

2025 Scoping review

Maternal – Prognostic Indicators of Severe Maternal Outcomes

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PIRTST (Patient, Index test, Reference test, Target condition, Study Designs and Timeframe)

Population: Pregnant and postpartum women

Index test: Early warning scores or severity prediction tools (e.g., Shock Index, Modified Early Obstetric Warning Score [MEOWS])

Reference test:

- Comprehensive expert diagnosis: A multidisciplinary team of specialists (e.g., obstetricians, intensivists, anesthesiologists) confirming the presence or absence of severe complications based on clinical course, laboratory findings, imaging studies, and treatment interventions.
- Established diagnostic criteria: For complications with defined diagnostic standards (e.g., disseminated intravascular coagulation [DIC], sepsis), fulfillment of these established criteria was used as the reference standard.

Target condition: Severe maternal complications (e.g., postpartum hemorrhage, sepsis)

Study designs: Diagnostic accuracy studies reporting measures such as sensitivity, specificity, or area under the receiver operating characteristic curve (AUC). In cases where sufficient studies were not available, case series with ≥ 5 patients were included.

Time frame: All studies published up to July 12, 2024, with an English abstract were considered

Search strategy

Database searched: Ovid MEDLINE(R) <July Week 2 2024>

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1. exp Early Warning Score/
 2. (shock adj2 (index or scor*)).mp.
 3. (early adj2 warning adj2 (system* or scor* or criteri* or trigger*)).mp.
 4. (MEOWS or MEWC or MEWT or SAAP).mp.
 5. (rapid adj2 response adj2 (system* or recogni* or score* or monitor*)).mp.
 6. geneva scor*.mp.
 7. wells scor*.mp.
 8. "sepsis-associated adverse outcomes in pregnancy score".mp.
 9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
 10. exp Maternal Mortality/
 11. exp Pregnancy Complications/
 12. exp Postpartum Hemorrhage/
 13. exp Uterine Hemorrhage/
 14. ((uterine or uterus or vaginal) adj2 (h?emorrhage* or bleed*)).mp.
 15. exp Placenta Accreta/
 16. exp Placenta Previa/

17. exp Embolism, Amniotic Fluid/
18. retained placenta.mp. or exp Placenta, Retained/
19. uterine atony.mp.
20. exp Disseminated Intravascular Coagulation/ or disseminated intravascular clotting.mp.
21. ((post partum or postpartum or postpartal or postnatal or post natal or puerperal or after childbirth or after birth or after giving birth or after delivery or after the delivery or following childbirth) adj3 (haemorrhag* or hemorrhag* or bleed* or bloodloss* or blood loss* or coagulopath*)).mp.
22. (abruptio placentae or metrorrhagia or placenta previa or anaphylactoid syndrome of pregnancy).mp.
23. ((uterus or intrauterine or "intra uterine" or uterine) adj3 (atony or atonic or inertia)).mp.
24. exp Puerperal Infection/
25. ((puerperal or postpartum or post-partum or post partum) adj2 (fever or infecti*)).mp.
26. ((amnioti* or amnion) adj3 (emboli* or embolu*)).mp.
27. 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26
28. (((("Disseminated Intravascular" or disorder*) adj3 (coagula* or clot*)) or "DIC" or coagulopathy).mp.
29. exp Resuscitation/ or exp Cardiopulmonary Resuscitation/ or exp Resuscitation Orders/
30. exp Shock/
31. exp Sepsis/
32. ((cardiac or cardio* or cardiovascular or cardiopulmo* or cardio* or heart or thoracic) adj3 (arrest* or massage or compression)).mp.
33. (asystole or "pulseless electrical activity").mp.
34. exp Pulmonary Embolism/
35. exp Aortic Dissection/
36. ((aorta or aortic) adj1 (dissection or rupture)).mp.
37. exp Intracranial Hemorrhages/
38. ((brain or cerebral) adj3 (h?emorrhag* or bleed* or blood*)).mp.
39. 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38
40. exp Pregnancy/
41. exp Obstetrics/
42. exp Pregnant Women/
43. (prenan* or matern* or parturie* or obstetric* or birth* or post partum or postpartum or post-partum or intra partum or intrapartum or intra-partum or antenatal or postnatal or childbirth).mp.
44. 40 or 41 or 42 or 43
45. 39 and 44
46. 27 or 45
47. exp "Sensitivity and Specificity"/
48. exp "Predictive Value of Tests"/
49. ((positive or negative) adj "likelihood ratio").mp.
50. ((true or false) adj (positive or negative)).mp.
51. receiver operating characteristic.mp. or exp ROC Curve/
52. 47 or 48 or 49 or 50 or 51

- 53. 9 and (27 or 39)
- 54. 9 and (27 or (39 and 44))
- 55. 9 and (27 or 45 or 44)
- 56. limit 55 to human

Search Name: CQ7CENTRAL

Date Run: 12/07/2024 13:22:24

Comment:

ID	Search Hits	
#1	MeSH descriptor: [Early Warning Score] explode all trees	11
#2	shock NEAR/2 (index or scor*)	289
#3	(early NEAR/2 warning NEAR/2 (system* or scor* or criteri* or trigger*))	352
#4	MEOWS or MEWC or MEWT or SAAP	18
#5	(rapid NEAR/2 response NEAR/2 (system* or recogni* or score* or monitor*))	45
#6	geneva NEXT scor*	11
#7	wells NEXT scor*	37
#8	"sepsis-associated adverse outcomes in pregnancy score"	0
#9	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8	731
#10	MeSH descriptor: [Maternal Mortality] explode all trees	199
#11	MeSH descriptor: [Pregnancy Complications] explode all trees	17886
#12	MeSH descriptor: [Pregnancy Complications] explode all trees	17886
#13	MeSH descriptor: [Postpartum Hemorrhage] explode all trees	992
#14	MeSH descriptor: [Uterine Hemorrhage] explode all trees	2446
#15	((uterine or uterus or vaginal) NEAR/2 (h?emorrhage* or bleed*))	4522
#16	MeSH descriptor: [Placenta Accreta] explode all trees	50
#17	MeSH descriptor: [Placenta Previa] explode all trees	82
#18	MeSH descriptor: [Embolism, Amniotic Fluid] explode all trees	3
#19	MeSH descriptor: [Placenta, Retained] explode all trees	88
#20	"retained placenta"	293
#21	"uterine atony"	301
#22	MeSH descriptor: [Disseminated Intravascular Coagulation] explode all trees	142
#23	"disseminated intravascular clotting"	243
#24	((("post partum" or postpartum or postpartal or postnatal or "post natal" or puerperal or "after childbirth" or after NEAR/3 birth or after NEAR/3 delivery or "following childbirth") NEAR/3 (haemorrhag* or hemorrhag* or bleed* or bloodloss* or "blood loss" or coagulopath*))	3585
#25	("abruptio placentae" or metrorrhagia or "placenta previa" or "anaphylactoid syndrome of pregnancy")	1097
#26	((uterus or intrauterine or "intra uterine" or uterine) NEAR/3 (atony or atonic or inertia))	362
#27	MeSH descriptor: [Puerperal Infection] explode all trees	163

#28 ((puerperal or postpartum or post-partum or "post partum") NEAR/2 (fever or infecti*)) 594

#29 ((amnioti* or amnion) NEAR/3 (emboli* or embolu*)) 45

#30 #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 25791

#31 (((("disseminated intravascular" or disorder*) NEAR/3 (coagula* or clot*)) or "DIC" or coagulopathy) 4147

#32 MeSH descriptor: [Resuscitation] explode all trees 7717

#33 MeSH descriptor: [Cardiopulmonary Resuscitation] explode all trees 1733

#34 MeSH descriptor: [Resuscitation Orders] explode all trees 57

#35 MeSH descriptor: [Shock] explode all trees 3482

#36 MeSH descriptor: [Sepsis] explode all trees 6523

#37 ((cardiac or cardio* or cardiovascular or cardiopulmo* or cardio* or heart or thoracic) NEAR/3 (arrest* or massage or compression)) 7695

#38 asystole or "pulseless electrical activity" 384

#39 MeSH descriptor: [Pulmonary Embolism] explode all trees 1534

#40 MeSH descriptor: [Aortic Dissection] explode all trees 216

#41 ((aorta or aortic) NEAR/1 (dissection or rupture)) 756

#42 MeSH descriptor: [Intracranial Hemorrhages] explode all trees 3178

#43 ((brain or cerebral) NEAR/3 (h?emorrhag* or bleed* or blood*)) 17094

#44 #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40 or #41 or #42 or #43 45334

#45 MeSH descriptor: [Pregnancy] explode all trees 34185

#46 MeSH descriptor: [Obstetrics] explode all trees 338

#47 MeSH descriptor: [Pregnant Women] explode all trees 1022

#48 prenan* or matern* or parturie* or obstetric* or birth* or "post partum" or postpartum or postpartum or "intra partum" or intrapartum or intra-partum or antenatal or postnatal or childbirth 109405

#49 #45 or #46 or #47 or #48 116771

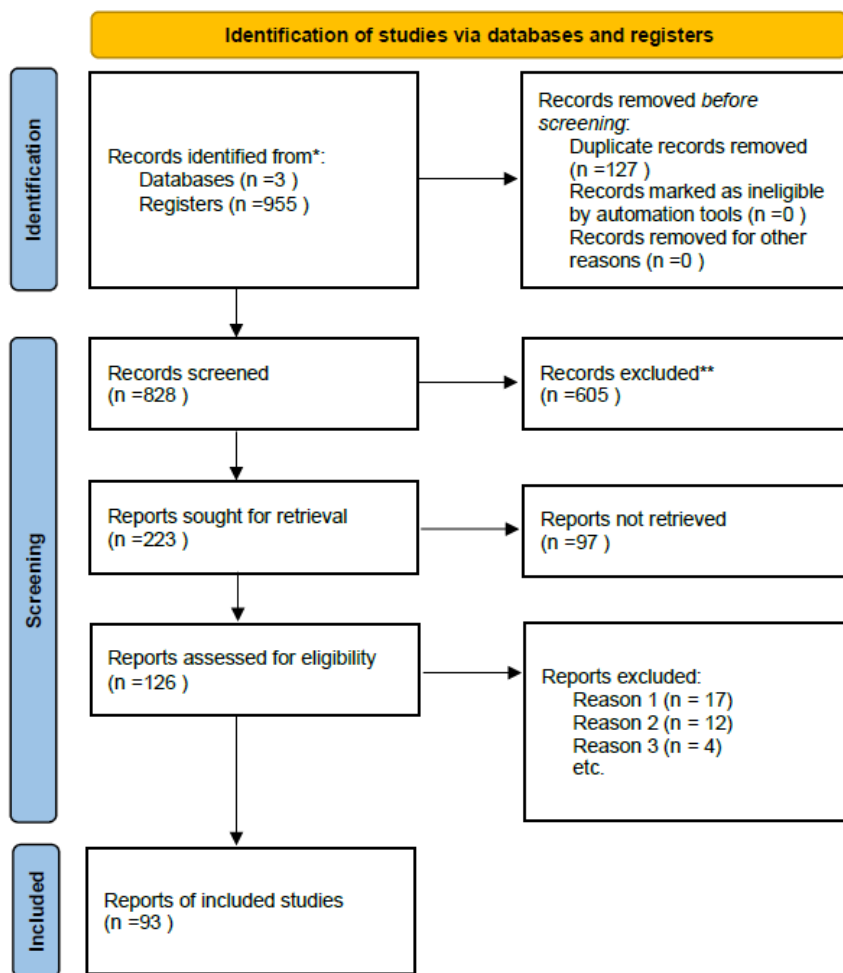
#50 #44 and #49 3499

#51 #9 and (#30 or #50 or #49) 67

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers

only

(Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. This work is licensed under CC BY 4.0. To view a copy of this license, visit <https://creativecommons.org/licenses/by/4.0/>)



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).

**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

Summary of Included Studies

Study	number of total patients	outcome	index test
ABO-ZED 2023	195	Sepsis	Modified Early Obstetric Warning Score MEOWS
Abutheraa 2021	2690	Sepsis	Maternal Early Warning Score MEWS; quick Sequential Organ Failure Assessment qSOFA
Alexander 2010	2240	Death	Maternal Early Warning Score MEWS; Other independent prediction models or machine learning methods
Arnolds 2019	400	Death; Postpartum hemorrhage; Sepsis; Hypertensive disorder of pregnancy	Maternal Early Warning Criteria MEWC

Arnolds 2022	19611	Death; Sepsis	Maternal Early Warning Score MEWS; Modified Early Obstetric Warning Score MEOWS; Maternal Early Warning Trigger MEWT; electronic Cardiac Arrest Risk Triage eCART
Attali 2022	94	Massive blood transfusion	Shock Index SI
Bauer 2024	1253	Sepsis	Maternal Early Warning Criteria MEWC; Maternal Early Warning Trigger MEWT
Blauvelt 2021	15055	Sepsis	Maternal Early Warning Score MEWS; quick Sequential Organ Failure Assessment qSOFA; Sepsis in Obstetric Score SOS
Blumenthal 2018	210	Massive blood transfusion	Maternal Early Warning Score MEWS; Modified Early Obstetric Warning Score MEOWS; Maternal Early Warning Trigger MEWT
Blumenthal 2019	202	Death; Postpartum hemorrhage; Sepsis; Massive blood transfusion; Hypertensive disorder of pregnancy; eclampsia	Maternal Early Warning Score MEWS; Modified Early Obstetric Warning Score MEOWS; Maternal Early Warning Trigger MEWT; maternal early recognition criteria MERC
Borovac-Pinheiro 2018	270	Postpartum hemorrhage	Shock Index SI
Celikkan 2024	883	Postpartum hemorrhage	Shock Index SI; Modified Shock Index; Age Adjusted Shock Index
Chaudhary 2020	1004	Death; Postpartum hemorrhage; Massive blood transfusion; Hypertensive disorder of pregnancy	Shock Index SI
Drew 2019	67	Postpartum hemorrhage	Shock Index SI
Drew 2021	66	Postpartum hemorrhage	Shock Index SI
Durocher 2018	1275	Postpartum hemorrhage	Shock Index SI
Dziadosz 2020	126	Postpartum hemorrhage; Massive blood transfusion	Shock Index SI
Edwards 2015	364	Sepsis	Modified Early Obstetric Warning Score MEOWS
El-Ayadi 2015	954	Death	Shock Index SI
ElAyadi 2016	958	Death	Shock Index SI
Eppes 2016	75	Postpartum hemorrhage	Shock Index SI

Era 2015	77	Massive blood transfusion	Shock Index SI
Escobar 2021	209611	Death; Postpartum hemorrhage; Hypertensive disorder of pregnancy	Other independent prediction models or machine learning methods
Gangwar 2023	496	Death; Massive blood transfusion	Modified Early Obstetric Warning Score MEOWS; Maternal Early Warning Criteria MEWC
Goodacre 2020	219	Pulmonary embolism	Modified Geneva; YEARS criteria
Hannola 2021	828	Postpartum hemorrhage; Sepsis	Obstetric Early Warning Score OEWS
Hedriana 2016	100	Postpartum hemorrhage; Sepsis; eclampsia	Maternal Early Warning Trigger MEWT
Hoppu 2022	827	Postpartum hemorrhage	Obstetric Early Warning Score OEWS
Kaur 2023	21	eclampsia	Modified Early Obstetric Warning Score MEOWS
Kern-Goldberger 2020	2451	Postpartum hemorrhage; Sepsis	Other independent prediction models or machine learning methods
Kern-Goldberger 2023	2451	Postpartum hemorrhage; Sepsis	Modified Early Obstetric Warning Score MEOWS; Maternal Early Warning Trigger MEWT; maternal early recognition criteria MERC
Khergade 2020	250	Death; Sepsis; Hypertensive disorder of pregnancy	Obstetric Early Warning Score OEWS; Modified Early Obstetric Warning Score MEOWS; quick Sequential Organ Failure Assessment qSOFA
Klumpner 2020	7853	Postpartum hemorrhage	Maternal Early Warning Criteria MEWC
Kohn 2019	82	Postpartum hemorrhage; Massive blood transfusion	Shock Index SI
Kong 2021	278	Massive blood transfusion	Shock Index SI; Delta neutrophil index DNI
Kumar 2022	350	Death	Obstetric Early Warning Score OEWS
Kwon 2024	612	Massive blood transfusion; Hypertensive disorder of pregnancy	Shock Index SI; Modified Shock Index
Langlois 2019	371	Pulmonary embolism	YEARS criteria
Lappen 2009	963	Sepsis	Maternal Early Warning Score MEWS
LeBas 2014	100	Massive blood transfusion	Shock Index SI
Lee 2017	302	Postpartum hemorrhage	Shock Index SI

Lee 2019	118	Massive blood transfusion	Shock Index SI
Leon 2018	105	Postpartum hemorrhage; Massive blood transfusion	Shock Index SI
Liu 2022	10520	Postpartum hemorrhage	Other independent prediction models or machine learning methods
Madar 2023	3891	Postpartum hemorrhage	Shock Index SI
Madar 2024	3891	Postpartum hemorrhage	Shock Index SI
Maguire 2014	47571	Sepsis	Obstetric Early Warning Score OEWS
Mantovani 2015	63	Massive blood transfusion	Shock Index SI
Marcano 2017	37	Massive blood transfusion	Shock Index SI
Martin 2022	265	Hypertensive disorder of pregnancy	Maternal Early Warning Criteria MEWC
MichaelStephanou 2012	401	Postpartum hemorrhage; Sepsis; Hypertensive disorder of pregnancy	Modified Early Obstetric Warning Score MEOWS
Mizutani 2024	331	Postpartum hemorrhage	Shock Index SI
Mori 2021	107	Postpartum hemorrhage	Shock Index SI
Nathan 2015	233	Massive blood transfusion	Shock Index SI
Nathan 2018	409	Postpartum hemorrhage; Sepsis	Shock Index SI
Nathan 2019	409	Death; Massive blood transfusion	Shock Index SI
O'Regan 2019	69	Sepsis	quick Sequential Organ Failure Assessment qSOFA; Early Maternal Infection Prompts EMIP
Oba 2019	84	Postpartum hemorrhage	inferior vena cava diameter
Oglak 2021	2534	Massive blood transfusion	Shock Index SI
Pacagnella 2022	270	Postpartum hemorrhage	Shock Index SI
Paternina-Caicedo 2017	702	Death	Obstetric Early Warning Score OEWS

Polic 2020	148	Postpartum hemorrhage; Sepsis	Maternal Early Warning Score MEWS
Polprasarn 2023	300	Postpartum hemorrhage; Sepsis; Hypertensive disorder of pregnancy	Modified Early Obstetric Warning Score MEOWS
Rathore 2020	500	Death; Postpartum hemorrhage; Pulmonary embolism; Cerebrovascular disease; Hypertensive disorder of pregnancy	Obstetric Early Warning Score OEWS; Obstetrics National Early Warning System ONEWS
Robert-Ebadi 2021	390	Pulmonary embolism	Other independent prediction models or machine learning methods
Rudakemwa 2021	94	Postpartum hemorrhage; Sepsis	Modified Early Obstetric Warning Score MEOWS; quick Sequential Organ Failure Assessment qSOFA
Sadeghi 2022	150	Pulmonary embolism	Well s criteria; Modified Geneva; YEARS criteria
Schmidt 2020	160	Massive blood transfusion	Shock Index SI
Sert 2021	201	Postpartum hemorrhage	inferior vena cava diameter
Shanahan 2020	105	Massive blood transfusion	Shock Index SI
Shields 2016	12611	Postpartum hemorrhage; Sepsis	Maternal Early Warning Trigger MEWT
Singh 2010	673	Postpartum hemorrhage; Sepsis; Hypertensive disorder of pregnancy	Modified Early Obstetric Warning Score MEOWS
Singh 2012	673	Postpartum hemorrhage; Sepsis; Hypertensive disorder of pregnancy	Modified Early Obstetric Warning Score MEOWS
Singh 2016	1065	Death; Postpartum hemorrhage; Sepsis; Hypertensive disorder of pregnancy	Modified Early Obstetric Warning Score MEOWS
Sohn 2013	126	Hypertensive disorder of pregnancy	Shock Index SI
Sohn 2018	302	Massive blood transfusion	Shock Index SI

Stuebe 2023	13433	Postpartum hemorrhage	Shock Index SI; Maternal Early Warning Score MEWS
Tanacan 2020	260	Massive blood transfusion	Shock Index SI
Thakur 2015	69	Death; Postpartum hemorrhage; Pulmonary embolism; Cardiovascular disease; Cerebrovascular disease; Sepsis	Acute Physiologic Assessment and Chronic Health Evaluation version 2 APACHE2
Thomson 2020	702	Death; Hypertensive disorder of pregnancy	Obstetric Early Warning Score OEWS
Touhami 2018	103	Pulmonary embolism	Modified Geneva; YEARS criteria
Umar 2020	97634	Death	Other independent prediction models or machine learning methods
Umar 2021	1200	Death; Postpartum hemorrhage; Sepsis; Hypertensive disorder of pregnancy	Obstetric Early Warning Score OEWS
Ushida 2021	30820	Postpartum hemorrhage	Shock Index SI
Valent 2017	123	Sepsis; Massive blood transfusion	Modified Early Obstetric Warning Score MEOWS; Acute Physiologic Assessment and Chronic Health Evaluation version 2 APACHE2
Welsh 2018	17522	Postpartum hemorrhage	Shock Index SI
Xu 2022	352	Death; Postpartum hemorrhage; Pulmonary embolism; Cardiovascular disease; Cerebrovascular disease; Sepsis	Modified Early Obstetric Warning Score MEOWS
Xu 2024	352	Postpartum hemorrhage; Cardiovascular disease; Hypertensive disorder of pregnancy	Obstetric Early Warning Score OEWS; Modified Early Obstetric Warning Score MEOWS; Maternal Early Warning Trigger MEWT
Yadav 2023	1802	Death; Massive blood transfusion	Modified Early Obstetric Warning Score MEOWS
Yahya 2023	545	Sepsis	quick Sequential Organ Failure Assessment qSOFA; obstetrically modified quick Sequential Organ Failure Assessment omqSOFA

Yerubandi 2024	45637	eclampsia	Maternal Early Warning Trigger MEWT
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