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REVIEW ARTICLE

Feasibility of universal screening for postpartum mood and anxiety disorders among caregivers of infants hospitalized in NICUs: a systematic review

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Abstract

This systematic review evaluated the feasibility of implementing universal screening programs for postpartum mood and anxiety disorder (PMAD) among caregivers of infants hospitalized in the neonatal intensive care unit (NICU). Four moderate quality post-implementation cohort studies satisfied inclusion criteria ($n = 2752$ total participants). All studies included mothers; one study included fathers or partners. Screening included measures of depression and post-traumatic stress. Screening rates ranged from 48.5% to 96.2%. The incidence of depression in mothers ranged from 18% to 43.3% and was 9.5% in fathers. Common facilitators included engaging multidisciplinary staff in program development and implementation, partnering with program champions, and incorporating screening into routine clinical practice. Referral to mental health treatment was the most significant barrier. This systematic review suggests that universal PMAD screening in NICUs may be feasible. Further research comparing a wider range of PMAD screening tools and protocols is critical to address these prevalent conditions with significant consequences for parents and infants.

Introduction

Of the 3.5 million infants born annually in the US, about 8% are admitted to the NICU [1, 2]. Caregivers (parents and guardians) for these neonates are at high-risk for postpartum mood and anxiety disorders (PMADs) [3, 4]. They often spend months with their newborn in this stressful environment [5], with limited ability to hold and care for their child. The infant's fragile condition can also interfere with attachment [6, 7]; and in families with more critically ill infants, there is more significant disruption to family dynamics and parenting roles [8–10].

This psychological toll puts NICU caregivers at increased risk for mental illness [6, 7, 9, 11–13]. The postpartum anxiety rate is 2.5 times higher in mothers with very preterm infants than mothers of term babies [14], and 40% of NICU mothers experience postpartum depression (PPD) [15] compared with up to 20% in the general population [16]. Fathers of preterm or ill neonates also experience higher levels of acute stress disorder, anxiety, and post-traumatic stress disorder than parents of healthy term infants [3, 17, 18].

When symptoms of PMADs are left untreated, caregivers can experience significant difficulties engaging

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with their infants [19]. This disruption compromises the child's cognitive and socio-emotional development, resulting in delayed achievement of developmental milestones [20, 21]. To prevent the adverse effects of impaired parent–child bonding, the US Preventive Task Force, American College of Obstetrics and Gynecology, and American Academy of Pediatrics recommend universal screening for PPD [22–24].

Outpatient perinatal depression screening programs have been implemented in many obstetric and pediatric clinics [25–29]. Researchers found these programs to be feasible but challenging to implement. Barriers included lack of provider and staff training [27], poor documentation of depressive symptoms and/or treatment recommendations [29], and liability and risk management [30]. Specifically, pediatricians were unfamiliar with screening tools, and clinic staff were insufficiently trained to provide maternal counseling [25, 27]. In addition, pediatricians had difficulty addressing maternal mental health while prioritizing the child's health [25]. Although obstetricians are generally more familiar with screening than pediatricians [25], most obstetricians feel inadequately trained to treat maternal depression and anxiety [26]. Despite these obstacles, obstetric and pediatric clinic PMAD screening programs have been associated with higher referral rates, mental health service use, and reduced symptomology [31]. Given the increased risk among NICU caregivers, NICU mental health screening may create opportunities for enhanced support and referrals during the neonates' hospitalizations and attention to caregivers' mental health upon discharge.

Prior systematic reviews have evaluated the effectiveness of treatment interventions for addressing caregiver distress in the NICU [32–37]. One recent narrative review summarized the clinical effectiveness of outpatient, inpatient, and community perinatal depression screening programs [31]. However, no reviews to date have focused on feasibility of implementing universal PMAD screening programs among caregivers of hospitalized neonates. Perinatal screening programs include "the infrastructure, tools, and procedures to evaluate, diagnose, treat/manage, and follow up [for perinatal depression]" [38]. This is a gap given the high risk of adverse psychological sequalae of these caregivers as described above and the challenges in practical application of screening recommendations. Therefore, the objectives of this study were as follows: (1) examine screening rate as the primary measure of feasibility of universal mental health screening of NICU caregivers, and (2) describe barriers and facilitators for successful universal NICU mental health screening program implementation.

Methods

Search strategy

A systematic literature search was conducted for studies published before May 2020 via PubMED, Embase, CINAHL, PsycINFO, Sociological Abstracts, and Cochrane. Each search contained database-specific vocabulary terms (eg, MESH terms) and keyword terms (eg, mass screening, anxiety disorders, neonatal intensive care, and parent) to identify NICU caregiver PMAD screening programs (see Supplementary Table 1 for full search term queries). The search was limited to peer-reviewed journal articles written in English. References cited by included studies were also screened for inclusion.

Study selection

We included studies meeting the following criteria: (1) described systematic screening for any PMAD, (2) sampled caregivers of neonates admitted to the NICU (hospitalized at birth or within first 28 days of life), (3) used validated depression and PMAD screening tool(s), (4) screened during the neonate's NICU stay, and (5) described implementation processes, barriers, and facilitators of the screening program. For this review, caregivers were defined as biological mother(s), biological father(s), adoptive parent(s), or other legal guardians of neonates admitted to the NICU for 3 or more days. Included study designs were randomized and non-randomized control trials, cohort studies, case control studies, cross-sectional studies, quasi-experimental studies, and quality improvement studies.

We excluded studies with any of the following sampling criteria: (1) infants admitted to non-NICU inpatient settings, outpatient or non-healthcare setting, (2) infant died in the NICU, (3) non-custodial parent, or (4) selective (not universal) NICU PMAD screening program. Case reports, case series, editorials, opinion articles, and review articles were also excluded.

One author (SM) screened titles and abstracts of identified articles. Full text screening was conducted by two authors (SM and LH). Disagreements were resolved through discussion with the study team.

Data extraction and synthesis

Two authors (SM and LH) independently extracted the following data: (1) study characteristics [(a) study design, (b) duration of study, (c) location (state), and (d) hospital type]; (2) target population for screening; (3) screening instruments utilized; (4) recruitment and implementation strategy, including modality of administration (in person, by paper, by computer, or tablet), staff involved with screening, and distribution protocol (timing to distribute screening tool, linkage with other routine screenings); (5) protocol for positive results; (6) screening rate; (7) prevalence of PMADs among screened caregivers; and (8) barriers and facilitators for screening program implementation. Study authors were contacted to provide additional clarification where needed. Data extraction was reviewed by the team and disagreements resolved by consensus.

Extracted data about program barriers and facilitators were classified into the following categories: patient, provider, administrative, screening, and referral. Data were analyzed between December 26, 2019 and April 30, 2020.

Quality assessment

Two authors (SM and LH) independently assessed the quality of included studies using the modified, validated Downs and Black checklist for randomized and non-randomized studies [39]. This 27-item checklist assesses the quality of reporting (items 1–10), external validity (items 11–13), internal validity (items 14–26) and statistical power (item 27), as used in previous systematic reviews. Study quality was classified as 'good' if the total score was 20–27 points, 'moderate' if the score was 11–19 points, or 'poor' if the score was <11 points. Discrepancies were reconciled through discussion.

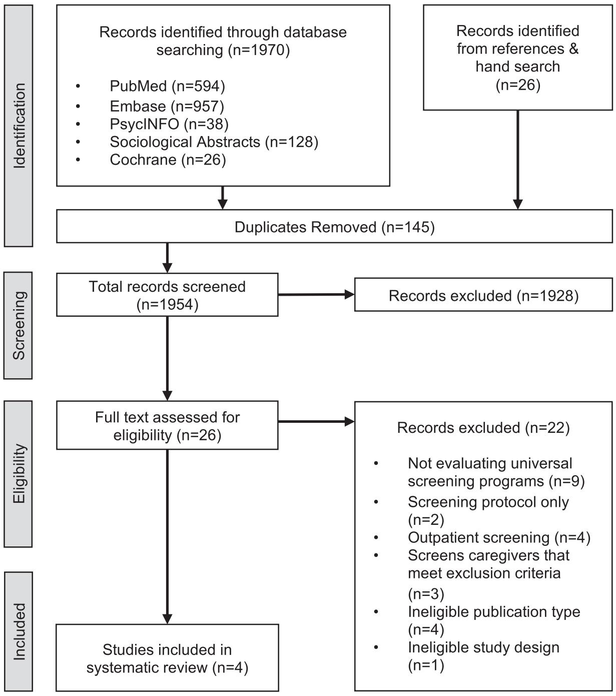

Fig. 1 PRISMA Diagram. Search results, study selection, and inclusion process.

Results

Included studies and study characteristics

The PRISMA [40] diagram of the study selection process is presented in Fig. 1. Literature search yielded 1954 studies after duplicate records were removed. Of these, 26 studies were considered potentially eligible after title and abstract evaluation for full text review. Only four of the 26 reviewed studies [41–44], involving 2752 participants, met eligibility criteria. The following are the reasons for excluding 22 records: (1) not evaluating universal screening programs, (2) screening protocol only, (3) outpatient screening, (4) screens caregivers that meet exclusion criteria, (5) ineligible study design, or (6) ineligible publication type. A full list of excluded studies is available in Supplementary Table 2.

All four included studies were post-implementation cohort studies published in peer-reviewed journals. Additional data about screening PPD rates in the Scheans et al. [43] study was derived from a supplemental study report [45] and confirmed through personal communication. Characteristics of included studies are reported in Table 1.

Included studies were graded moderate quality, with ratings ranging from 11 to 15 (mean quality score = 13.5). Interrater agreement was moderate ($k = 0.67$, 95% CI 0.60, 0.74). Quality assessment scores are summarized in Table 2. Details of scoring with the assessment tool are available in Supplementary Table 3.

Each study was conducted in a different region of the US (West [43], Midwest [41], Northeast [42], and South [44]). Three programs were implemented within the NICU [41, 43], and one was implemented in an obstetrics unit housed within a pediatric hospital, with collaboration between obstetrics and NICU staff [42]. Screening program durations ranged from 2 to 24 months.

Screening protocols

All studies utilized frontline staff to implement screening. Cherry et al. [41], Cole et al. [42], and Vaughn et al. [44] had research coordinators who worked with nursing staff to recruit and screen caregivers. Scheans et al. [43] utilized a lactation consultant, NICU case managers, NICU social workers, and nurses to implement PMAD screening.

Three of the four studies identified key stakeholders and champions during program development. Cole et al. [42] described collaboration between the clinical psychologist and the special delivery unit nurses to develop a screening protocol based on a similar prenatal program screening pregnant mothers. In the year before implementation, a nurse champion was identified to assist the clinical psychologist in staff training, and a clinical research coordinator was recruited to collect data instruments and contact

Table 1 Characteristics of NICU universal screening programs for postpartum depression and anxiety disorders ($n = 4$).

Study	Screening setting	Target population	Number of eligible participants	Screened sample characteristics			Study duration, mo
				Number screened	Age, mean (SD) y	Race/ethnicity, *n*(%)	
Cherry et al. [41]	Oklahoma City, OK NICU within a children's hospital in an academic, tertiary center	Mothers with infants admitted to NICU for at least 14 days	793	385	25.77 (5.95)	Caucasian 242 (63); Black/African American 56 (15.3); Native American/Alaska Native 28 (7.3); Hispanic/Latino 28 (7.3); Other/Unknown 25 (6.5)	18
Cole et al. [42]	Philadelphia, PA Obstetric unit within a pediatric hospital in quaternary care center, academic setting	Mothers of NICU infants with prenatally diagnosed birth defects	753	725	29.8 (5.7)	White 500 (68.9); African American 79 (10.9); Hispanic 79 (10.9); Asian 33 (4.6); Other 34 (4.7)	24
		Fathers/ Partners	757	602	32.5 (6.1)	White 389 (64.6); African American 53 (8.8); Hispanic 52 (8.6); Asian 28 (4.7); Other 20 (3.3); Unknown 60 (13.3)	
Scheans et al. [43]	Portland, OR NICU within a children's hospital in tertiary care center, community hospital	Mothers with infants hospitalized at NICU at 2 weeks, 1 month, 2 months, and 4 months postpartum	419 [45]	373 [45]	Not Reported	Not Reported	18 [45]
Vaughn et al. [44]	Fort Worth, TX Level III NICU at high-risk perinatology referral center, within community hospital and tertiary care center (gestational ages 22–48 weeks, average length of stay 27 days)	Birth mothers with infants hospitalized at NICU for more than 30 days postpartum, must speak English	36	30	Not Reported	Not Reported	2

the clinical psychologist for elevated scores. Cherry et al. [41] and Vaughn et al. [44] also worked with a nurse research coordinator.

Prior to screening, three of four studies educated the staff on the impact of PMADs on infants and families [42–44]. Cole et al. [42] was the only study that reported providing a formal introduction of their screening and referral protocols and specific staff instruction on how to use screening instruments.

During the implementation phase, studies engaged staff with a range of different roles to distribute the screening instruments, including obstetric charge nurse [42], lactation consultants [43], NICU case managers [43], social works [43], and NICU nurses [43, 44]. Cherry et al. [41] was unique in modifying their screening protocol over the course of the study. When insufficient participants were reached by the research coordinator, nurses were asked to incorporate PMAD screening with routine phenylketonuria screening. When this option created administrative barriers, the research coordinator ultimately placed the instrument in each room with informational brochures for mothers and return instructions.

Screening instruments varied in each study. Cherry et al. [41] and Cole et al. [42] used the Postpartum Depression Screening Scale (PDSS) to screen for PPD among mothers. In the Cole et al. [42] study, mothers and fathers also completed the Impact of Event Scale-Revised (IES-R) to evaluate for symptoms of post-traumatic stress. Fathers also completed the Center of Epidemiological Studies Depression Scale (CES-D) to evaluate for symptoms of depression. Scheans et al. [43] and Vaughn et al. [44] screened for PPD among mothers using the Edinburgh Postnatal Depression Scale (EPDS). Details about screening protocols are reported in Table 3.

Screening and PMAD detection rates

Screening rate was lower in the Cherry et al. study, [41] at 48.5% compared with 89% by Scheans et al. [43], 83.3% by Vaughn et al. [44], and 96.2% by Cole et al. [42] Although Scheans et al. screened at multiple time points, they only reported the overall screening rate. Only Cole et al. [42] screened fathers or partners, reaching 79.5% of these caregivers.

Cherry et al. [41] reported that 35.6% (137/385) of screened mothers had PDSS scores consistent with major PPD (PDSS ≧ 80) and 30.4% (117/385) screened positive for PPD symptoms (PDSS = 60–79) at 14 days postpartum. Cole et al. [42] reported major PPD (PDSS ≧ 80) in 8.8% (64/725) and PPD symptoms (PDSS = 60–79) in 27% (196/725) of screened mothers at 1–3 days postpartum. Scheans et al. [43] reported an overall 18% (67/373) [45] rate of positive screens for mothers screened with the EPDS

Table 2 Quality assessment with Modified Downs and Black checklist.

Study	Reporting (11 points)	External validity (3 points)	Internal validity—Bias (7 points)	Internal validity—Confounding (6 points)	Power (1 point)	Total score (28 points)	Overall assessment*
Cherry et al. [41]	6	2	5	2	0	15	Moderate
Cole et al. [42]	6	2	5	2	0	15	Moderate
Scheans et al. [43]	4	2	3	2	0	11	Moderate
Vaughn et al. [44]	7	1	4	1	0	13	Moderate

*Good 20–28, Moderate 11–19, Poor 0–10.

Table 3 Universal screening programs for postpartum depression and anxiety disorders: protocols and screening outcomes.

Study	Screening instruments	Staff involved with screening	Distribution timing and protocol	Screening rate	Incidence of postpartum depression and other anxiety disorders	Referral procedure
Cherry et al. [41]	PDSS^1	Research coordinator, NICU nursing staff	Timing: 14 days postpartum Protocol: Research coordinator screens participants; Due to difficulty reaching participants, procedure changed to nursing staff incorporating PDSS screen with routine PKU screening; finally changed to research coordinator placing PDSS and informational screening brochure in room with envelope and instructions for completing. Mothers were not consented, considered part of routine clinical care	48.5% (385/793)	Postpartum depression in mothers (PDSS $\geqq$ 80): 35.6% (137/385) Postpartum depression symptoms in mothers (PDSS = 60–79): 30.4% (117/385) Normal adjustment (PDSS = 35–59): 34.0% (131/385)	• Referred to psychology team for diagnostic interviewing • Participants with positive screen received feedback forms including results and information about PPD and referral resources
Cole et al. [42]	Mothers: PDSS^1 & IES-R^2 Fathers/partners: IES-R^2 & CES-D^3	Research coordinator, obstetric nursing staff	Timing: 1–3 days postpartum, or after first NICU visit Protocol: Research assistant contacted charge nurse to identify day 1 postpartum women. Research assistant collected screeners at the end of the day. If mother not medically stable, she received the screener on postpartum day 2 or 3. If parents unable to visit their infant in the NICU on postpartum day 1, screener was provided after first NICU visit. Obstetric nurse provided the family with the screener and collected it after completion. Every weekday morning and mid-afternoon, the CRA scored the screeners, and notified the psychologist of positive screens. Parents were not consented, considered part of routine clinical care	Mothers: 96.2% (725/753) Fathers/partners: 79.5% (602/757)	Postpartum depression in mothers (PDSS $\geqq$ 80): 8.8% (64/725) Postpartum depression symptoms in mothers (PDSS = 60–79): 27% (196/725) Depression in father/partner (CES-D $\geqq$ 21): 9.5% (57/602) High risk category for post-traumatic stress symptoms (IES-R $\geqq$ 33): - Mothers: 5.5% (40/725) - Fathers: 5.5% (33/602)	• Referral was made to clinical psychologist who met with the family to determine next steps. • On call social worker notified by charge nurse about elevated screening results when psychology support staff unavailable. • If mother and/or father/partner discharged prior to contact, NICU social work and psychology teams were notified to follow up.

Table 3 (continued)

Study	Screening instruments	Staff involved with screening	Distribution timing and protocol	Screening rate	Incidence of postpartum depression and other anxiety disorders	Referral procedure
Scheans et al. [43]	EPDS[4]	Lactation consultant, NICU case managers, NICU social workers, NICU nurses	Timing: 2 weeks, 1 month, 2 months, and 4 months postpartum Protocol: Screening by lactation consultant; NICU case manager, social worker, and interested NICU nurses trained to perform screening and referral; screening mostly conducted in person, occasionally by phone.	89.0% (373/419)[5] [45]	Mild, moderate, or severe postpartum depression (EPDS $\geqq$ 10 or suicidal ideation): 18% (67/373)[5] [45]	Mild to moderate depression (EPDS = 10–19 without suicidal ideation): • refer to health care provider • provide self-care/community resource information • notify NICU case manager/social worker Severe depression (EPDS $\geqq$ 20 or suicidal ideation): • instruct mother to contact crisis line • instruct to call health care provider • encourage to contact family/friend consider escorting to ED • notify NICU case manager/social worker • provide self-care/community resource info
Vaughn et al. [44]	EPDS[4]	NICU nurses, study investigator	Timing: >30 days postpartum Protocol: consent and enrollment by study investigator, instrument distributed by NICU nurses, study investigator scored completed screenings	83.3% (30/36)	Mild, moderate, or severe postpartum depression (EPDS $\geqq$ 10 or suicidal ideation): 43.3% (13/30)	Mild, moderate, or severe postpartum depression (EPDS $\geqq$ 10 or suicidal ideation): • qualified for evaluation and diagnosis for postpartum depression • provided referral reference handouts complied by social worker and case manager • study investigator follows up within 2 weeks to ensure appointment was made

[1] *PDSS* Postpartum Depression Screening Scale, criteria for positive screen: 35–59 = normal adjustment, 60–79 = signs of depressive symptoms, $\geqq$80 = positive screening for major depressive disorder.

[2] *IES-R* Impact of Event Scale-Revised, criteria for positive screen: 0–23 = no risk, 24–32 = clinical risk, $\geqq$33 = high risk.

[3] *CES-D* Center for Epidemiological Studies Depression Scale, criteria for positive screen: 0–15 = no risk, 16–20 = mild to moderate depression, $\geqq$21 = major depression.

[4] *EPDS* Edinburgh Postpartum Depression Scale, criteria for positive screen: 10–19 without suicidal ideation = mild to moderate, $\geqq$20 or suicidal ideation = severe.

[5] Overall screening rate and PMAD incidence rates were reported in the study. Rates at each time point for screening were not reported.

(EPDS ≧ 10 or suicidal ideation). Vaughn et al. [44] also used the EPDS with same criteria for positive screen, reporting an incidence of 43.3% (13/30) at >30 days postpartum. Depression rates in fathers or partners was significantly lower, at 9.5% (57/602) using the CES-D (CES-D ≧ 21), as reported by Cole et al. [42]

Symptoms of post-traumatic stress were only evaluated by Cole et al. Prevalence was the same for both mothers and fathers/partners at 5.5% [mothers: (40/725), fathers: (33/602) using the IES-R (IES-R ≧ 33)] [42].

Referral protocols

In each study, caregivers who met the prespecified threshold scores that recommended referral were referred to hospital and community services. Cherry et al. [41] and Cole et al. [42] referred mothers with positive screens to inpatient psychologists. Scheans et al. [43] escorted mothers with severe depression scores to the emergency room for immediate intervention. Information about mental health providers in the community via referral brochures were included in all studies. Cherry et al. [41] also faxed screening results to all participants' primary care providers.

Two of the four studies attempted follow-up with participants beyond the NICU hospitalization [41, 44]. Vaughn et al. [44] followed up within 2 weeks of screening completion and found 4 of 12 contacted mothers were successful in making an appointment. Further details about referral protocols are summarized in Table 3.

Universal PMAD screening and referral implementation facilitators and barriers

Facilitators for screening were identified at the staff and administrative levels. All four studies emphasized that staff engagement was essential for implementation. Inclusion of multidisciplinary staff in protocol development and implementation was beneficial [41–44]. Having a nurse champion who was familiar with the setting supported streamlining screening into routine care [42]. Hospital administration buy-in [42, 44], partnership with a clinical psychologist [42], staff training [42, 44], and continued support for frontline staff addressed staff concerns and patient safety issues [42]. Modifications in workflow after implementation and subsequent assessment optimized tracking, screening, provider and patient education, and referral [43]. Screening rates improved when linked with routine clinical activities, when staff coverage was increased, and when screening reminders were included in monthly staff meetings, health records, and discharge checklists [41–43]. Referrals were more successful when mental health services were available in-house [42], or collaborations with community health centers were established [41]. Collecting release of information forms allowed programs to provide screening results to caregivers' primary care providers [41].

The studies identified several implementation barriers at the staff and administrative levels. Staff frequently perceived screening as a competing priority, especially in high volume settings [41, 43]. Furthermore, larger units experienced more difficulty training staff and incorporating screening as part of routine care [41]. Administrative issues, including reimbursement and risk management, were also identified. In contrast with the other three programs with sufficient administrative buy-in, Cherry et al. [41] noted insufficient support from administration to harness necessary resources for training nursing staff to administer the PDSS during routine PKU screening.

Numerous barriers for screening and referring caregivers were reported in all studies. Cherry et al. [41] identified language and cultural factors hindering accurate screening. Lack of bilingual staff, as well as the cultural relevance of the screening tool used, were thought to contribute to a lower screening rate among Hispanic participants. Establishing contact with parents for screening proved to be a challenge in the Cherry et al. and Scheans et al. studies [41, 43]. Notably, these two screening programs were conducted in the NICU setting, whereas Cole et al. conducted screening the first day postpartum on the obstetric floor where the caregiver was admitted. Mothers in the NICU were frequently unavailable when staff approached the infant room to screen [41, 43], and screening rates remained low when screening instruments were left at the infant's bedside [41]. An open layout in the NICU hindered privacy during program enrollment and screening [44]. Once high-risk caregivers were identified, referral to mental health services was especially challenging for those without health insurance [41, 44] or those who did not meet criteria at community health centers [41]. Because mothers had outpatient status while their neonates were admitted, Vaughn et al. [44] were unable to provide hospital-based diagnosis and evaluation for PPD. Implementation barriers and facilitators are summarized in Table 4.

Discussion

Only four studies of the feasibility of implementing universal PMAD screening for NICU caregivers were identified in this systematic review. All programs included in this review were able to reach and screen more than half of NICU caregivers during the evaluation periods, demonstrating promise. The PMAD screening and referral protocols varied with respect to screening tools, procedure for distributing and collecting instruments, and available mental health services, but all utilized frontline staff and a program champion to reach targeted caregivers.

Table 4 Barriers and facilitators for implementing screening, by theme.

Themes	Barriers	Facilitators
Staffing issues	Additional work burden and competing priority for infant care [41–43], especially in high volume setting [41] Large unit size and NICU support staff made difficult to train and incorporate screening as part of routine care [41] Challenges delivering care over weekends [41, 43] Staff turnover and leadership changes [42] Burden on nursing staff in a high-volume setting [41, 43]	Stakeholder engagement (staff buy-in) was essential for implementation [41–44] Champions (e.g., nurse or research coordinator overseeing program) decreased burden on other screening staff and ensured program continuity [41, 42, 44] Leveraged existing staff (e.g, lactation consultants, nursing staff) who would ordinarily meet with mothers to conduct screening [43, 44] Inclusion of multiple provider types in screening and referral process, including protocol development [41–44] Monthly meetings with multidisciplinary staff [44] Positive and negative screening feedback forms provided by coordinator based on mother's result saved time for coordinator and screening staff [41] Clinical psychologist on staff provided support, project resources, and additional training to staff [42] Nurse champion with 20% protected work time allowed for insight into nursing process and successful incorporation of screening into routine care [42] Nursing supervisor and staff recruited to provide input on screening protocol, as anticipated primary screeners [44] Streamlined protocol for participants with positive screens offsets additional work burden [42] Training staff prior to and throughout program implementation [42, 43] Nursing educator provided comprehensive postpartum depression education plan for NICU staff [44] Staff received feedback on screening compliance rate in monthly report [42]
Screening logistics	Inability to reach mothers in the infant room during required time frame for screening [41, 43] Part-time work status for overseeing nurse coordinator made difficult to administer screener consistently [41] Distribution of screening instrument in rooms without explanation from providers resulted in low screening rate [41] Open concept map provides minimal privacy for consent, enrollment, and screening [44]	Linkage with routine clinical care was helpful. For example, some studies used linkages to PKU screening and lactation consultation, contributes to feasibility and improves screening compliance; computer terminal screensavers provided reminders to screen, screening incorporated into discharge checklist, and monthly screening rates reported at staff meetings [41–43] Specialized maternity unit in children's hospital allowed continued follow-up with caregivers with positive screens, provided minimal disruption in clinical services, and maintained family-centered care approach [42] Increasing coverage on nights and weekends [43]
Administrative issues (reimbursement, risk management)	Reimbursement for mental health and/or social service providers not feasible due to lack of appropriate billing codes [41] Lack of senior-level administrative support made difficult to incorporate screening with routine clinical activities [41]	Proper infrastructure and institutional support to address staff concerns and patient safety issues facilitates staff buy-in [42] Permission for serial modifications in workflow allows optimized tracking, screening, provider and patient education, and referral (e.g. entering maternal data into infant's electronic medical record, discharge summaries included maternal screening results and referral services) [43] Hospital administration facilitated program approval by connecting multidisciplinary team with policy approval committee [44]

Table 4 (continued)

Themes	Barriers	Facilitators
Referral issues	Women did not qualify for services at local community mental health centers because they lost Medicaid insurance at 60 days postpartum or did not meet criteria of population served [41] Mother has outpatient status, and therefore, did not qualify for hospital-based diagnosis and evaluation of postpartum depression after a positive screen [44] Investigator not allowed to follow up with mothers with positive screen after baby had been discharged from NICU [44]	Automatic referral to self-care and community resources [43] Release of information form facilitated communication of screening results to other referral sources, like mother's primary care provider [41] In-house clinical psychologist available for consultation [42] Collaboration with local federally qualified health center to get access to mental health services for caregivers with and without insurance [41] Input from social worker and case manager on NICU staff on available public and private referrals [44]
Patient-level considerations	Possibly different depression trajectories among Hispanic caregivers compared with other populations [41] Lack of bilingual screeners contributed to lower screening rate among Hispanic caregivers [41] Study investigators could not include non-English-speaking participants because of staff language limitations [44]	Not reported

Screening feasibility and incidence of PPD

All four studies were able to engage at least half of their targeted population. However, screening rates are difficult to compare because of variation in protocols. Changes in screening protocols and lack of top leadership support in the Cherry et al. [41] study may have contributed to the low screening rate. Possible explanations for high screening rates by Scheans et al. [43] include screening at four different time points, dedicated time for staff and provider education, and strong hospital administration engagement.

The diversity of screening instruments may also have influenced screening rates. Cherry et al. [41] used the PDSS, which is a 35-item self-report tool, while Scheans et al. [43] and Vaughn et al. [44] used the EPDS, which has 10 items. Although both tools are well-validated in this population [46, 47], the length of the PDSS may be a barrier for some populations, especially non-English speakers. Cole et al. [42] had a similar screening rate to the Scheans et al. [43] and Vaughn et al. [44] studies, but Cole et al. [42] screened in an obstetric rather than NICU setting. Screening in NICU settings, especially in standalone children's hospitals with limited services and resources for adult care [48], may be more challenging since the mother is not considered the primary focus of care.

The primary PMAD reported is PPD. Although the range of PPD rates in all four studies were relatively consistent with up to 40% reported in previous literature [15], direct comparison is challenging given heterogenous timing for screening, screening rates, and targeted populations. For example, Cole et al. [42] found an incidence of 35.8% at 1–3 days postpartum, compared with 66% at 14 days postpartum by Cherry et al. [41] This is consistent with the findings of a previous systematic review demonstrated increasing point prevalence of PPD in the first 3 months postpartum [16]. In contrast, Scheans et al. [43] had a much lower rate of 18%, perhaps because it reflected the overall rate at multiple time points. Vaughn et al. [44] implemented their program for a shorter time than the other programs, limiting the comparability in PPD incidence. Similarly, the lower response rate may have affected the accuracy of the reported incidence in the study by Cherry et al. [41] Mothers who did not complete screening may have been functioning more poorly or, alternatively, were not experiencing symptoms. Finally, Cole et al. [42] targeted a very specific subpopulation: parents of newborns with prenatally diagnosed birth defects. Taken together, these findings suggest universal PMAD screening programs should include assessment at multiple time points during the NICU stay and that efforts be made to make screening available to hard-to-reach populations.

Implementation facilitators and barriers

Despite the diverse approaches to universal PMAD screening and referral, common programmatic components emerged that are consistent with key facilitators identified in program implementation literature. For example, program champions are essential for sustainability and successful implementation because they can address concerns throughout the implementation stage, act as an organizational buffer, and facilitate networking [49–51]. Staff engagement in program development (including training and protocol feedback) establishes buy-in [52]. In addition to promoting staff self-efficacy and bolstering management support [50], monthly feedback allows stakeholders to observe meaningful results and helps sustain interventions [53]. Finally, linkage with existing screening efforts or routine clinical tasks makes this additional screening easier to adopt [52]. Serial workflow modifications into the EMR, such as premade screening feedback forms, automatic referrals, and release of information forms, are examples of built-in sustainability without creating significant barriers to frontline staff [49, 50, 52].

The most significant barrier revealed in this review was referral to mental health services. Barriers included lack of access to in-house psychiatric services, absence of appropriate billing codes for mental health and social service providers, lapsed Medicaid coverage postpartum, and ineligibility for mental health services at community health organizations. These results echo literature emphasizing that a clear referral path is helpful for both providers and families [52]. However, the most powerful predictors of successful screening programs are based on external factors, particularly health policy, insurance reimbursement, and community resources [50]. In fact, one study showed that pediatricians in the Midwest are five times more likely to identify and manage mothers with depression [54]. When the study was published, Michigan, Wisconsin, and Illinois had implemented initiatives to increase awareness, screening, and treatment of PPD [55]. While discussions with payers can support program sustainability beyond grant funding, policy changes that ensure sufficient reimbursement and expansion of mental health services are crucial to bridge the gap between recommendation and clinical practice.

Conversely, community partnerships enhanced screening and referrals [52]. If similar community resources are not available locally, referral barriers can be overcome by integrating mental health services into the routine care offered in the NICU. For example, Cole et al. [42] worked with a clinical psychologist on staff in both the NICU and maternity ward. Access to a clinical psychologist has contributed to the success of screening and referral programs in primary care settings [56–58]. A colocated mental health professional would allow for immediate triage for screening positive results and psychosocial support for caregivers [24, 59].

Limitations of studies included in the review

Many universal screening programs in NICUs may have been implemented, but are not yet published. Among the four studies identified in our search, we found varying approaches in evaluation and reporting of screening and moderate study quality, per the Downs and Black criteria. We focused our search on studies addressing barriers and facilitators for universal screening implementation, which may have excluded studies focused on referral issues. Only one included study screened fathers or non-birthing parents, a frequently excluded subpopulation in PMAD screening studies. Furthermore, the unique contexts for each program limits replicability. That said, by identifying common facilitators and barriers, this systematic review gleans successful elements and potential barriers other organizations may face while developing a universal screening program. This focus on implementation facilitators and challenges, rather than program specifics, can help inform future implementation efforts for universal PMAD screening [60].

Notably, the Cole et al. study [42] is unique when compared with the other studies in this review, and limits generalizability. First, they targeted a specific subpopulation of NICU caregivers whose children have malformations. Second, the maternal caregiver was hospitalized in the obstetric setting while their child was in the NICU. That hospitalization provided a clear opportunity for this mother/caregiver to be an identified patient in the hospital electronic health care system, which facilitates access to inpatient psychiatry consultation and services. This model would not be replicable in a standalone children's hospital that does not provide adult medical care.

In addition, few studies in this review examined issues related to health equity. Low-income and minority populations are the most vulnerable in this already high-risk population [52], and the reach of the screening intervention for this subpopulation was only analyzed by Cherry et al. [41] Understanding characteristics of individuals who accept and refuse services is an important factor in evaluating successful screening implementation and ensures equitable support [50, 52]. A recent review of PPD treatment interventions in the NICU found that low income mothers had lower participation because they were unable to be physically present in the NICU due to inadequate paid family leave, access to childcare, and transportation [61].

Recommendations

Our review of the evidence suggests that universal mental health screening programs for NICU caregivers may be feasible to implement. However, given that only four studies were found in this review, we strongly recommend further research to examine the efficacy of specific components of these programs, such as the benefit of sequential screening in one hospitalization. Three studies employed research assistants to distribute and score the screeners, rather than incorporate these duties to the roles of existing staff. Although the use of research assistants demonstrates feasibility and acceptability of the protocol, further studies will be needed to demonstrate that additional screening duties can be incorporated into existing roles, to identify which roles are best suited for screening, or to determine if additional staff members like community health workers or peer navigators are necessary for implementation.

Future studies must be designed to reach these high-risk NICU caregivers, particularly those with low SES and other underserved populations facing additional barriers to care. Future screening programs should also reach fathers and non-birth mother caregivers to discern the most effective approaches for their engagement in screening and treatment. Research using strong implementation science techniques is critical to understand essential components to optimize universal PMAD screening in neonatal care settings [62]. Additional lessons may be learned from the successful screening and referral programs in outpatient obstetric and pediatric settings [25–28, 31, 63, 64].

Future research should also focus on cost-effectiveness of implementing universal PMAD screening in NICU settings. Insufficient data regarding resources necessary for program implementation and lack of reimbursement mechanisms are a significant barrier for widespread adoption [52]. Cost-effectiveness and payer data are useful to motivate buy-in from administrative leaders [49].

In summary, this novel systematic review examined the feasibility of implementing universal screening programs for PMADs among NICU caregivers. While only four studies were identified, all programs reached at least half of their target population and identified a high burden of disease. Policy changes that financially support mental health screening programs and services for high-risk caregivers in NICUs can facilitate broader implementation of universal screening recommendations, program sustainability, and improved outcomes for caregivers and neonates alike.

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Compliance with ethical standards

Conflict of interest The authors declare no competing interests.

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