C	Inpatient	1 hospital, Children's Hospital of Pittsburgh	223	median: 3.9, ≤4	NR	ICD-9-CM	CR	Verification by hospital-based CPT for probable/definite AHT
Durand, 2019[65]	CM	USA, 2017	C	Inpatient	1 Level one pediatric trauma center	115	≤5		ICD-10	CR	CR verification for social work notes /Stricter: CPS report

Table S6. Selected study characteristics of included studies by outcome (continued)

Source	Indicator	Country, period	D	Setting	No. of centres, data source	N	Mean age years, range	Prev,%	Coding sys	Ref	Definition reference standard/alternative reference standard
Child maltreatment (CM)											
Gessner, 2004[66]	CM	USA, 1996-2000	L	Inpatient	NR, Alaska Division of Family & Youth Services registry for child abuse cases	68	≤1	0.46	ICD-9	CR & EL	Positive CPS match & CR verification for physical abuse /Stricter: Social service substantiated CM
Risen, 2015[67]	CM	USA, 1995-2012	C	Inpatient	1 Paediatric acute hospital/rehabilitation unit	28	20, 0-4.25	NR	ICD-9	CR	Confirmed CM by MDT & witnessed/confessed CM OR confirmed by expert at a referral centre
Högberg, 2019[68]	COMB/RF[b]	Sweden, 1997-2014	L	Inpatient	Nationwide, All births with a diagnosis in NPR	1855267	≤1	NR	ICD-10	EL	Positive match for out-of-home-care placement using linkage
Somji, 2011[69]	COMB	Canada, 1997-2007	C	ED	2 EDs, Hospital for Sick Children & Children's Hospital of Eastern Ontario	308	≤2	NR	ICD-9/ICD-10	CR	Abusive fractures/injuries determined by onsite CPT using defined criteria/ Stricter: Confirmed by CPT
Tingberg, 2010[70]	COMB	Sweden, 2005-2008	C	ED	1 ED, Astrid Lindgren Children's Hospital	301	≤18	NR	ICD-10	CR	Verification for social service or police referrals and/or determined CM by/Stricter: Social service report filed
Gonzalez-Izquierdo, 2015[71]	COMB	England, 2010-2011	C	ED	1 ED, University College London Hospitals NHS Foundation Trust	138	≤18	0.0028	ICD-10	CR	Verification of CSS safeguarding notifications
Evasovich, 1998[72]	BURN	USA, 1990-1994	C	Inpatient	1 Hospital, Children's Burn Unit, Akron Hospital Medical Centre	104	3.8, ≤12	NR	ICD-9	CR	Verification for social service referrals for suspected CM/ Stricter: Convicted parent for CM
Sharkey, 2018[73]	LLF/ULF/RF	USA, 2007-2010	C	ED	1 ED, non-specified HD in New Haven & Child abuse registry	551	<3	5.63	ICD-9	CR	Verification by MDT of CM
Lavin, 2018[74]	ULF/RF/SF	USA, 2008-2012	C	ED	1 Paediatric ED, admin database	509	<1	NR	ICD-9	CR	Verification by 2 reviewers for considered CM by initial clinician/CM team or skeletal survey
Strait, 1995[75]	ULF	USA, 1990-1993	C	Out/inpatient	1 hospital, Cincinnati Children's Hospital Medical Centre	474	0.8, ≤15 mo	8.06	ICD-9	CR	Verification for definitive/likely CM using stated criteria/Stricter: Definitive CM
Baldwin, 2011[76]	LLF	USA, 2000-2003	CC	Inpatient	1 paediatric tertiary care centre & SCAN database, NR	209	≤1.5	NR	ICD-9	EL	Positive match in in SCAN database with CPT confirmed diagnosis
Capra, 2013[77]	LLF	USA, 1995-2004	C	Inpatient	1 Hospital, Hospital for Sick Children	203	3.0, 1-5	2.96	ICD-9/ICD-10	CR	Verification of suspected/confirmed CM by stated criteria/CPS notification & positive match in SCAN database/ Stricter: CPS confirmed
Ryznar, 2015[78]	ULF	USA, 2007-2012	C	Inpatient	2 hospitals, Ann & Robert L Children's Hospital & John H. Stroger Hospital	142	1.2, <1.5	8.15	ICD-9	CR	Verification for any reports from the hospital's MCPT/ law enforcement investigation/CPS notification / Stricter: CM determined by CPT
Hui,[79] 2008	LLF	USA, 1994-2005	C	Inpatient	1 hospital, Alberta Children`s Hospital	127	≤1	7.87	ICD-9/ICD-10	CR	Verification for disagreement between injury and cause, indicative of CM/ Stricter: Definitive CM by criteria
Hansoti,[80] 2008	LLF	Scotland, 2003	C	ED	1 ED, Royal Hospital for Sick Children	122	≤2	4.1	ICD-10	CR	Verification of by senior ED staff for referral to child-protection review / Stricter: Child protection referral
O'Donnell, 2010b[81]	POISN	AU, 1990-2005	CC	Inpatient	NR, All Births in Western Australia eligible linked to CPS/hospital data	68240	All ages	3.43	ICD-10	EL	Positive match for substantiated or allegation of CM/ Stricter: Social service substantiated
Wood, 2012[82]	POISN	USA, 2006-2008	C	Inpatient & ED	1 hospital, Children's Hospital of Philadelphia	928	≤5	3.66	ICD-9-CM	CR	Verification by 2 research for suspected CM recorded by the hospital social workers or the child protection team or for referrals to local CPS/Stricter: Referral to CPS
Kim, 2017[83]	SF	USA, 2008-2015	C	Inpatient	1 Paediatric trauma registry, Cincinnati Children's Hospital Medical Centre	563	<1	NR	ICD-9	CR	Verification for suspicion of CM by the CAT and social service interview feedback
Lyons,[84] 2016	SF	USA, 2008-2015	L	ED	1 ED, Boston Children's Hospital	438	median: 11 mo, 0.4-3.6	NR	ICD-9-CM	CR	Verification for social work/child protection notification
Lane, 2002[85]	SF	USA, 1994-2000	C	Inpatient	1 Hospital, Children's Hospital of Philadelphia	414	<1	NR	ICD-9	CR	Verification of recorded CPS referrals/positive abusive skeletal surveys & 100 random charts confirmed by external CM expert/ Stricter: recorded CPS referral only

Table S6. Selected study characteristics of included studies by outcome (continued)

Source	Indicator	Country, period	D	Setting	No. of centres, data source	N	Mean age years, range	Prev, %	Coding sys	Ref	Definition reference standard/alternative reference standard
Child maltreatment (CM)											
Ettaro, 2004[86]	SF/SDH /TBI	USA, 1995-1999	C	Inpatient	1 Hospital, Children's Hospital of Pittsburgh	377	≤2	NR	ICD-9-CM	CR	Verification of physical examinations/radiographs for "presumptive abuse" or "suspicious for abuse" based on criteria /Stricter: Convicted parent/presumptive CM
Anderst, 2008[87]	SF	USA, 2001-2005	C	ED	2 hospitals, Christus Santa Rosa Children's Hospital/non-specified University Hospital	349	1.1, ≤3	NR	ICD-9	CR	Verification of recorded CPS referrals
Wood, 2009,[88]	SF	USA, 1997-2006	C	Inpatient & ED	1 hospital, Children's Hospital of Philadelphia	341	<1	NR	ICD-9	CR	Verification of skeletal survey findings for potential CM/recorded CPS referrals
Rangel, 2009[89]	SF	USA, 2003-2008	C	Inpatient	1 hospital, Cincinnati Children's Hospital Medical Centre	260	<1	NR	ICD-9	CR	Verification for social service referral or meeting criteria as "not concerning for abuse," "possible abuse," "probable abuse," or "definite abuse" / Stricter: definite abuse
Lasekey, 2013[90]	SF	USA, 2004-2010	C	Inpatient	1 Hospital, Trauma Services Registry at Riley Hospital for Children	175	5 mo, 0-18 mo	1.32	ICD-9	CR	Verification for clinical findings suggestive of abuse (so called, "red flags") by stated criteria incl. CPS or social service referrals
Payne, 2016[91]	RH	USA, 2004-2014	C	Inpatient & ED	1 Hospital, Cardinal Glennon Children's Medical Centre Missouri	816	<1	NR	ICD-9	CR	Verification for concerns of CM by paediatrician and CM expert
Hooft, 2013[92]	RH	USA, 2007-2010	C	Inpatient & SURVL	1 Hospital, Yale-New Haven Children's Hospital	133	≤3§	0.0015	ICD-9-CM	CR	Meeting CM criteria by CAP, using a 7-point likelihood scale
Thyen, 1997[93]	TBI	USA, 1988-1990	C	Inpatient	NR, Hospitalisations in Rochester, Boston or New Haven	1875	5.2, 2-11	2.9	ICD-9	CR	Verification of reports to Child Protective Services
Keenan, 2004[94]	TBI	USA, 1998-2001	C	Inpatient	9 PICUS, North Carolina	245	≤2	0.01	ICD-9-CM	CR	Verification of intracranial injury by trained PICU nurse and CM verification by the project manager (no criteria stated)
Parrish, 2013b[54]	TBI	USA, 2005-2010	C	Inpatient & SURVL	1 paediatric care centre, Alaska Medical Centre	186	≤2	0.03	ICD-9-CM-ICD-10-CM	CR	Verification using stated criteria by two reviewers
Ricci, 2003[95]	TBI	USA, 1992-1994	C	Inpatient	2 Medical centres, Bangor Maine Eastern Maine Medical Centres	94	7.5 mo, ≤2	NR	ICD-9-N	CR	Verification for social service referrals or for meeting criteria according defined criteria / Stricter: Definitive
Myhre, 2007[96]	TBI/SDH	Norway, 1995-2005	C	Inpatient	1 Hospital, Trauma Registry Ulleval University	91	≤2	NR	ICD-NR	CRB	Verification of documented presumptive CM/ Stricter: CPS referral seen by study researcher & external reviewer
Tzioumi, 1998[97]	SDH	AU, 1987-1996	C	Inpatient	1 hospital, Royal Alexandra Hospital for Children	38	≤2	NR	ICD-9-CM	CR	Verification for hospital Child Protection Teams diagnosis of confirmed nonaccidental injury
Intimate partner violence (IPV) among predominately women											
Kernic, 2000[98]	A/C/FF	USA, 1992	C C	Inpatient	NR, Linkage to Washington State Hospital data/ King County protection records	37887	18-44	3.58	ICD-9	EL	Positive match protection order database for females being victims to severe types of abuse
Lipsky, 2009[99]	A	USA, 2004-2005	C	Inpatient	73 hospitals, Dallas Hospital inpatient discharge data linked to Dallas Police Dept	32825	18-49	NR	ICD-9	EL	Positive match to police reported IPV
Yau, 2013[100]	A	USA, 2000-2007	C	ED & SURVL	≥20 EDs, NYC DOHMH Injury SRUVL/SPARCS	22525	15-65[d]	NR	ICD-9	CR	Verification of assault by ex/current partner by two trained DOHMH staff
Fanslow, 1998[101]	A	NZ, 1992-1993	C	ED	2 EDs, Auckland & Middlemore	8051	30, 15-81	1.02	ICD-9	CR	Agreement in re-coding by a trained nurse
Brown, 2005[102]	A	USA, 2000-2002	L	ED	118 EDs, Oklahoma stratified by hospital size	3988	32.0, 16-66[d]	0.001	ICD-9	CR	Verification of assault or adult maltreatment committed by a current/ex intimate partner (broad inclusion)
Biroscak, 2006[103]	A	USA, 1999-2000	C	ED	23 EDs, Michigan IPV Surveillance System	3111	31, 16-81[d]	NR	ICD-9-CM	CR	Verification by ED nurse for physical or sexual violence committed by a current/ex intimate partner (broad inclusion)
Saltzman, 2005[104]	A[g]	USA, 2000-2001	C	ED	NR, ED data from the National Electronic injury Surveillance System	2521	10-39	9.57	ICD-9-CM	CR	Verified by two researchers as perpetrator being a spouse or partner of the patient
Ranney, 2011[105]	A	USA, 2004-2007	C	ED	1 hospital, ED billing database non-specific location	828	16, 10-19	0.08	ICD-9-CM	CRB	Verification of intentionality and perpetrator by three independent reviewers
Kivelä, 2019[106]	A[g]	Finland, 2008-2012	L	Inpatient	NR, Hospital database for one health care provider district	798	15-70[d]	0.00	ICD-10	CR	Verification of violence being classified as related to a partner/ex-partner or spouse/ex-spouse

Table S6. Selected study characteristics of included studies by outcome (continued)

Source	Indicator	Country, period	D	Setting	No. of centres, data source	N	Mean age years, range	Prev, %	Coding sys	Ref	Definition reference standard/Alternative reference standard
Intimate partner violence (IPV) among predominately women											
Muelleman, 1996[107]	C/FF	USA, 1993-1994	C	ED	10 EDs, all women presenting Omaha/Kansas/Missouri	9057	34.0, 19-65	1.7	ICD-9/ISS	Survey & CR	Positive for battering by Flitcraft criteria using CR & survey responses
Bonomi, 2009[108]	C	USA, 2003-2005	C	Out/inpatient	NR, Randomly sample of Washington state/northern Idaho insurance plan	3568	18-64	7.9	ICD-9	Survey	Past IPV per the WEB scale & added BRFSS items, assessed via phone
Wong, 2016[109]	IPV[c]	Hong Kong, 2010-2014	L	ED	2 EDs, A &E Information System & Clinical Data Analysis & Reporting System	965	32.3-39.8	NR	ICD-9	CR	Verification for IPV among women by a current co-habiting partner.
Schafer, 2008[110]	IPV/A[g]	USA, 2000	C	Inpatient & ED	58 Hospitals, Oregon EDs & adult inpatient care	677	12-50[d]	0.07	ICD-9-CM	CR	Verification of intentional physical or sexual assault by a current or former spouse, nonmarital partner, or dating partner.
Muelleman, 1998[111]	IPV	USA, 1992	C C	ED	1 Hospital, UMKC School of Medicine	114	median: 27, ≥18	0.51	ICD-9	CR	Verification for assault made by present or former husband or boyfriend
Clark, 2014[112]	OI/FF	USA, 1995-2013	C	Out/inpatient	1 Hospitals, University of Iowa Hospitals and Clinics	1354	32.1-34.5	0.005	ICD-9	CR	Verification for relationship of the perpetrator (if known) based on WHO definition.
Arosarena, 2009[113]	OI/FF	USA. 1998-2004	C	Out/inpatient	2 centres, Kentucky medical services billing records	326	35, 19-60	0.006	ICD-9-CM	CR	Verification of injuries caused by assault by current/ex-partner or dating relationship.
Cohen, 2019[114]	OI[c]	USA, 1995-2015	C	ED	NR, University of Iowa Hospitals and Clinics	211	Median: 28	NR	ICD-9	CR	Verification for assault and IPV using CDC criteria
Goldberg, 2000[115]	OI	USA, 1984-1996	C C	ED	1 medical centre, local database	41	≥13	NR	ICD-9	CR	Verification of physical attack by boyfriend or spouse.

Studies are sorted alphabetically by outcome, primary indicator and descending size of sample size.

Indicators: A=Assaults, BURN=Multiple Burn Injuries, COMB=Combination of assault and maltreatment and adversity codes, C=Contusions (upper body), LLF=Lower limb fractures, FF=Facial Fractures/injuries, OI=Ocular injuries (mainly orbital fractures), POISN=Poisonings, RH=Retinal Haemorrhage, SDH=Subdural Hematoma, SF=Skull Fractures, RF=Rib fractures, TBI=Traumatic Brain Injury, ULF=Upper Limb Fractures.

Abbreviations: AU=Australia, CC=Case-control study, CDC=Centers for Disease Control and Prevention, C=Cross-sectional study, CR=Chart Review, CRB=Chart Review Blinded, CSS=Children's Social Service, CPS=Child Protection Services, CPT=Child Protection Team, D=Study design, ED=Emergency Department, EL=External Linkage, FNAST=Finnegan Neonatal Abstinence Syndrome Tool, HDDS=Hospital Discharge Data System, ICD-10/ICD-9=International Classification of Diseases=10th/9th Revision, ICD-10-CM=ICD-10 Clinical Modification, ICD-10-AM=ICD-10 Australian Modification, L=Longitudinal study, MCPT=Multidisciplinary CPT, mo=months, NZ=New Zealand, NY=New York, NR=Not Reported, NICU=Neonatal Intensive Care Unit, PICU=Paediatric Intensive Care Unit, Prev=Prevalence, Ref=Reference standard, SURVL=Surveillance, SW=Social worker/social services, SCAN=Suspected Child Abuse and Neglect, TR=Trauma registry.

[a] Study comprises six different data sources, with unpublished data provided from three different US states upon request.
[b] Author(s) provided unpublished data upon request.
[c] Author(s) confirmed using ICD codes for initial identification of cases.
[d] Refers to maternal age.
[e] Refers to unpublished dissertation involving two different data sources.
[f] A small proportion (11%-13%) were aged above 3 years old.
[d] Indicates that the study included a small proportion of women above reproductive age including: Brown, 2005=90% aged 18-44 years; Kivelä, 2019= 98% aged 18-59 years; Yau, 2013= 97% aged 15-54 years; Schafer, 2008=95% aged <50 years; Biroscak, 2006=96.8% aged <50 years.
[g] Indicates that study included a small proportion of men which could not be excluded due to inadequate sample description including: Kivelä, 2019=7% were men; Schafer, 2008=4% were men; Saltzman, 2005=17% were men.

Table S7. Individual study QUADAS-2 scores by outcome[a]

		Methods						Applicability		
Source	**EHR setting[b]**	**1. Select**	**2. Test**	**3. Ref[d]**	**3. Ref ex.[e]**	**4. Blind**	**5. Flow & T**	**6. Select[c]**	**7. Test**	**8. Ref**
Neonatal Abstinence Syndrome (NAS)										
Lind, 2015	HDD/SURVL	1	1	3	N/A	0	U	0	0/1[g]	U
Yam, 2019	HD	1	1	3	N/A	0	U	0	1	U
Huybrechts, 2017	HDD	1	1	3	N/A	1	U	1	1	U
Chisamore, 2016	HDD	1	1	3	N/A	0	U	0	1	U
Patrick, 2015	Billing	1	1	3	N/A	0	U	0	1	U
Alsaleem, 2019	HDD	1	0	3	N/A	0	0	0	U	0
Phillips-Bell, 2019	HDD/SURVL	1	1	3	N/A	0	U	0	1	U
Lind, 2019abcdef	HD/SURVL	0	1	1	N/A	0	1	1	0	0
Maalouf, 2019ab	Billing	1	1	3	N/A	1	U	0	1	U
Umer, 2018	HD/SURVL	1	1	3	N/A	0	U	0	0	U
Fetal Alcohol Syndrome (FAS)										
Harris, 2003	HHD	1	1	3	N/A	0	U	0	1	U
Allen, 2007	SURVL	1	1	3	N/A	1	U	1	0	U
Egeland, 1998	HDD	1	1	3	N/A	0	U	1	1	U
Welty, 1995	HD/SURVL	1	1	3	N/A	0	1	0	1	U
Miller, 1995	HDD/SURVL	1	1	3	N/A	0	U	0	0	U
Miller, 2002	HDD/SURVL	1	1	3	N/A	0	U	0	0	U
Fox, 2003	SURVL	1	1	3	N/A	0	U	0	0	U
Child maltreatment (CM)										
McKenzie, 2012	HDD	1	1	3	NR	0	1	1	1	1
Risen, 2015	CPD/HDD	0	1	5	TF, FALLS, ACCI	0	U	0	1	0
Gessner, 2004	SURVL/TR/HDD	1	0	4	NR	0	U	0	0/1[g]	U
Gumbs, 2013	Billing	0	1	4	NR	0	1	1	1	1
Schnitzer, 2004	HDD/ED	1	1	5	NR	0	U	1	1	U
Parrish, 2013a	HDD/SURVL	1	1	3	NR	0	U	1	0	1
Berger, 2013	HDD	1	1	4	NR	0	U	0	1	U
Paroskie, 2014	Billing	1	1	1	NR	0	U	0	1	U
Krawiec, 2019	Billing	1	1	3	NR	0	U	0	1	0
Karatekin, 2018	HD	1	1	3	NR	0	1	1	1	1
O'Donnell, 2010	HDD	1	1	2	NR	0	U	1	1	U
O'Donnell, 2012	HDD	1	1	3	NR	0	U	1/C	1	U
Garza, 2019a	SURVL/TR	1	1	4	Age	0	U	0	0	U
Garza, 2019b	SURVL/TR	1	1	4	Age	0	U	0	0	U
Raghavan, 2015	Billing	1	1	3	ACCI/Birth	0	U	0	1	0
Schnitzer, 2011	HDD/ED	1	1	3	PA, TF, BD, BIRTH	0	U	1/Rand	1	U
Wu, 2015	HD	1	1	3	ACCI	0	1	0	1	1
Hooft, 2015	HDD/TR	1	0	2	ACCI	0	U	0	0/1[g]	0
Somji, 2011	HDD	1	1	4	ACCI	0	U	0	0	U
Gonzalez-Izquierdo, 2015	HD	1	1	3	NR	0	U	0	1	U
Tingberg, 2010	HD	1	0	3	ACCI	0		0	1	0
Evasovich, 1998	HDD	1	1	2	ACCI	0	U	0	1	U
Payne, 2016	Billing/TR	1	1	4	NR	0	U	0	0/1[g]	U
Hooft, 2013	SURVL/TR	0	1	3	Birth/ACCI	0	1	0	0	U
Myhre, 2007	HDD	1	0	3	ACC	0	U	0	1	U
Hansoti, 2008	RE-Code	1	0	5	NA	0	U	0	0	U
Hui, 2008	HDD	1	0	3	BD/TF	0	U	0	1	U
Capra, 2013	HDD/SURVL	1	0	3	Age, BD, TF, FALL	0	U	0	1	U
Baldwin, 2010	SURVL/TR	0	1	2	Age, BD, ACCI	0	U	0	0	U
Sharkey, 2018	HDD/TR	1	1	3	BD, ACCI	0	U	0	1/0[g]	U
Strait, 1995	HDD	1	1	3	ACCI, BIRTH	0	U	0	1	U
Ryznar, 2015	HDD/RE-Code	1	1	2	BD/BIRTH/	0	U	0	0	U
Lavin, 2018	HD	1	1	1	ACCI, INJU, Birth	0	1	0	1	0
Högberg, 2019	HDD	1	1	1	NR	0	1	0	1	0
Lane, 2002	HDD	1	0	3	Birth/ACCI/BD	1	U	0	1	U
Wood, 2009	HD	1	1	1	TF, BIRTH, BD	0	U	0	1	U
Anderst, 2008	HDD	1	1	1	Age, TP, BD, PA	0	U	0	1	U
Rangel, 2009	TR	1	1	3	FALL, ACCI	0	U	0	0	U
Lasekey, 2013	TR	1	0	1	Birth/ACCI/BD	0	U	0	0	U

Table S7. Individual study QUADAS-2 scores by outcome[a] (continued)

		Methods						Applicability		
Source	**EHR setting[b]**	**1. Select**	**2. Test**	**3. Ref[d]**	**3. Ref ex.[e]**	**4. Blind**	**5. Flow & T**	**6. Select[c]**	**7. Test**	**8. Ref**
Child maltreatment (CM)										
Kim, 2017	TR	1	1	2	N/A	0	U	0	0	U
Lyons, 2016	TR/HD	0	1	2	N/A	0	1	0	U	0
Ettaro, 2004	HDD	1	1	3	Age, SI, TF	0	U	0	1	U
Tzioumi, 1998	HD	1	0	1	ACCI, OTHER	0	U	0	1	U
Thyen, 1997	HD	1	0	2	ACCI	0	U	1/Broad	1	U
Ricci, 2003	HDD	1	1	3	N/A	0	0	0	1	U
Keenan, 2003	HDD/SURVL	0	1	5	N/A	0	U	0	1	U
Durand, 2019	TR	0	1	3	ACCI	0	1	C	1	0
Parrish, 2013b	HDD/SURVL	1	1	3	N/A	0	U	1	0	1
Intimate Partner Violence (IPV)										
Kivela, 2019	HDD	1	1	3	N/A	0	U	0	1	U
Fanslow, 1998	RE-Code	1	1	3	N/A	0	U	1/Rand	0	U
Saltzman, 2005	HDD/SURVL	1	0	3	N/A	0	U	1	1	U
Brown, 2002	SURVL	1	1	3	N/A	0	U	0	U	U
Yau, 2013	HD/SURVL	1	0	3	N/A	0	1	1/Broad	0	1
Lipsky, 2008	HDD	1	1	3	N/A	0	U	0	1	U
Biroscak, 2006	SURVL	1	1	3	N/A	0	U	0	0	U
Ranney, 2011	Billing	1	1	3	N/A	1	U	1/C	1	U
Kernic, 2000	HDD	1	0	1	N/A	0	U	0	1	U
Bonomi, 2009	HDD	1	0	3	N/A	0	0	1	1	1
Muelleman, 1996	RE-Code	1	1	3	N/A	0	0	1/C	0	1
Wong, 2016	HDD	1	0	3	N/A	0	1	0	1	0
Muelleman, 1998	HD	1	1	3	N/A	0	U	0	1	U
Schafer, 2008	HDD/ED	1	1	2	N/A	0	U	1	1	U
Goldberg, 2000	Billing	1	0	3	N/A	0	U	0	1	U
Cohen, 2019	HDD	1	1	3	N/A	0	U	0	1	U
Clark, 2014	HDD	0	0	2	N/A	0	U	0	1	U
Arosarena, 2009	Billing	1	1	3	N/A	0	U	0	1	U

[a] For all quality domains, except for "3.Ref": 1=low bias/higher quality; 0=high bias/lower quality; U=unknown bias.
[b] Type of electronic health records used to identify cases: HDD=hospital discharge database, HD=Hospital database, Billing=Billing records, SURVL=Surveillance database, TR=Trauma registry, RE-Code=Manual recoding of medical records into ICD codes.
[c] Where applicable: C=Consecutive sample; Rand=Random sample; Broad=Broader sample (i.e. not only positively coded cases).
[d] Quality ratings correspond to the level of certainty that the reference standard is a true measure of CM, NAS, FAS, or IPV.
[e] Indicates the type of exclusions made to distinguish non-abuse from abuse before applying reference standard (only applicable to injury related indicators consistent with CM): Age=Specific age criteria; ACCI=Multiple accidental causes, Birth= Birth injuries, BD= Metabolic bone diseases; FALL=Fall accidents, TP=Transport injuries; OTHER= Other medical conditions such as childhood cancer and congenital heart diseases; PA=Children with Previous Abuse recordings.
[f] Overall risk of bias judgement: High=High risk of bias, Mod=Moderate risk of bias, Low=Low risk of bias.
[g] Ratings dependent on indicator studied, as study contributed with estimates for more than one indicator.

Abbreviations: Blind=Blinded reference standard; Flow & T=Flow and timing; N/A=Not applicable; Ref=Reference standard; Ref ex=Reference standard exclusions; Select=Patient selection.

Table S8. Codes used for identifying CM, NAS, FAS, or IPV by individual study, indicator and care setting

Source	Indicator	Setting	System[a]	Codes[b]
Outcome: Neonatal Abstinence Syndrome (NAS)				
Chisamore, 2016	NAS	Inpatient	ICD-10	P96.1
Lind, 2019a	NAS	Inpatient & SURVL	ICD-10	P96.1
Lind, 2019c	NAS	Inpatient & SURVL	ICD-10	P96.1
Lind, 2019f	NAS	Inpatient & SURVL	ICD-10	P96.1
Maalouf, 2019b	NAS	Inpatient	ICD-10	P96.1
Umer, 2019	NAS	Inpatient & SURVL	ICD-10	P04.1–P04.4, P04.8, P04.9, P96.1.27
Yam, 2019	NAS	Inpatient & SURVL	ICD-10	P96.1
Alsaleem, 2019	NAS	Inpatient	ICD-9	779.5 or 760.72
Huybrechts, 2017	NAS	Inpatient	ICD-9	779.5x
Lind, 2015	NAS	Inpatient	ICD-9	779.5, 760.72
Lind, 2019b	NAS	Inpatient & SURVL	ICD-9	779.50
Lind, 2019d	NAS	Inpatient & SURVL	ICD-9	779.50
Lind, 2019e	NAS	Inpatient & SURVL	ICD-9	779.50
Maalouf, 2019a	NAS	Inpatient	ICD-9	779.5
Patrick, 2015	NAS	Inpatient	ICD-9	779.5
Phillips-Bell, 2019	NAS	Inpatient	ICD-9	779.5
Lind, 2019a	Newborn affected by drugs	Inpatient & SURVL	ICD-10	P04.49
Lind, 2019b	Newborn affected by drugs	Inpatient & SURVL	ICD-9	760.72
Lind, 2019c	Newborn affected by drugs	Inpatient & SURVL	ICD-10	P04.49
Lind, 2019d	Newborn affected by drugs	Inpatient & SURVL	ICD-9	760.72
Lind, 2019e	Newborn affected by drugs	Inpatient & SURVL	ICD-10	P04.49
Lind, 2019f	Newborn affected by drugs	Inpatient & SURVL	ICD-9	760.72
Phillips-Bell, 2019	Newborn affected by drugs	Inpatient	ICD-9	760.72
Outcome: Fetal Alcohol Syndrome (FAS)				
Harris, 2003	FAS	Out/inpatient	ICD-10/ICD-9	760.71, Q86.0,742.1, Q02, P04.3, 099.3, F10.2, 779.5, P96.1
Allen, 2007	FAS	Inpatient	ICD-9	742.1, 760.76
Egeland, 1998	FAS	Inpatient	ICD-9	760.71, 760.76
Fox, 2003	FAS	Inpatient & SURVL	ICD-9	760.71
Miller, 1995	FAS	Inpatient & SURVL	ICD-9	760.71
Miller, 2002	FAS	Inpatient & SURVL	ICD-9	760.71
Welty, 1995	FAS	Inpatient & ED	ICD-9	760.71
Outcome: Child maltreatment (CM)				
Garza, 2019b	CM	Inpatient	ICD-10	T74.12, T76.12, T74.92 or T76.92, Y07, Y09, Z04.72, Z62
McKenzie, 2012	CM	Inpatient	ICD-10	T74.0-T74.9, Z04.4, Z04.5, Z61.4, Z61.5, Z61.6, Z62.0, Z62.3, Z62.4, Z62.5, Z62.6, X85-Y09
O'Donnell, 2010a	CM	Inpatient	ICD-10	T74, Y07.1–Y07.3, Y07.8, Y07.9
O'Donnell, 2012	CM	Inpatient & ED	ICD-10	T74, Y06, Y07
Garza, 2019a	CM	Inpatient	ICD-9	995.50, 995.54, 995.55, 995.59, E960-968.
Gessner, 2004	CM	Inpatient	ICD-9	995.5, E960–969
Hooft, 2015	CM	Inpatient	ICD-9	967, 995.50, 995.54, 995.55, 995.59, E967, E960–966,968, 995.55
Karatekin, 2018	CM	Inpatient & ED	ICD-9	995.50-995.59, E967.0-E967.9, E904.0, V71.81
Krawiec, 2019	CM	Inpatient	ICD-9 & SNOMED-CT	995.54, 995.55, 890, V71.6 /SNOMED CT: 165701015, 253494019, 1210375015, 1218825014, 1777529016, 246704011, 1491714010, 2576622013, 2576624014, 2576625010, 2642513011
Paroskie, 2014	CM	Inpatient & ED	ICD-9	995.5, 995.50, 995.54, 995.55, 995.59
Raghavan, 2015	CM	Inpatient	ICD-9	995.5
Schnitzer, 2004	CM	Inpatient & ED	ICD-9	995.50-995.59, 994.2–994.3, E967.0–E967.9
Schnitzer, 2011	CM	Inpatient & ED	ICD-9	V71.81
Wu, 2015	CM	Inpatient	ICD-9	995.50–995.59
Durand, 2019	CM	Inpatient	ICD-10	NR: "'Child abuse' in our trauma registry was identified via International Classification of Diseases, Tenth Revision (ICD-10) diagnostic codes (T codes) and ICD-10 external cause codes (Y codes)."
Berger, 2013	AHT/CM*	Inpatient	ICD-9	781.0–781.4, 781.8, 800, 801, 803, 804.1–804.4, 804.6-804.9, 850, 851, 852.0–852.5, 853.0, 853.1, 854.0, 854.1, 925.1, 950.0–950.3, 959.01, 995.55*, E960.0, E967, E968.1, E968.2, E968.8, E968.9,E987, E988.8, E988.9 995.50, 995.54, 995.59
Gumbs, 2013	AHT/CM	Inpatient & ED	ICD-9	800.1x–800.4x; 800.6x–800.9x, 803.1x–803.4x; 803.6x–803.9x, 850.0x–850.9x, 851.0x–851.9x, 852.0x–852.5x, 853.0x–853.1x, 854.0x–854.1x, 959.01, 995.55, 995.50, 995.54, 995.59,361.01-361.9, 362.4x,379.23,E960.0,E967.x,E968.1, E968.2, E968.8, E968.9, E969
Parrish, 2013a	AHT/CM	Inpatient	ICD-9	781.0 781.4, 781.8, 800, 801, 803, 804.1 804.4, 804.6 804.9, 850, 851, 852.0 852.5, 853.0, 853.1, 854.0, 854.1, 925.1, 950.0 950.3, 959.01; S02, S02.0 SO2.1, S02.7 S02.9, S04.0, S06.0 S06.9, S07.1, S07.8 S07.9, S09.7 S09.9, T90.2, T90.5, T90.8 T90.9
Risen, 2015	AHT/CM	Inpatient	ICD-9	995.x
Garza, 2019b	Assaults	Inpatient	ICD-10	Y09
O'Donnell, 2010	Assaults	Inpatient	ICD-10	X85–Y09
O'Donnell, 2012	Assaults	Inpatient & ED	ICD-10	T74, X85-Y09, Z04.4, Z04.5, Y10-Y34
Garza, 2019a	Assaults/CM	Inpatient	ICD-9	E960-966, 968-969
Raghavan, 2015	Assaults	Inpatient	ICD-9	E961-E966, E968
Schnitzer, 2011	Assaults	Inpatient & ED	ICD-9	E968.9
Gonzalez-Izquierdo, 2014	Assaults/CM/adversity	ED	ICD-10	Y04, Y05, X85 -Y03, Y08-Y09, Y10-Y34, Z04.0, Z04.5, Z04.8, P96.1, Z60, Z61, Z62, Z63, Z65.3, Z72, Z74, Z76.1, Z76.2, Z81, Z86.5, Z91.6, Z91.8
Tingberg, 2010	Assaults/CM/adversity	ED	ICD-10	T741, T742, T743, T748, T749, Y0619' 'Y0699' 'Y0700' 'Y0701' 'Y0702' 'Y0703' 'Y0704' 'Y0708' 'Y0709' 'Y0713' 'Y0718' 'Y0719' 'Y071A' 'Y071C' 'Y0720' 'Y0721' 'Y0723' 'Y0724' 'Y0728' 'Y0729' 'Y0731' 'Y0733' 'Y0734' 'Y0738' 'Y0739' 'Y0780' 'Y0781' 'Y0782' 'Y0783' 'Y0784' 'Y0788' 'Y0789' 'Y078A' 'Y078C' 'Y078X' 'Y0790' 'Y0791' 'Y0792' 'Y0793' 'Y0794' 'Y0798' 'Y0799,Z038K
Hogberg, 2018	Assaults/CM/adversity	Inpatient	ICD-10/ICD-9	Z03.8K, Y07.9, 995F, T74.1, Y06, Y07
Somji, 2011	Assaults/CM/adversity	ED	ICD-10/ICD-9	ICD-9: 955.5, 995.50-995.59, E960-969, V15.4, V15.41, V61.2, V61.21, V68.2, V71, V71.6, V71.81: ICD-10-CA: T74-T74.9, CM, X85-Y07, Z04-Z04.8, Z61, Z61.6
Raghavan, 2015	Assaults/CM/adversity	Inpatient	ICD-9	995.5, 994.2, 994.3, V15.4, V61.21, V71.81, E960.1, E967, E904.0, E968.4, E961-E966, E968, E904.1, 904.2, V71.5
Schnitzer, 2011	Assaults/CM/adversity	Inpatient & ED	ICD-9	054.1, 098, 922.4, 614.9, V71.5, V71.81, 362.81, 807.0, 807.1, 811, 852.2, 853, 863.1, E965, E966, E968.2, E968.9, E988, 800, 805, 852, 862, 863.2, 863.3, 865, 952, 262, 521, 692.7, 808, 860, 861, 863.8, 864, 866, 941, 942, 945, 946, 960–979, 994.1, E869.4, E910.2, E910.4, E910.8, E910.9, E960.0, E980, V60, E985

Table S8. Codes used for identifying CM, NAS, FAS, or IPV by individual study, indicator and care setting (continued)

Source	Indicator	Setting	System[a]	Codes[b]
Outcome: Child maltreatment (CM)				
Evasovich, 1998	Burns	Inpatient	ICD-9	995.50, 942.13, 942.23, 942.33
Schnitzer, 2011	Burns	Inpatient & ED	ICD-9	946
Wu, 2015	Burns	Inpatient	ICD-9	920.0–949.9
Hansoti, 2008	Lower limb fractures	ED	ICD-10	NR/Re-coded: "Site of fracture: femur"
Hui, 2008	Lower limb fractures	Inpatient	ICD-10/ICD-9	NR: "…a diagnosis of femur fracture who presented…. Identified from our institution database (Clinibase; Logibec, Montreal, Canada) using ICD-10/ICD-9 diagnostic codes for the years identified for study"
Baldwin, 2010	Lower limb fractures	Inpatient	ICD-9	820.0-820.9, 821.0-821.9, 995.50-995.59
Sharkey, 2018	Lower limb fractures	ED	ICD-9	800–829
Wu, 2015	Lower limb fractures	Inpatient	ICD-9	805–848
Capra, 2012	Lower limb fractures	Inpatient	ICD-10/ICD-9	NR: "diagnostic codes, for a diagnosis of femur fracture"
Lavin, 2018	Upper limb fractures	ED	ICD-9	800.0-839.9
Ryznar, 2015	Upper limb fractures	Inpatient	ICD-9	813, 818, 819, 829
Sharkey, 2018	Upper limb fractures	ED	ICD-9	800–829
Strait, 1995	Upper limb fractures	Inpatient	ICD-9	812.00-812.99, 959.2, 959.3
Wu, 2015	Upper limb fractures	Inpatient	ICD-9	805–848
Hogberg, 2019	Rib fractures	Inpatient & ED	ICD-10	S22.3, S22.4
Lavin, 2018	Rib fractures	ED	ICD-9	800.0-839.9
Schnitzer, 2011	Rib fractures	Inpatient & ED	ICD-9	807.0, 807.1
Sharkey, 2018	Rib fractures	ED	ICD-9	800–829
Wu, 2015	Subdural haematoma	Inpatient	ICD-9	950–959.9
Myhre, 2007	Subdural haematoma, TBI	Inpatient	ICD-9	NR: "Fracture(s) of the skull/base, excluding fracture of the facial bones, traumatic intracranial haemorrhage, intracerebral haemorrhage, cerebral parenchymal injuries."
Payne, 2016	Retinal haemorrhage	Inpatient & ED	ICD-9	362.81
Schnitzer, 2011	Retinal haemorrhage	Inpatient & ED	ICD-9	362.81
Wu, 2015	Retinal haemorrhage	Inpatient	ICD-9	950–959.9
Anderst, 2008	Skull fracture	ED	ICD-9	800–804, 850–854.19, 920–921.9, 924.9
Ettaro, 2004	Skull fracture	Inpatient	ICD-9	853.00–853.19
Kim, 2017	Skull fracture	Inpatient	ICD-9	800–804, 851–854
Lane, 2002	Skull fracture	Inpatient	ICD-9	NR: "Codes for an acute primary skull or long-bone fracture were identified"
Lasekey, 2013	Skull fracture	Inpatient	ICD-9	800-804.9
Lavin, 2018	Skull fracture	ED	ICD-9	800.0-839.9
Lyons, 2015	Skull fracture	ED	ICD-9	800.00-800.09
Rangel, 2009	Skull fracture	Inpatient	ICD-9	851-854, 800-804
Schnitzer, 2011	Skull fracture	Inpatient & ED	ICD-9	800
Wood, 2009	Skull fracture	Inpatient & ED	ICD-9	800–804
Wu, 2015	Skull fracture	Inpatient	ICD-9	800–804.99, 850.0–854.19
Ettaro, 2004	Subdural haematoma	Inpatient	ICD-9	852.00–852.59
Schnitzer, 2011	Subdural haematoma	Inpatient & ED	ICD-9	852.2
Tzioumi, 1998	Subdural haematoma	Inpatient	ICD-9	NR: "…with the diagnosis of subdural hematoma.."
Wu, 2015	Subdural haematoma	Inpatient	ICD-9	950–959.9
Ettaro, 2004	TBI	Inpatient	ICD-9	852.00–852.59, 853.00–853.19, 800.00–800.99, 801.00–801.99, 803.00–803.99, 804.00–804.99, 854.00–854.19,959.01, 995.55
Hooft, 2015	TBI	Inpatient	ICD-9	800–959
Keenan, 2004	TBI	Inpatient	ICD-9	800.0-800.4, 800.6-800.9, 801.1-801.9, 803.1-803.4, 803.6-803.9, 804.1-804.9, 850.0-850.9, 851.0-851.9, 852.0-852.5, 853.0-853.1, 854.0-854.1, 959.8-959.9
Parrish, 2013b	TBI	Inpatient & SURVL	ICD-9	362, 431, 432.9, 800 804, 850-854, E960-E969, E980 E989
Ricci, 2003	TBI	Inpatient	ICD-9	N348.5, N362.81, N800–01.9, N803–04.9, N850–54.1, N905, N907, N995.5
Thyen, 1997	TBI	Inpatient	ICD-9	NR: "ICD-9 and procedure codes for each of the selected diagnostic groups"; "head trauma (ages 6 months-11 years)"
O'Donnell, 2009	Poisonings	Inpatient	ICD-10	S00-T98
Schnitzer, 2011	Poisonings	Inpatient & ED	ICD-9	960–979
Wood, 2012	Poisonings	Inpatient & ED	ICD-9	960–979, 980–989, 909.0–909.1, V15.6, V82.5, E850–E858, E860–E869, E950–E952, E962, E969, E980–E982: environmental cause of injury code corresponding to poisoning and overdoses
Wu, 2015	Poisonings	Inpatient	ICD-9	950–959.9
Outcome: Intimate Partner Violence (IPV)				
Kivela, 2019	Assaults	Inpatient	ICD-10	X85–Y09, T74.1
Biroscak, 2006	Assaults	ED	ICD-9	995.80-995.85
Brown, 2005	Assaults	ED	ICD-9	E960-E968.9, 995.81-995.85
Fanslow, 1998	Assaults	ED	ICD-9	NR: "Nature of injury by ICD chapter: assaults"
Kernic, 2000	Assaults	Inpatient	ICD-9	960–969
Lipsky, 2009	Assaults	Inpatient	ICD-9	995.80–995.85, E960-E969
Ranney, 2011	Assaults	ED	ICD-9	917.0–917.9, 920.0–920.9, 922.0–922.9, 928.3, 955.0–955.6, 956, 960.0–960.1, 966, 965.0–965.4, 967.0–967.9, 968.2, 968.6–968.7, 970, 973, 974, 975, 985.0–985.6, 986
Saltzman, 2005	Assaults	ED	ICD-9	NR: "Unintentional, sexual and physical assault, self-harm", and "legal intervention where injuries are inflicted by law enforcement personnel during official duties"
Schafer, 2008	Assaults	ED	ICD-9	E968.0–E968.9
Yau, 2013	Assaults	ED	ICD-9	NR: "intentional injuries and all gunshot wounds"
Arosarena, 2009	Facial fracture	Out/inpatient	ICD-9	802.0-802.9
Kernic, 2000	Facial fracture	Inpatient	ICD-9	850–854
Muelleman, 1996	Facial fracture	ED	ICD-9/AIS	251002,251202, 251800 (re-coded to abbreviated injury scale)
Clark, 2014	Facial fracture, Ocular injuries	Out/inpatient	ICD-9	NR: "facial and orbital floor fractures"
Muelleman, 1998	IPV	ED	ICD-9	995.81
Schafer, 2008	IPV	Inpatient & ED	ICD-9	E967.3, 995.81,995.80
Wong, 2016	IPV	ED	ICD-9	NR: "abuse", "spousal abuse", "elderly abuse". Authors confirmed using ICD-9 codes upon request.
Arosarena, 2009	Ocular injuries	Inpatient & ED	ICD-9	802.0-802.9
Goldberg, 2000	Ocular injuries	ED	ICD-9	NR: "Seven different codes of skull, facial, and orbital fractures"
Cohen, 2019	Ocular injuries	ED	ICD-9/ICD-10	871.0-871.9, 921.9, 802.0-802.9; S05.20XA-S05.90XA, S02.2XA-S02.92XB
Bonomi, 2009	Upper body contusions	Out/inpatient	ICD-9	NR: "Contusions and abrasions"
Kernic, 2000	Upper body contusions	Inpatient	ICD-9	920-924
Muelleman, 1996	Upper body contusions	ED	ICD-9/AIS	110202, 110402 (ICD re-coded to abbreviated injury scale)

[a] Study specific version/revision of coding systems are provided in Table S6.

[b] Depicts the original study description of codes when specific codes were unable to be obtained from study authors or the original study.

Abbreviations: AIS=Abbreviated Injury Scale; NR=Not Reported; ICD-10/ICD-9=International Classification of Diseases, 10th/9th Revision; SURVL=Surveillance.

Figure S1. Primary diagnoses for neonatal abstinence syndrome: pooled positive predictive values of individual studies

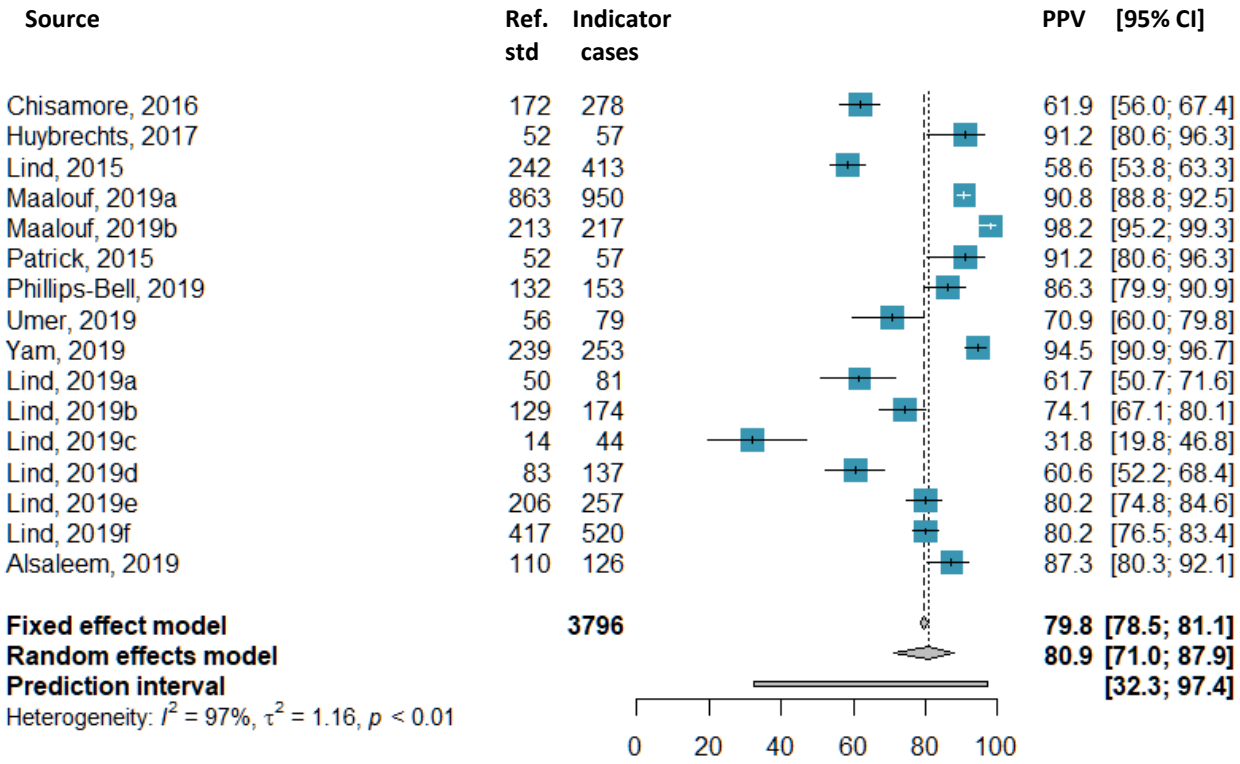


Figure S2. Primary diagnoses for fetal alcohol syndrome: pooled positive predictive values of individual studies

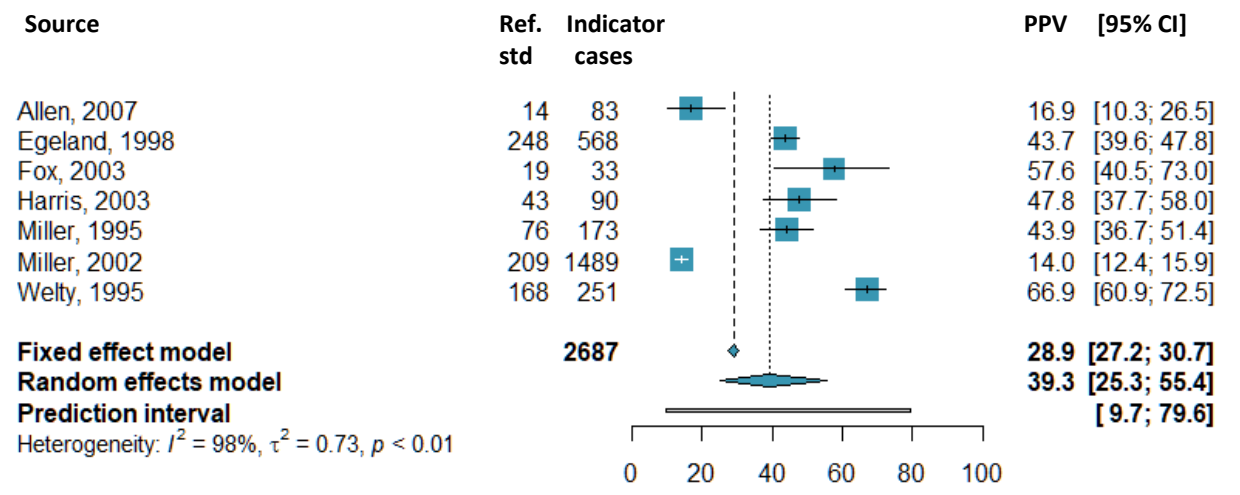


Figure S3. Primary diagnoses for CM: Pooled positive predictive values of individual studies

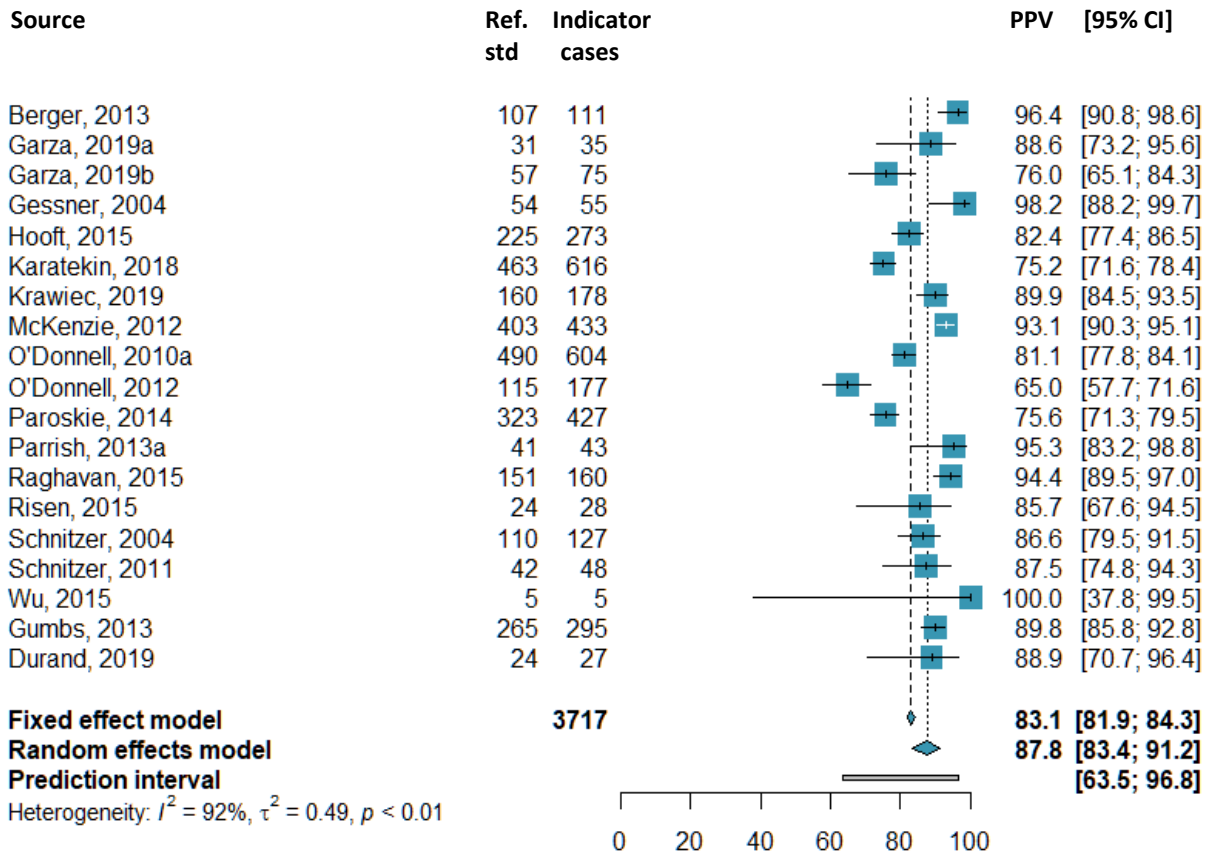


Figure S4. CM and abusive head trauma: Pooled positive predictive values of individual studies

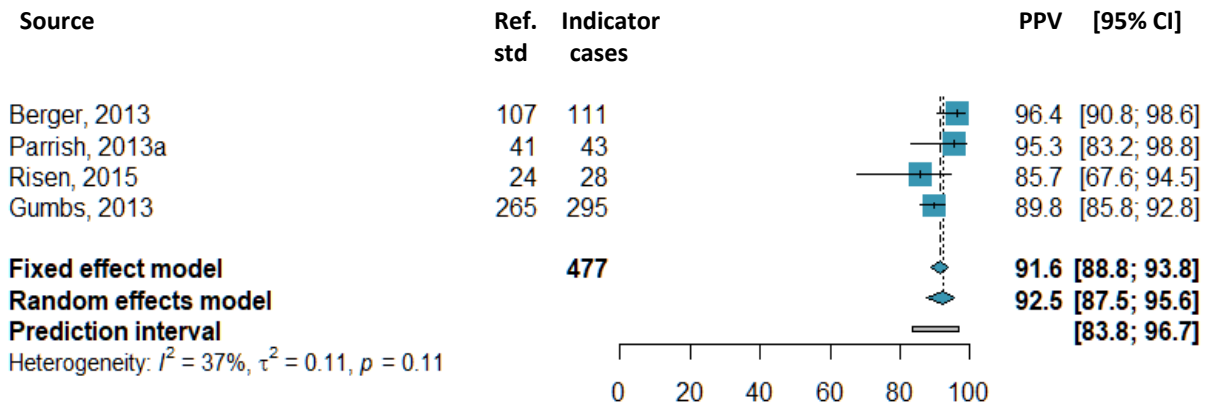


Figure S5. CM and traumatic brain injury: Pooled positive predictive values of individual studies

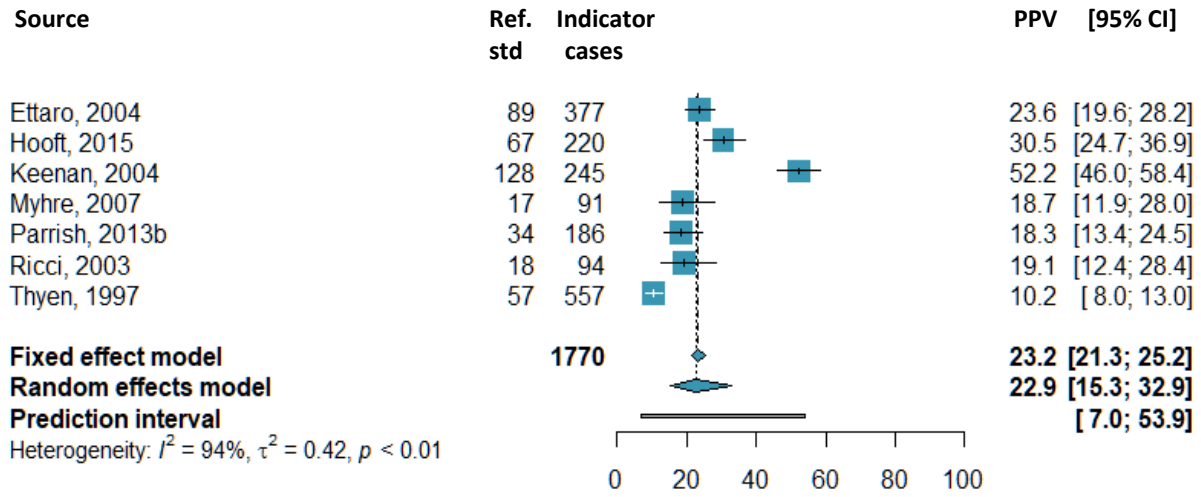


Figure S6. CM and skull fracture: Pooled positive predictive values of individual studies

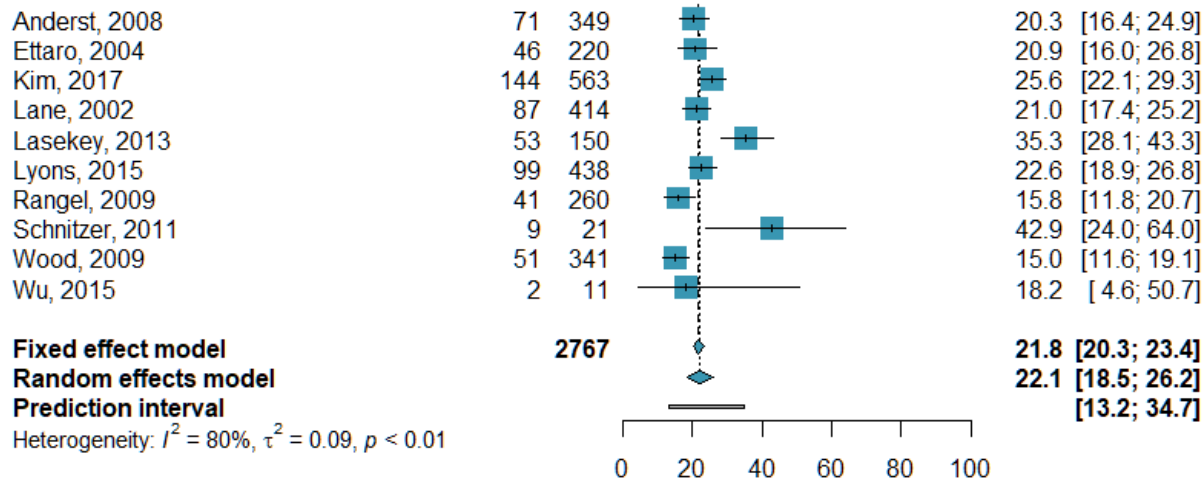


Figure S7. CM and subdural haematoma: Pooled positive predictive values of individual studies

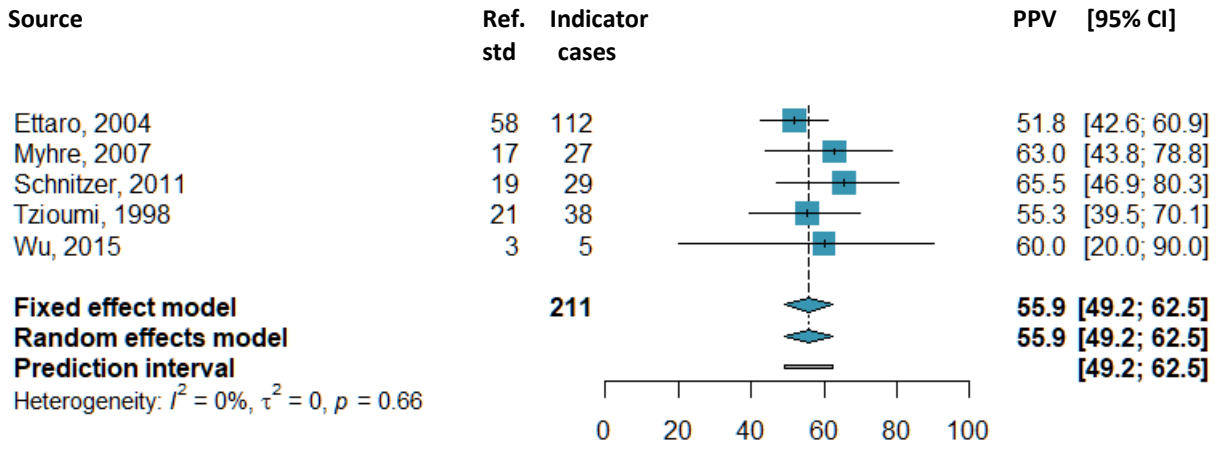


Figure S8. CM and retinal haemorrhages: Pooled positive predictive values of individual studies

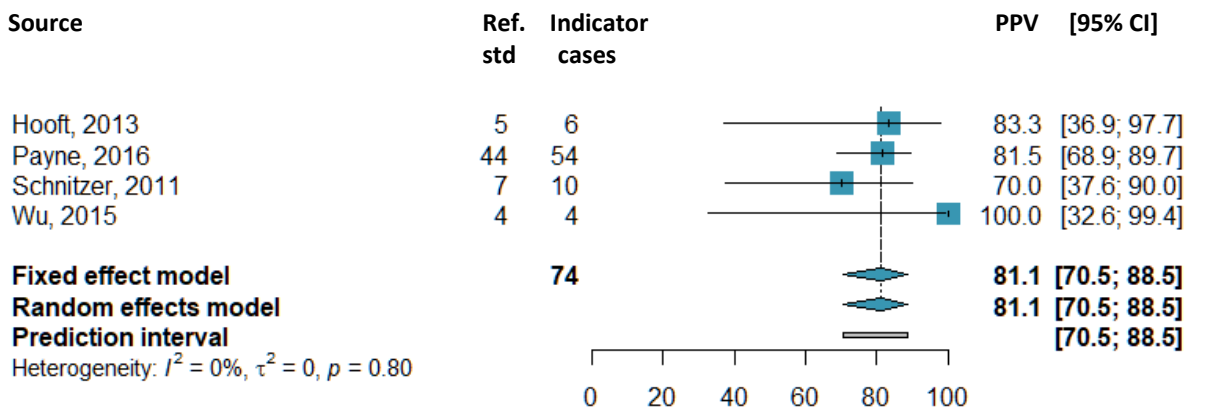


Figure S9. CM and upper limb fractures: Pooled positive predictive values of individual studies

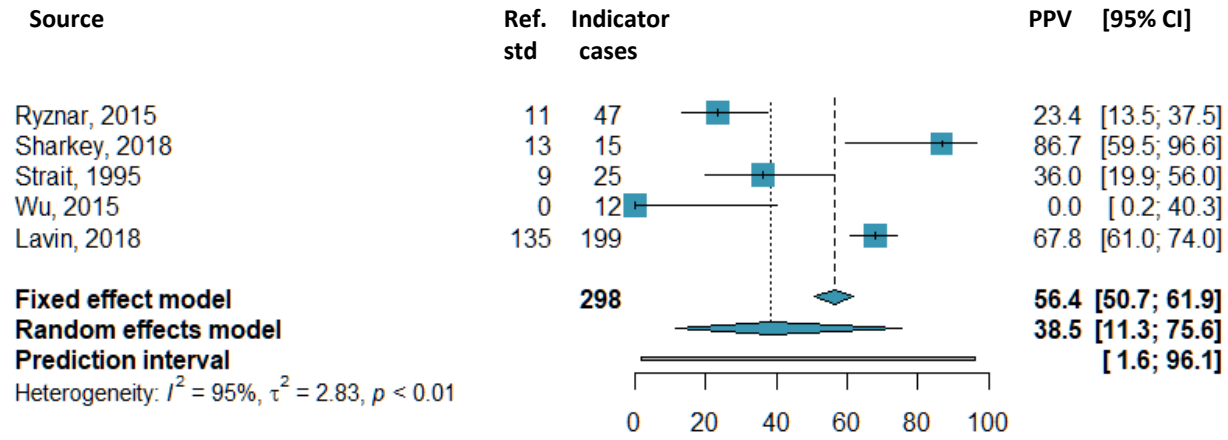


Figure S10. CM and lower limb fractures: Pooled positive predictive values of individual studies

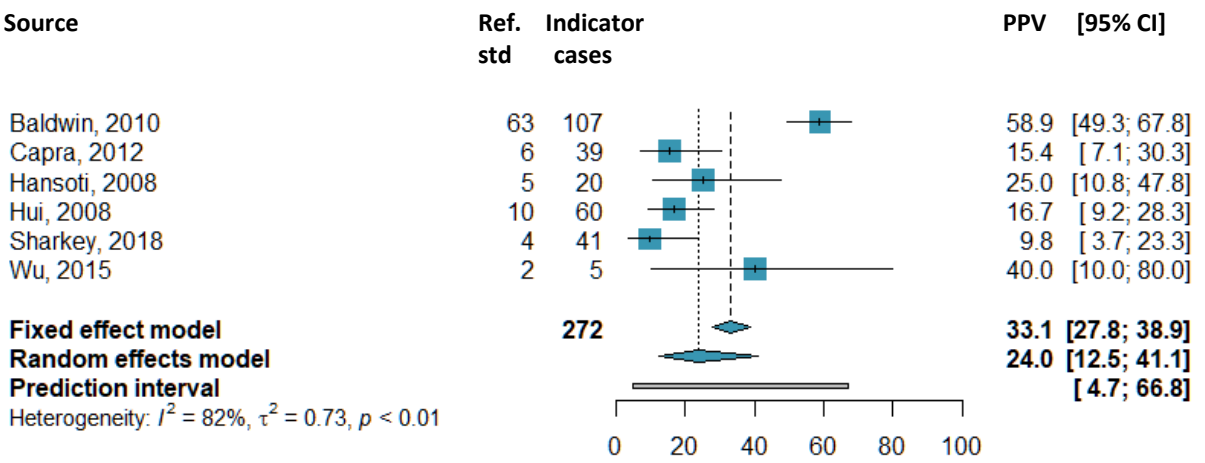


Figure S11. CM and rib fractures: Pooled positive predictive values of individual studies

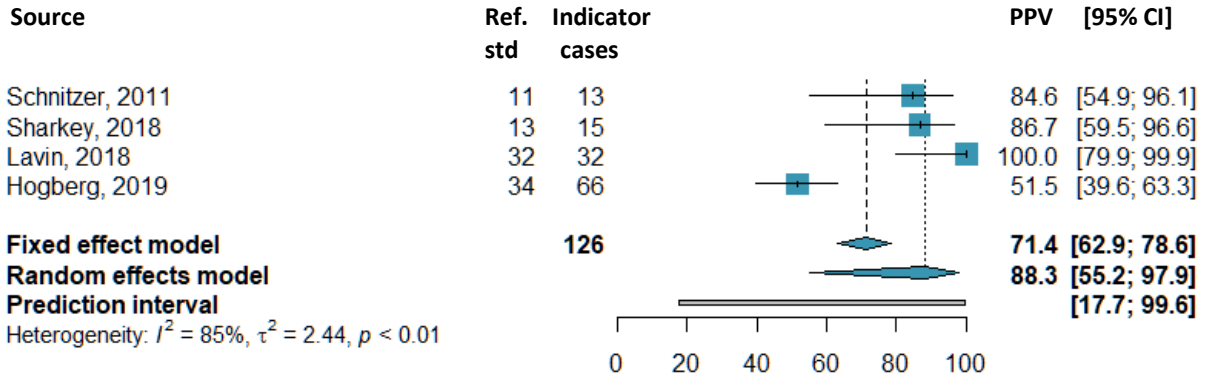


Figure S12. CM and multiple burns: Pooled positive predictive values of individual studies

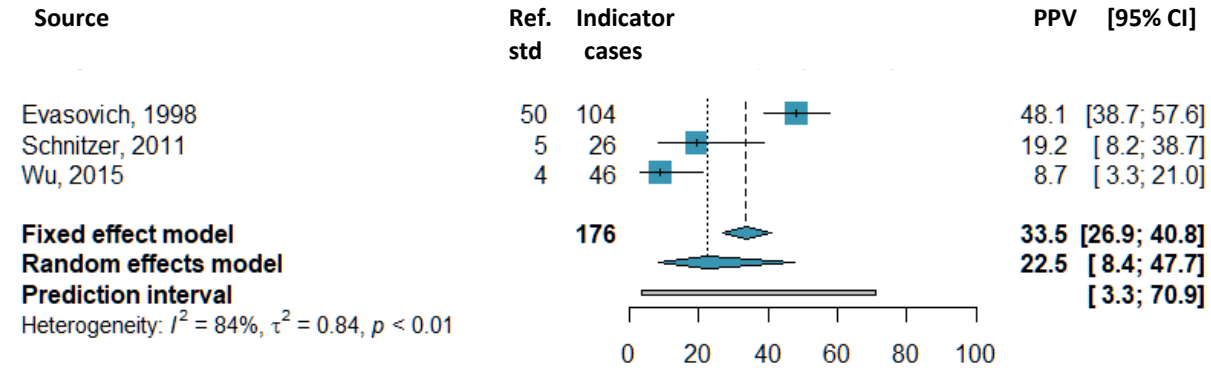


Figure S13. CM and assaults: Pooled positive predictive values of individual studies

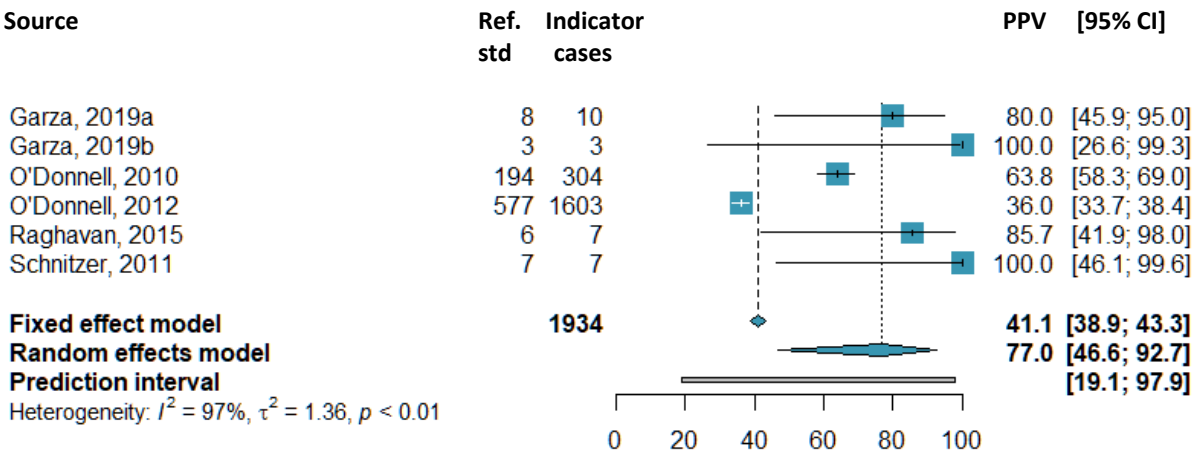


Figure S14. Combination of assaults, adversity, CM and social risk factors for identifying CM: Pooled positive predictive values of individual studies

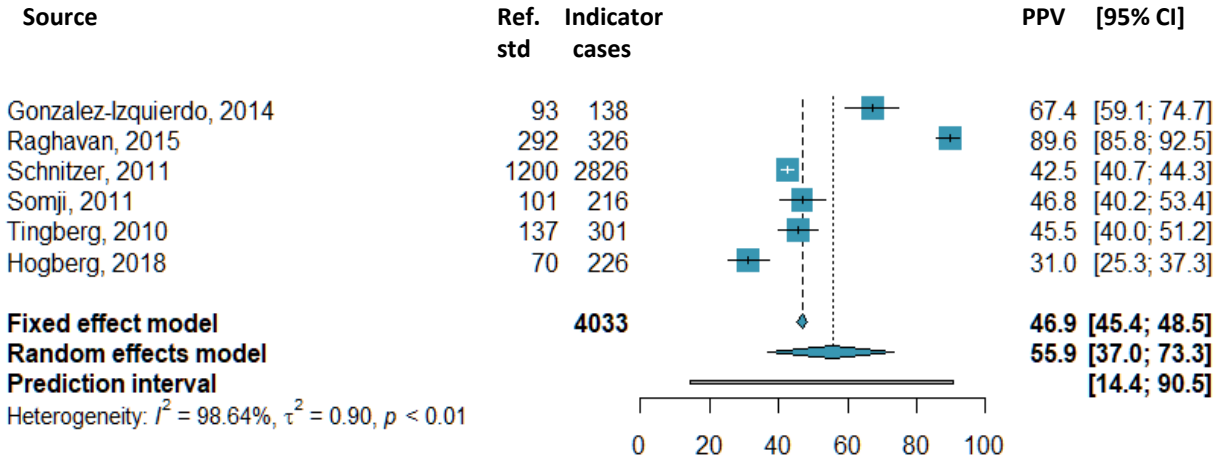


Figure S15. Primary diagnoses for IPV: Pooled positive predictive values of individual studies

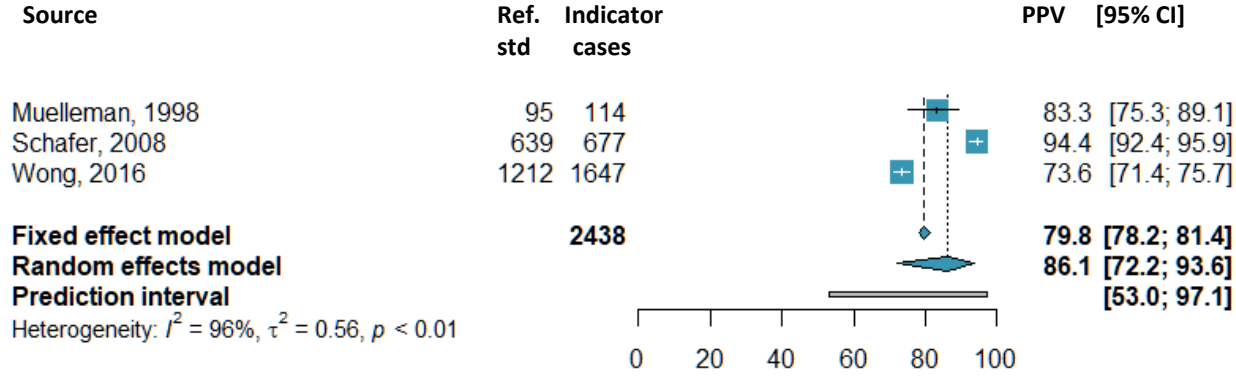


Figure S16. IPV and ocular injuries (e.g., orbital fractures): Pooled positive predictive values of individual studies

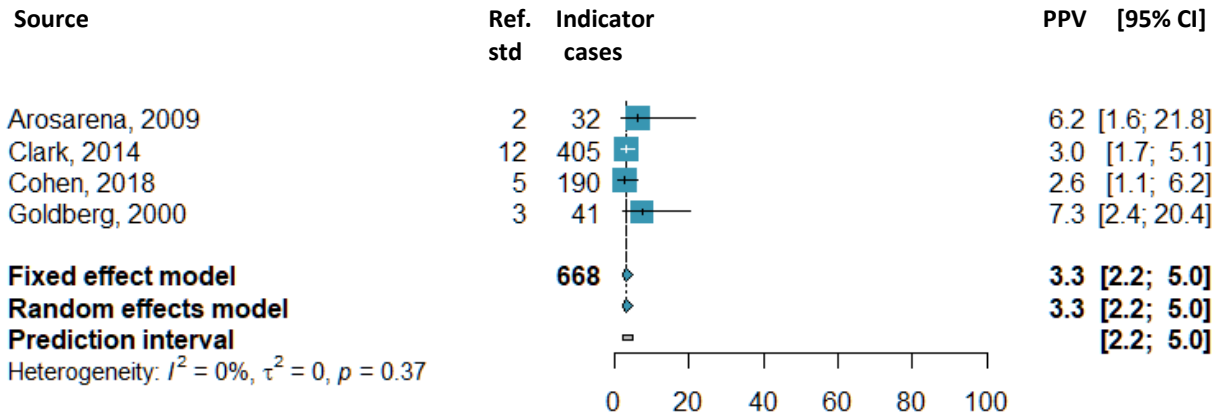


Figure S17. IPV and facial fractures: Pooled positive predictive values of individual studies

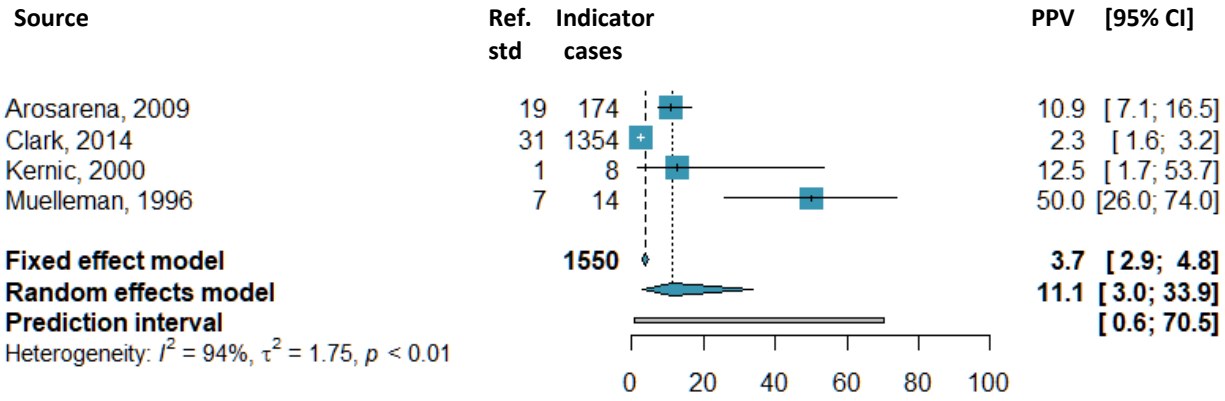


Figure S18. IPV and upper body contusions: Pooled positive predictive values of individual studies

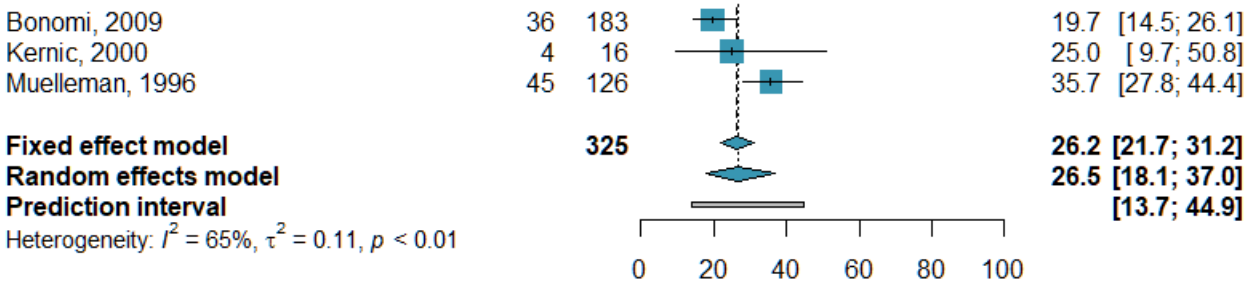


Figure S19. IPV and assaults: Pooled positive predictive values of individual studies

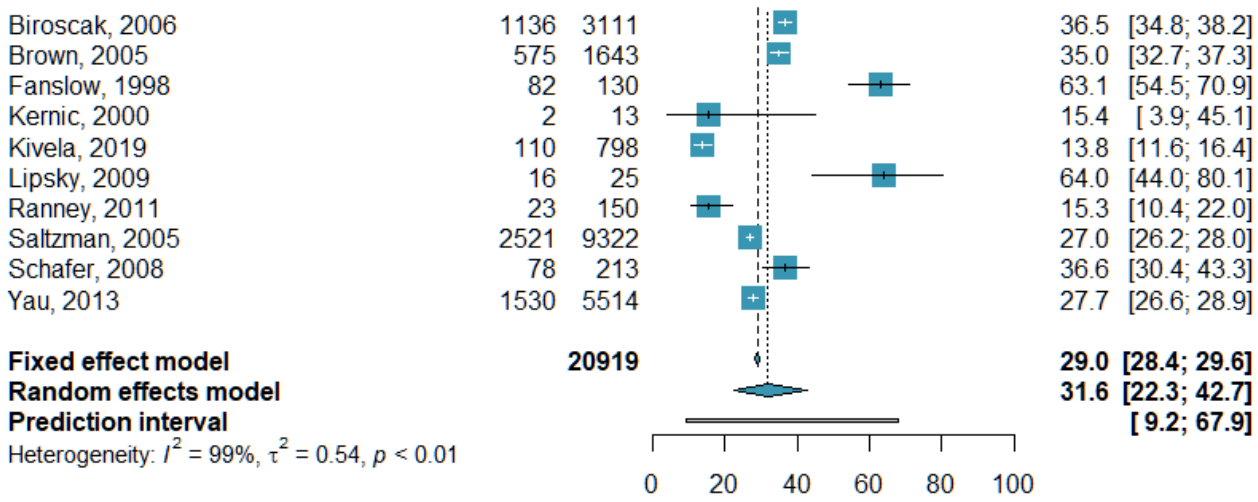


Table S9. Subgroup analyses for the pooled positive predictive values of neonatal abstinence syndrome, fetal alcohol syndrome and child maltreatment*

EHR Indicator & age criteria in years*	Sources	Indicator cases/Ref std.	Pooled PPV (95% CI)	(95% Prediction interval)††	I^2, %	τ^2	*Q*	Test for between-study heterogeneity
NAS								
Overall	16	3030/3796	80.9 (71.0-87.9)	(32.3-97.4)	97.4	1.163	457.5	
Coding system								
ICD-9 (779.5)	9	1869/2324	82.0 (73.5-88.3)	(50.5-95.3)	94.3	0.520	231.6	*Q*=0.1, *P*=1.00
ICD-10 (P96.1)	7	1161/1472	78.9 (56.0-91.7)	(15.6-98.7)	98.1	2.050	224.6	
Reference standard								
Higher threshold only	13	2870/3603	74.8 (65.3-82.4)	(35.9-94.5)	96.6	0.787	331.6	
FAS								
Overall	7	777/2687	39.3 (25.3-55.4)	(9.7-79.6)	97.6	0.729	445.0	
Outliers								
Excluding studies with substantially lower/higher study prevalences†	5	554/1115	51.7 (42.8-60.4)	(32.7-70.2)	85.0	0.130	42.0	
Reference standard								
Higher threshold only	7	423/2687	19.5 (12.6-28.9)	(5.7-49.4)	94.7	0.436	125.3	
CM ≤18 years								
Overall	19	3090/3717	87.8 (83.4-91.3)	(63.5-96.8)	92.1	0.493	196.5	
Setting								
ED	6	1318/1690	80.8 (72.8-86.9)	(57.7-92.9)	91.8	0.277	23.8	*Q*=6.6, *P*=0.01
Inpatient	13	1772/2027	90.6 (86.2-93.7)	(72.1-97.3)	84.1	0.402	84.4	
Age inclusion								
Age <5‡	8	1181/1386	89.4 (83.5-93.3)	(72.4-96.4)	81.4	0.285	25.8	*Q*=0.5, *P*=0.46
Age <19‡	11	1909/2331	86.6 (79.8-91.3)	(57.4-96.9)	93.6	0.576	120.1	
Coding system								
ICD-9	14	2001/2401	89.4 (84.8-92.8)	(68.9-97.0)	89.0	0.423	120.0	*Q*=2.2, *P*=0.14
ICD-10	5	1089/1316	82.6 (71.4-90.9)	(52.0-95.4)	92.9	0.4613	66.9	
Reference standard								
Lower threshold	6	1099/1380	89.4 (78.6-95.1)	(56.2-98.2)	94.9	0.744	39.5	*Q*=5.2, *P*=0.02
Higher threshold	13	1533/2337	70.8 (55.5-82.6)	(17.6-96.5)	97.7	1.423	312.6	

Pooled estimates are based on random-effects meta-analyses by subgroup and outcome, unless otherwise specified.

*For each indicator, subgroup analyses were only performed and presented when at least four studies where available for each subgroup.
†Excluding outlying studies for which individual study estimates suggested extreme underlying prevalences, ranging from 0.3-1.5 cases per 1000 live births across four US large states,[44] to 22.7 cases per 1000 live births in Indian health services.[46]
‡Subgroups depicts the oldest possible age of participants included in each group of studies, determined by the studies original age inclusion criteria.
††A 95% prediction interval is a measure of between-study variation and approximates where the PPV is to be expected for 95% of similar future studies.
Abbreviations: CM=Child maltreatment; ED=Emergency departments; FAS=Fetal alcohol syndrome; NAS=Neonatal abstinence syndrome; PPV=Positive predictive value; Ref Std.=Reference standard.

Table S10. Subgroup analyses for the pooled positive predictive values of injury presentations for child maltreatment*

EHR Indicator & age criteria in years*	Sources	Indicator cases/Ref std.	Pooled PPV (95% CI)	(95% Prediction interval)††	I^2, %	τ^2	*Q*	Test for between-study heterogeneity
Traumatic Brain Injury ≤2	7	410/1770	22.9 (15.3-32.9)	(7.0-53.9)	94.2	0.422	170.1	
Excluding natural disaster focused study†	6	282/1525	19.2 (14.3-25.3)	(9.1-36.0)	84.8	0.161	53.5	
Upper limb fractures ≤3	5	249/2379	37.2 (11.2-73.4)	(1.5-96.0)	98.3	2.925	563.7	
Lower limb fractures ≤3	6	90/272	24.0 (12.5-41.1)	(4.7-66.8)	82	0.731	57.4	
Excluding study of multiple expert consensus ratings‡	5	86/231	16.4 (11.5-22.8)¶	(6.4-69.7)	0.0	0.629	4.07	
Rib fractures ≤4	5	90/126	88.3 (55.2-97.9)	(17.7-99.6)	84.7	2.439	36.4	
Skull fractures ≤4	11	619/2872	21.5 (18.2-25.4)	(12.8-33.9)	78.9	0.090	43.4	
Age inclusion§								
<1.5 years	7	463/2182	20.6 (16.5-25.5)	(11.3-34.7)	38.1	0.112	84.5	*Q*=0.48, *P*=1.00
≤4 years	4	156/690	22.6 (19.6-25.9)	(19.6-25.9)	0.0	0.000	4.7	
Setting								
ED	4	230/1149	20.6 (15.9-26.3)	(13.0-31.1)	68.1	0.053	13.3	*Q*=0.1, *P*=1.00
Inpatient	7	389/1723	21.8 (17.4-26.9)	(12.5-35.3)	78.7	0.097	27.5	

Pooled estimates are based on random-effects meta-analyses by subgroup and outcome, unless otherwise specified.

*For each indicator, subgroup analyses were only performed and presented when at least four studies where available for each subgroup.
†Excluding one outlying study,[94] as the study focused on inflicted traumatic brain injury in children following a natural disaster, where increased resources and higher detection rate was likely, and less representative to other studies.
‡Excluding one study,[73] which applied a reference standard using six experts from three different fields who rated each case on the likelihood the fracture, where increased resources and higher detection rate was likely, and less representative to other studies.
¶Estimates based on a fixed-effects meta-analysis due to lower between-study heterogeneity (i.e. I^2 <50%).
§Subgroups are categorised by the oldest possible age of participants included for each study, determined by the studies original age inclusion criteria.
††A 95% prediction interval is a measure of between-study variation and approximates where the PPV is to be expected for 95% of similar future studies.

Abbreviations: ED=Emergency departments; PPV=Positive predictive value; Ref Std.=Reference standard.

Table S11. Meta-regressions: influence of publication year on the pooled PPV by outcome for indicators with at least four studies*

Outcome	Indicator & age in years	Studies	Estimate*	95% LCI	95% UCI	*P*-value	I^2, %	t^2
NAS	NAS primary diagnoses	16	0.070	-0.301	0.44	0.713	97.0	1.146
FAS	FAS primary diagnoses	7	-0.123	-0.248	0.003	0.055	95.9	0.459
CM	CM primary diagnoses ≤18	19	-0.05	-0.130	0.039	0.299	91.0	0.470
	Abusive head trauma ≤4	4	-0.399	-1.085	0.288	0.255	32.8	0.098
	Traumatic brain injury ≤2	7	0.035	-0.048	0.118	0.410	93.5	0.383
	Skull fractures ≤4	10	0.028	-0.012	0.068	0.179	72.5	0.066
	Subdural haematoma ≤3†	5	0.033	-0.034	0.100	0.331	0.0	0.000
	Retinal haemorrhages ≤4†	4	0.110	-0.190	0.411	0.472	0.0	0.000
	Upper limb fractures ≤3	4	0.057	-0.046	0.160	0.280	86.7	0.831
	Lower limb fractures ≤3	6	-0.094	-0.301	0.114	0.377	80.5	0.620
	Rib fractures ≤4	4	-0.035	-0.572	0.502	0.898	81.1	2.372
	Assaults ≤19	6	0.162	-0.141	0.464	0.295	92.6	0.970
	Assaults/CM/adversity ≤19	6	0.047	-0.226	0.319	0.738	98.6	0.888
IPV	Assaults ≤65	10	-0.082	-0.136	-0.027	0.003	98.2	0.209
	Facial fractures ≤50	4	-0.199	-0.270	-0.128	0.000	28.1	0.044
	Occular injuries ≤50	4	-0.066	-0.144	0.012	0.098	0.0	0.000

*Estimates based on random-effects meta-regressions, unless otherwise indicated, aimed at investigating whether the publication year of each study are associated with a change in the overall pooled PPV.
†Estimates based on a fixed-effects meta-analysis due to lower between-study heterogeneity (i.e. I^2 <50%)

Abbreviations: LCI=Lower confidence interval; PPV=Positive predictive value; UCI=Upper confidence interval.

Figure S20. Prevalence of misclassifications due to coding errors in studies reporting on NAS, CM, and IPV

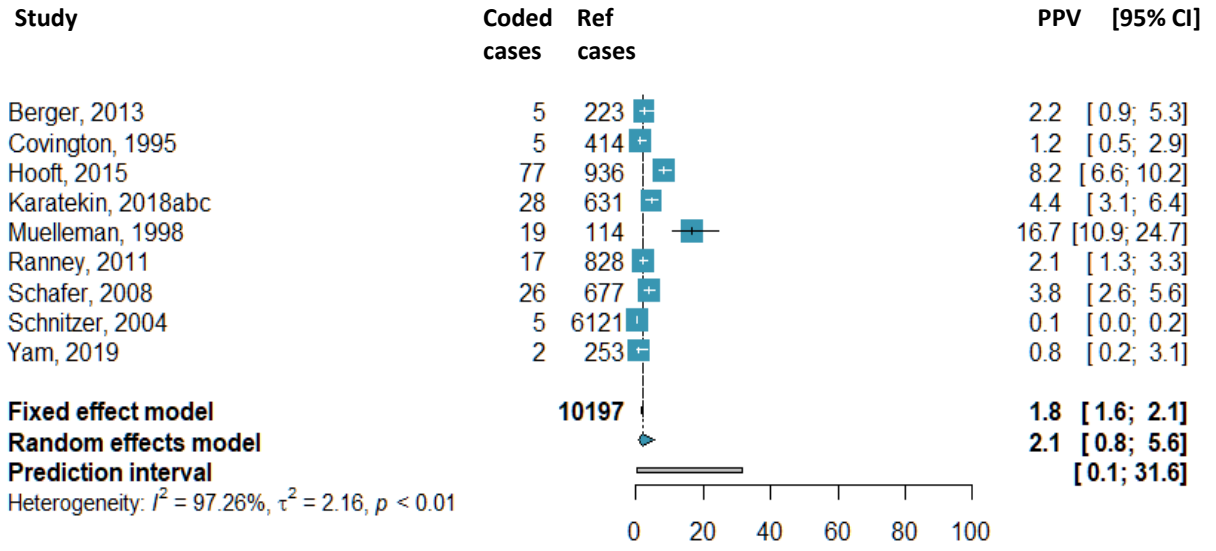


Figure S21. Prevalence of missing perpetrator information in women's medical charts coded as assaults

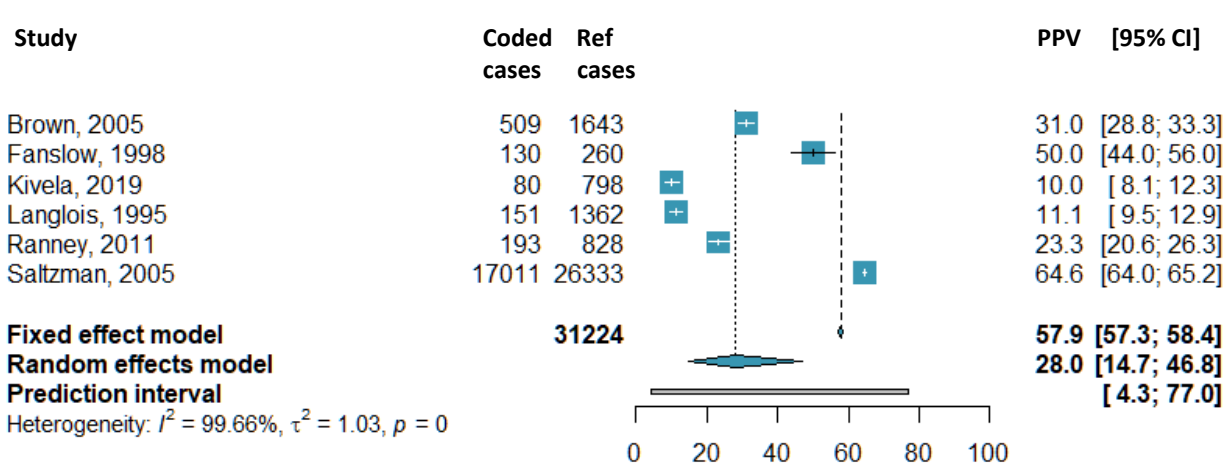
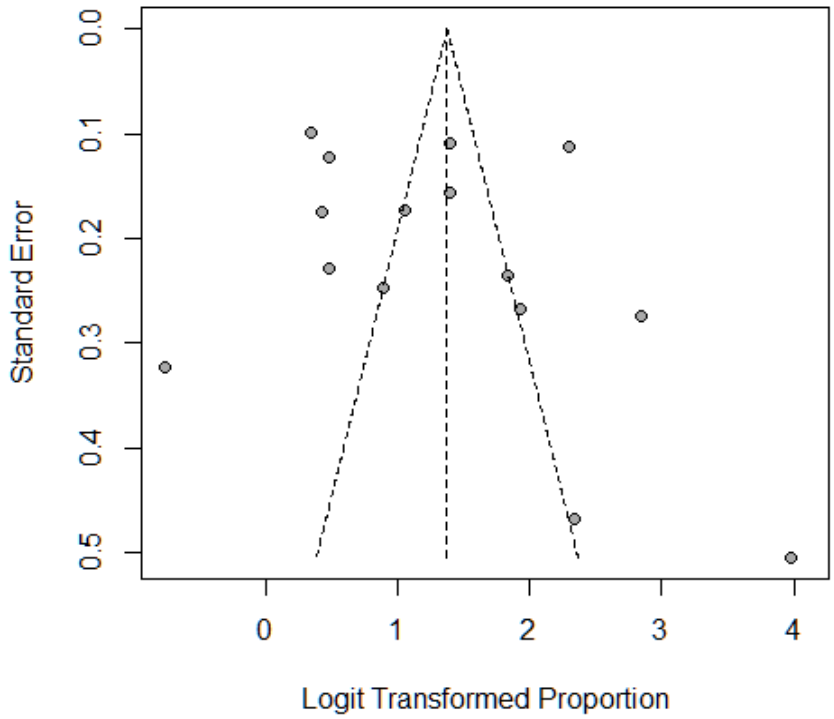


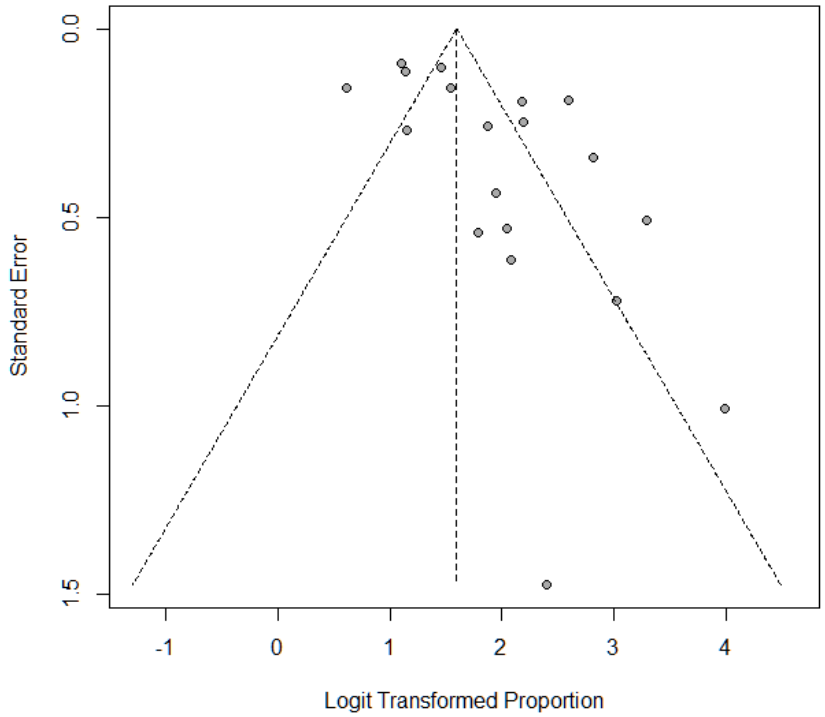
Figure S22. Funnel plot for studies reporting on neonatal abstinence syndrome



Eggers test= 2.67, slope=0.737, *p*=0.3559

Begg's and Mazumdar rank correlation test= 29.0, *p*=0.1908

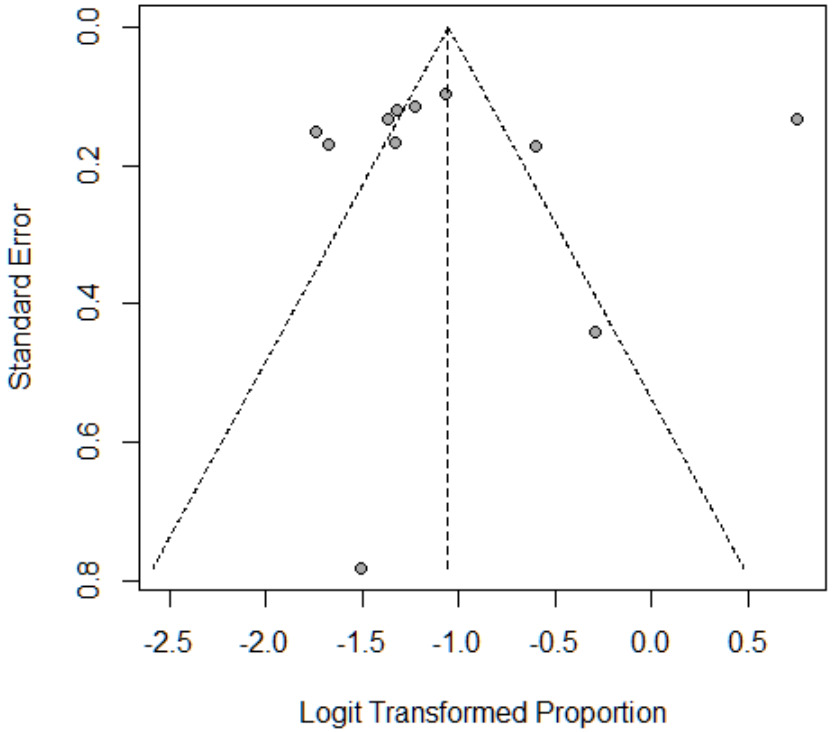
Figure S23. Funnel plot for studies reporting on primary diagnoses of child maltreatment



Eggers test= 2.92, slope=0.999, *p*=0.009

Begg's and Mazumdar rank correlation test= 33.0, *p*=0.248

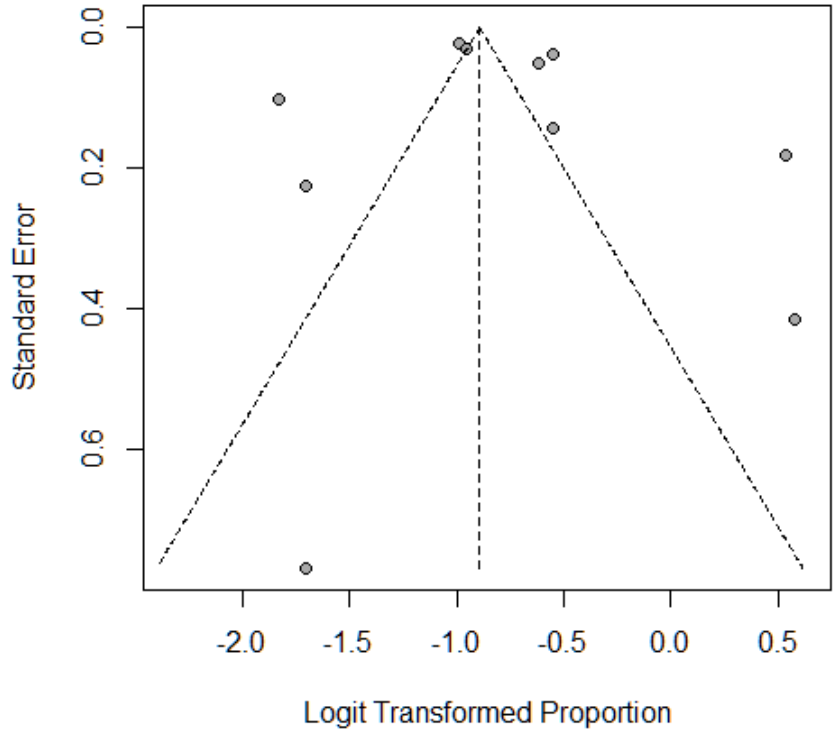
Figure S24. Funnel plot for studies reporting on skull fractures as an indicator of child maltreatment



Eggers test= -0.005, slope= -1.032, *p*= 0.9992.

Begg's and Mazumdar rank correlation test= 1.0, *p*=0.9379.

Figure S25. Funnel plot assessment for studies reporting on assault presentations as an indicator of intimate partner violence



Eggers test= 1.33, slope=-0.928, *p*=0.6582.

Begg's and Mazumdar rank correlation test= 3.0, *p*=0.7884.

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Table S14. Meta-analyses Of Observational Studies in Epidemiology Checklist (MOOSE)

A reporting checklist for Authors, Editors, and Reviewers of Meta-analyses of Observational Studies. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Reporting Criteria	Reported on page
Reporting of Background	
Problem definition	2,3,6
Hypothesis statement	2,3,6
Description of Study Outcome(s)	2,3, 6, 8, table 1-2, figure 3
Type of exposure or intervention used	2, 4, 7, table 1-2, table 3
Type of study design used	2, 3, 6
Study population	2, 7, table 2
Reporting of Search Strategy	
Qualifications of searchers (eg, librarians and investigators)	6, supplement tables 1-2
Search strategy, including time period included in the synthesis and keywords	6, supplement tables 1-2
Effort to include all available studies, including contact with authors	6,7,8, and supplement tables 1-2
Databases and registries searched	7, supplement tables 1-2
Search software used, name and version, including special features used (eg, explosion)	7, supplement tables 1-2
Use of hand searching (eg, reference lists of obtained articles)	6, supplement tables 1-2
List of citations located and those excluded, including justification	Available upon request
Method for addressing articles published in languages other than English	Supplement table 1
Method of handling abstracts and unpublished studies	7, 8
Description of any contact with authors	6, 8, appendix tables 1-2
Reporting of Methods	
Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	7-9
Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	7-9
Documentation of how data were classified and coded (eg, multiple raters, blinding, and interrater reliability)	7-9
Assessment of confounding (eg, comparability of cases and controls in studies where appropriate.	Table 1, supplement table 3
Reporting Criteria	
Assessment of study quality, including blinding of quality assessors; stratification or regression on possible predictors of study results	8, supplement table 3 & 6
Assessment of heterogeneity	8-9
Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	8-9, supplement table 4
Provision of appropriate tables and graphics	Tables 1-3, figure 1 + supplement
Reporting of Results	
Table giving descriptive information for each study included	supplement table 6
Results of sensitivity testing (eg, subgroup analysis)	supplement figure 20-21, supplement tables 9-10
Indication of statistical uncertainty of findings	Table 3, 10-14
Reporting of Discussion	
Quantitative assessment of bias (eg, publication bias)	14, supplement figures 24-27
Justification for exclusion (eg, exclusion of non–English-language citations)	Figure 1/
Assessment of quality of included studies	10, appendix tables 3 & 6
Reporting of Conclusions	
Consideration of alternative explanations for observed results	16, 17
Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	14-17
Guidelines for future research	15-17
Disclosure of funding source	18

Adapted From: Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, Moher D, Becker BJ, Sipe TA, Thacker SB. Meta-analysis of observational studies in epidemiology: a proposal for reporting. JAMA, 2000 Apr 19;283(15):2008-12.

Table S15. Preferred Reporting Items for a Systematic Review and Meta-analysis of Diagnostic Test Accuracy Studies (PRISMA-DTA)

Section/topic	#	Checklist Item	Reported on page #
TITLE / ABSTRACT			
Title	1	Identify the report as a systematic review (+/- meta-analysis) of diagnostic test accuracy (DTA) studies.	1: title includes "positive predictive values"
Abstract	2	Abstract: See separate PRISMA-DTA for abstracts. Due to word limit restrictions we include 10/12 abstract item recommendations. We omitted: "4. List key databases searched" and "5. Risk of bias assessment" in abstract.	3,4.
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4,5-6
Clinical role of index test	D1	State the scientific and clinical background, including the intended use and clinical role of the index test, and if applicable, the rationale for minimally acceptable test accuracy (or minimum difference in accuracy for comparative design).	7,8
Objectives	4	Provide an explicit statement of question(s) being addressed in terms of participants, index test(s), and target condition(s).	7, table 1
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	6
Eligibility criteria	6	Specify study characteristics (participants, setting, index test(s), reference standard(s), target condition(s), and study design) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	7,8
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6 & supplement table 1
Search	8	Present full search strategies for all electronic databases and other sources searched, including any limits used, such that they could be repeated.	6 & supplement table 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6-8
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	8
Definitions for data extraction	11	Provide definitions used in data extraction and classifications of target condition(s), index test(s), reference standard(s) and other characteristics (e.g. study design, clinical setting).	7,8
Risk of bias and applicability	12	Describe methods used for assessing risk of bias in individual studies and concerns regarding the applicability to the review question.	8, supplement table 6
Diagnostic accuracy measures	13	State the principal diagnostic accuracy measure(s) reported (e.g. sensitivity, specificity) and state the unit of assessment (e.g. per-patient, per-lesion).	8
Synthesis of results	14	Describe methods of handling data, combining results of studies and describing variability between studies. This could include, but is not limited to: a) handling of multiple definitions of target condition. b) handling of multiple thresholds of test positivity, c) handling multiple index test readers, d) handling of indeterminate test results, e) grouping and comparing tests, f) handling of different reference standards	8,9 + additional descriptions provided in all table footnotes

Section/topic	#	PRISMA-DTA Checklist Item	Reported on page #
Meta-analysis	D2	Report the statistical methods used for meta-analyses, if performed.	6-7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	8,9
RESULTS			
Study selection	17	Provide numbers of studies screened, assessed for eligibility, included in the review (and included in meta-analysis, if applicable) with reasons for exclusions at each stage, ideally with a flow diagram.	Figure 1
Study characteristics	18	For each included study provide citations and present key characteristics including: a) participant characteristics (presentation, prior testing), b) clinical setting, c) study design, d) target condition definition, e) index test, f) reference standard, g) sample size, h) funding sources	Table 1-3 & supplement Tables 6-8
Risk of bias and applicability	19	Present evaluation of risk of bias and concerns regarding applicability for each study.	supplement table 6
Results of individual studies	20	For each analysis in each study (e.g. unique combination of index test, reference standard, and positivity threshold) report 2x2 data (TP, FP, FN, TN) with estimates of diagnostic accuracy and confidence intervals, ideally with a forest or receiver operator characteristic (ROC) plot.	supplement figures 1-19
Synthesis of results	21	Describe test accuracy, including variability; if meta-analysis was done, include results and confidence intervals.	Table 3, 10-14
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression; analysis of index test: failure rates, proportion of inconclusive results, adverse events).	13, supplement figures 20, 21
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence.	14
Limitations	25	Discuss limitations from included studies (e.g. risk of bias and concerns regarding applicability) and from the review process (e.g. incomplete retrieval of identified research).	15-17
Conclusions	26	Provide a general interpretation of the results in the context of other evidence. Discuss implications for future research and clinical practice (e.g. the intended use and clinical role of the index test).	15, 17
FUNDING			
Funding	27	For the systematic review, describe the sources of funding and other support and the role of the funders.	18

Adapted From: McInnes MDF, Moher D, Thombs BD, McGrath TA, Bossuyt PM, The PRISMA-DTA Group (2018). Preferred Reporting Items for a Systematic Review and Meta-analysis of Diagnostic Test Accuracy Studies: The PRISMA-DTA Statement. JAMA. 2018 Jan 23;319(4):388-396. doi: 10.1001/jama.2017.19163.

For more information, visit: **www.prisma-statement.org**.

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