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REDESIGNING CARE: EVALUATION OF A POSTPARTUM DEPRESSION
SCREENING AND TREATMENT PROGRAM IN OBSTETRIC CLINICS IN HOUSTON,
TEXAS

by

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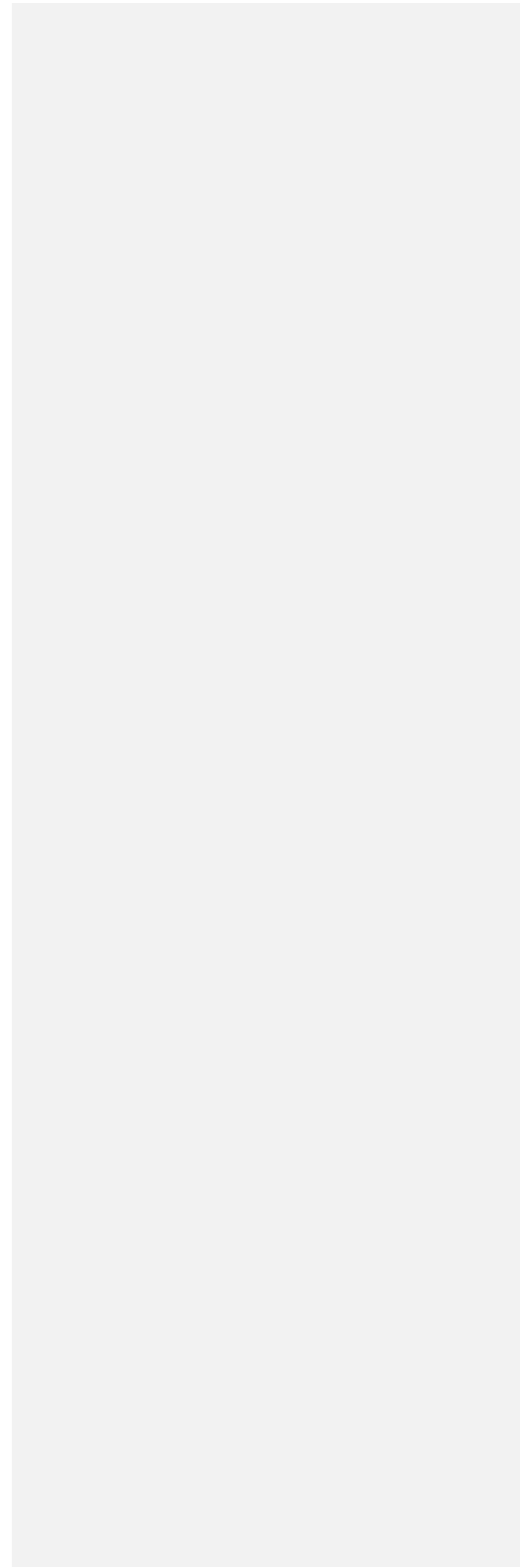
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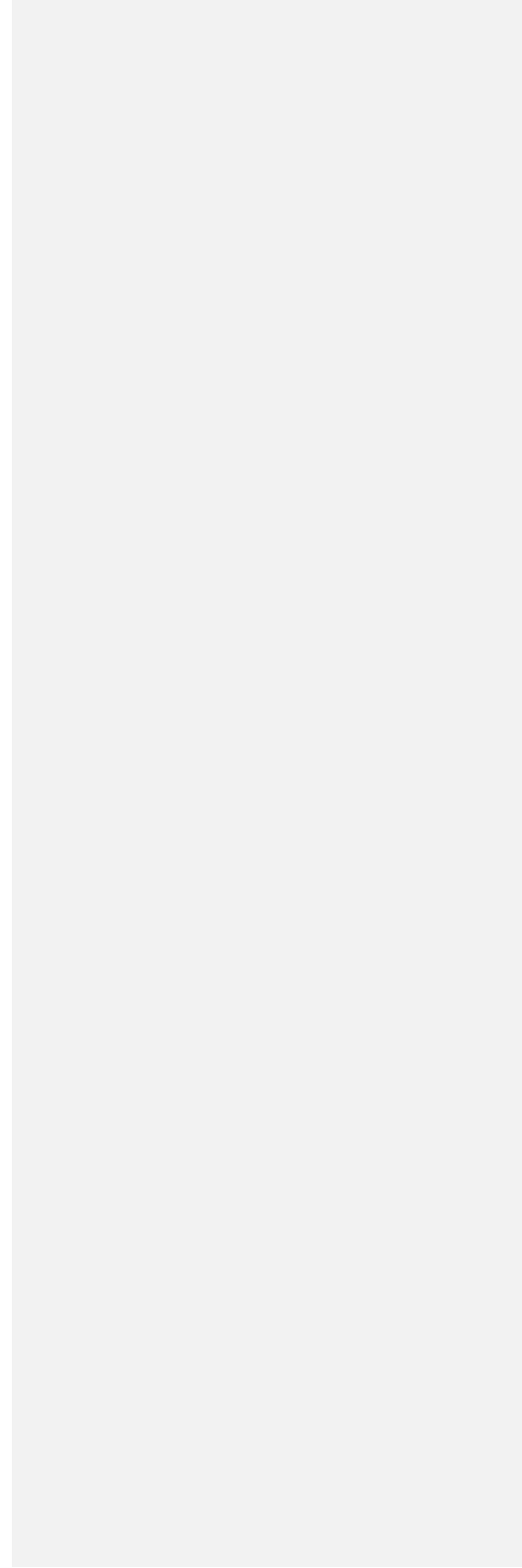
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2019



DEDICATION

To Willie Joseph Jackson



REDESIGNING CARE: EVALUATION OF A POSTPARTUM DEPRESSION
SCREENING AND TREATMENT PROGRAM IN OBSTETRICS CLINICS IN
HOUSTON, TX

by

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Presented to the Faculty of The University of Texas

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in Partial Fulfillment

of the Requirements

for the Degree of

DOCTOR OF PUBLIC HEALTH

THE UNIVERSITY OF TEXAS
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Houston, Texas
May 2019

REDESIGNING CARE: EVALUATION OF A POSTPARTUM DEPRESSION
SCREENING AND TREATMENT PROGRAM IN OBSTETRIC CLINICS IN HOUSTON,
TEXAS

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Postpartum depression is a common complication of childbirth and is often underdiagnosed although it affects about 13-15% of new mothers (O'Hara and Swain, 1996; Munk-Olsen et al., 2006). To improve detection and treatment for postpartum depression, four obstetric clinics in Houston, Texas were trained to use the Edinburgh Postnatal Depression Scale (EPDS) to screen women for postpartum depression at the 6 week postpartum visit. The purpose of this study was to evaluate compliance with screening women for postpartum depression at the 6 week postpartum visit, with referring women that score at-risk to the women's reproductive mental health clinic, and with treating at-risk women referred to the women's reproductive mental health clinic in two service delivery models - co-located and integrated. The co-located model refers to 3 obstetric clinics and the women's reproductive mental health clinic being located within a single building, while the integrated model refers to a women's reproductive mental health provider being embedded inside of a single obstetric clinic.

Postpartum women presenting for a 6 week postpartum visit at four obstetric clinics in Houston, Texas from October 1, 2014 – September 30, 2016 were included in the study

and their outcomes were traced across the continuum of the training protocol from screening, referral to care and treatment at the women's reproductive mental health clinic. The integrated service delivery model screened women at the 6 week postpartum visit significantly more than the co-located service delivery model ($p < 0.001$) and was 62% more likely to refer women at-risk of postpartum depression to the women's reproductive mental health.

There was not a significant difference in getting women into treatment between the two service delivery models; however, when considering outcomes of the protocol and off protocol findings, the rate of women getting into treatment is higher in both models compared to what has been reported in the literature (Rowan P. , Greisinger, Brehm, Smith, & McReynolds, 2012) (Horowitz & Cousins, 2006).

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BACKGROUND

Postpartum psychiatric disorders span a continuum and are generally classified as postpartum blues (often referred to as baby blues), postpartum depression and postpartum psychosis (Di Florio, Smith, & Jones, 2013). Maternal depression, also referred to as perinatal depression, spans pregnancy and the year following delivery (American College of Obstetricians and Gynecologists, 2015). After delivery, women are vulnerable to postpartum psychiatric disorders due to the rapid decline in estrogen and progesterone, as well as the new responsibility of caring for a newborn (Nolen-Hoeksema, 2001). Postpartum blues is the most common and typically resolves within the first 2 weeks postpartum (Bashiri & Spielvogel, 1999). Postpartum psychosis is the rarest, affecting about 0.2% of women and is considered a medical emergency (Di Florio, Smith, & Jones, 2013). Postpartum depression affects approximately 13-15% of new mothers and can be diagnosed up to 1 year after delivery (O'Hara and Swain, 1996; Munk-Olsen et al., 2006). Santoro et al. (2010) estimate that 45-65% of women with no prior history of depression experience their first episode of depression within the first year postpartum. Furthermore, epidemiologic studies have demonstrated that women are more likely to be admitted to a psychiatric unit after giving birth than at any other time in their lives (Kendall et al., 1976; Evans et al., 2001).

Among younger and socioeconomically disadvantaged mothers, the prevalence of postpartum depression is about 23% (Hobfoll et al., 1995). Risk factors for developing postpartum depression include a history of depression, experiencing depression or anxiety during the pregnancy, and low socioeconomic status (O'Hara and Swain, 1996). In addition, a woman's relationship with her partner can be a predictive variable for postpartum

depression; women that are less satisfied, have higher levels of conflict, and receive less support from their partners are potentially at greater risk for postpartum depression (O'Hara and Swain, 1996).

Because maternal depression is often underdiagnosed, recent literature has encouraged screening to improve the identification of women that may benefit from treatment (Evins, Theofrastous, & Galvin, 2000; American Council of Obstetricians and Gynecologists, 2015). Using the Edinburgh Postnatal Depression Scale (EPDS), a tool validated to identify maternal depression, with a cut-off of ≥ 10 points, Evins, Theofrastous, & Galvin (2000) found that having a universal postpartum depression screening protocol in an outpatient setting improved detection rates compared to not having a universal screening protocol (35.4% and 6.3%, respectively). Further, the American College of Obstetricians and Gynecologists (2015) endorses screening during pregnancy and postpartum, but only with appropriate follow-up and treatment. Because a woman's risk of developing depression is higher in the first year postpartum, obstetric providers are key to improving the recognition of postpartum depression (Bhat, Reed, & Unutzer, 2017). Many women consider their obstetric provider to be their primary care provider, seeking care from obstetric and gynecological providers between pregnancy episodes (Melville et al., 2014).

Validated screening tools are available to assist with the identification of maternal depression (Boyd, Le, & Somberg, 2005; Myers, et al., 2013). The Edinburgh Postnatal Depression Scale was developed by Cox, Holden and Sagovsky (1987) to screen new mothers for postpartum depression taking into account that many symptoms of new motherhood may overlap with common symptoms of depression. It is arguably the most

commonly used tool to identify maternal depression (Boyd, Le, & Somberg, 2005). While most extensively used, the EPDS compares favorably to other validated tools that measure depression including the Patient Health Questionnaire (PHQ-9) (Yawn et al., 2009).

Women experiencing symptoms of postpartum psychiatric illnesses often refrain from treatment, despite the availability of services (Moore, Ayres and Drey, 2016; Rowan et al., 2012; Horowitz & Cousins, 2006). The Center on the Developing Child at Harvard University (2009) found that large numbers of affected women often are not identified and only 15% of affected women get treatment (de Albuquerque, 2017). Reasons women do not seek treatment when available vary from lack of knowledge of the illness, poor literacy, failure to disclose symptoms to their provider, to shame and/or social stigma (Moore, Ayres and Drey, 2016). Healthcare service delivery design has the potential to impact access to and use of health care resources, which can affect healthcare outcomes of individuals and populations. Ramdas, Teisberg and Tucker (2012) postulate that location of service delivery is an often overlooked characteristic that influences outcomes. The authors go on to say that when access to services is difficult, patients are less likely to adhere to a provider's recommendations, which can compromise outcomes (Ramdas, Teisberg and Tucker, 2012). Applying service delivery design concepts to treating women for postpartum psychiatric disorders may have implications on a woman's likelihood to follow-through and receive available care for a treatable condition.

Public Health Significance

Postpartum depression has implications far reaching beyond the affected mother (Goodman et al., 2011; Bernard-Bonnin, 2004; Curtis et al., 2014; Balbierz et al., 2015; Tuttle and Kendall, 2011). Not only is the mother impacted, but the child and family are also at risk of experiencing negative consequences (Goodman et al., 2011). Research indicates that children of depressed women often experience negative behavioral and cognitive consequences beginning in infancy and continuing throughout adolescence (Bernard-Bonnin, 2004).

Negative consequences for the child may include, but are not limited to, poor mother-infant bonding, withdrawal, anger, lower cognitive performance, passive noncompliance, anxiety and conduct disorders, substance and alcohol dependence and attention deficit / hyperactivity disorder (Bernard-Bonnin, 2004). In addition to negative effects on the child, Curtis et al. (2014) found robust evidence that maternal mental illness places families with young children at risk for homelessness. Balbierz et al. (2015) examined the association between postpartum depression and parenting and found that, compared to non-depressed mothers, mothers with postpartum depression were less likely to always use a car seat, less likely to place the infant in the back to sleep position, and more likely to bring their babies to the emergency room. Children of depressed mothers also have higher medical claims than children of healthy women because they bear a higher burden of illness, use health services more frequently and have more medical office and emergency department visits (Tuttle and Kendall, 2011). Because maternal depression has potentially far-reaching harmful effects on families and children, its widespread incidence has the potential to have negative and

potentially preventable impacts on children, women and families. (Center on the Developing Child at Harvard University, 2009).

In 2014, the Women's Mental Health Delivery System Reform Incentive Payments (DSRIP) project began with two goals: (1) train obstetric and pediatric practices to implement universal screening for maternal depression in hopes of improving the detection of this treatable condition, and (2) to expand access to women's reproductive mental health services in Greater Houston. This research will explore process and short-term outcomes of postpartum screening in the project, comparing two distinct service delivery models: an integrated model where women's reproductive mental health services are embedded into the obstetric clinic, and a co-located model where women's reproductive mental health services are in the same building with the obstetric clinic.

Using four obstetric practices that were trained to use a validated screening tool and protocol further described later in the paper, the current research aims to compare compliance with implementing universal postpartum depression screening among postpartum women within two distinct service delivery models. Furthermore, the aim is to compare compliance with implementing universal referral for postpartum women who screen at-risk for postpartum depression within two distinct service delivery models and lastly, to compare follow-through to treatment among at-risk postpartum women referred to women's reproductive mental health services within two distinct delivery models.

LITERATURE REVIEW

Defining Maternal Depression

The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V; 2013), defines maternal depression as a diagnosis of major depression and is differentiated by the peripartum-onset specifier “during pregnancy or within 4 weeks after childbirth.” The previous version, DSM-IV (2000), recognized major depression with a postpartum-onset. The onset-specifier was broadened in DSM-V to recognize that the onset of depression can occur throughout the peripartum period. Though this is the definition in the DSM-V, several experts dispute that the onset be limited to the first four weeks after delivery. Instead, experts agree that the onset can occur at any time within the first year after delivery (ACOG, 2015).

Screening for Maternal Depression

The American College of Obstetricians and Gynecologists (ACOG) (2015) states that screening for maternal depression is not sufficient to improve clinical outcomes. ACOG advocates that screening must be combined with appropriate follow-up and treatment when indicated. They further recommend that clinicians screen patients at least once during the perinatal period for depression symptoms using a standardized, validated tool and suggests that clinical staff in obstetrics and gynecology practices be prepared to initiate medical therapy, refer patients to appropriate behavioral health resources when indicated, or both.

Several instruments have been validated to assist with systematically screening for maternal depression during pregnancy and the postpartum period (Table 1). de Albuquerque Moraes (2017) reviewed various instruments used over a recent 5-year period to screen and diagnose postpartum depression and found the Edinburgh Postnatal Depression Scale (EPDS)

to be the most commonly used validated tool. The EPDS consists of 10 self-reported items, takes less than 5 minutes to complete, has been translated into more than 12 languages, has a low required reading level, and is easy to score (ACOG, 2012). The EPDS was developed to avoid over-identification of postpartum depression based on physical symptoms such as fatigue, weight and appetite changes, and problems with sleeping that can be suggestive of depression but are a normal part of postpartum recovery (Yawn, 2009). Other validated scales include the Patient Health Questionnaire 9, Beck Depression Inventory, Postpartum Depression Screening Scale and the Center for Epidemiologic Studies Depression Scale; however, these screening tools include somatic symptoms, which can make differentiating normal physiological responses and symptoms of postpartum depression difficult (Whiffen, 1988).

Table 1. Depression screening tools and associated characteristics (American College of Obstetricians and Gynecologists, 2015).

Screening Tool	Number of Items	Time to Complete (Minutes)	Sensitivity and Specificity	Spanish Available
Edinburgh Postnatal Depression Scale	10	Less than 5	Sensitivity 59-100% Specificity 49-100%	Yes
Postpartum Depression Screening Scale	35	5-10	Sensitivity 91-94% Specificity 72-98%	Yes
Patient Health Questionnaire 9	9	Less than 5	Sensitivity 75% Specificity 90%	Yes
Beck Depression Inventory	21	5-10	Sensitivity 47.6-82% Specificity 85.9-89%	Yes
Beck Depression Inventory-II	21	5-10	Sensitivity 56-57% Specificity 97-100%	Yes
Center for Epidemiologic Studies Depression Scale	20	5-10	Sensitivity 60% Specificity 92%	Yes
Zung Self-rating Depression Scale	20	5-10	Sensitivity 45-89% Specificity 77-88%	No

Because women are at higher risk for depression than men, especially during reproductive years, Bhat, Reed, & Unutzer (2017) posit that obstetrician-gynecologists play a key role in recognizing women in need of extra support and treatment for depression and provide a framework for managing depression within a clinic practice. In addition to seeing the woman frequently for care during phases of life when she is at highest risk, many women also consider their obstetric provider as their primary care provider (Melville et al., 2014).

Rowan et al. (2012) implemented systematic screening for maternal depression in obstetric clinics in Houston and found that 4.6% (N=2,199) of pregnant women screened positive for symptoms of maternal depression. When referred for behavioral health assessment, none of the women pursued further treatment. The prevalence of depression

during postpartum visits was slightly higher (4.9%) with 17.9% self-reporting receiving treatment after referral (Rowan, 2012). Rowan et al. (2013) conducted a follow-up study to understand barriers to receiving further treatment and concluded that better coordination and additional resources and education within the clinic setting may positively impact women seeking treatment for maternal depression.

Systems of Care/Health Services Delivery

Crossing the Quality Chasm (2001) was released in 2001 and proposed a transformed health care system, challenging stakeholders to act and bring about change to improve quality of care via health care delivery. Before *Crossing the Quality Chasm*, Stroul & Freidman (1986) introduced the system of care approach in response to the systemic problems in serving children, youth and young adults with mental health challenges and their families. Originally, the goal of systems of care was to create a comprehensive spectrum of mental health and other necessary services organized into a coordinated network to meet the multiple needs of children and their families (Stroul et al., 2015). With demonstrated outcomes and improvements due to the structured framework, systems of care gained popularity and application in other areas of health care. Updated in 2010, the system of care framework now incorporates applicability to other populations, recognizes its relevance across the developmental spectrum from early childhood to adults, broadens conceptualization of services to incorporate a public health approach and captures the dynamic nature of systems of care (Stroul et al., 2015). Systems of care intends to provide a framework and philosophy to guide service delivery for people with mental health challenges and should be viewed as a paradigm shift to describe how a range of services can be

provided, which are guided by philosophy and supported by infrastructure (Stroul et al., 2015). It is not intended for any two implementations to be alike; each implementation will engage in its own process based on its resources, goals and existing landscape (Stroul et al., 2015).

The systems of care model consists of three interrelated parts: (1) conceptualization, (2) operationalization and (3) implementation (Stroul et al., 2015). Conceptualization includes the set of values and principles that are the foundation for the services provided. Operationalization is the infrastructure and includes providers, technology, patients, clinics and other critical components. Lastly, implementation includes the intervention at the services delivery level that are consistent with the values and principles (Stroul et al., 2015). Vinson et al. (2001) conducted a systematic review of the literature to examine twenty-seven communities that implemented systems of care and their outcomes over a five-year period. Researchers found that after five years, no system fully implemented a system of care to comprise an ideal system, even those sites with experience in system reform (Vinson et al., 2001). This indicates there are challenges with practical application; however, implementing components of the full model proved beneficial (Vinson, et al., 2001). The updated systems of care framework can be applied to other areas of mental health, such as maternal depression, to improve outcomes for mothers, babies and families.

Impact of Healthcare System Design on Health Outcomes

Healthcare system design can impact health outcomes (Heath, Romero, & Reynolds, 2013; Gjerdingen & Yawn, 2007). Heath, Romero & Reynolds (2013) present a conceptual

framework, the Framework for Levels of Integrated Healthcare, for bridging healthcare and bringing various types of care together, specifically primary care and mental health care. The proposed framework is a continuum of three models, each with increasing levels of collaboration and integration among various types of care, but with the goal of treating the whole patient (Health, Romero & Reynolds, 2013). The three models of care are coordination, co-location and integration, in ascending order of collaboration (Health, Romero & Reynolds, 2013). Authors of the framework hypothesize that higher levels of collaboration and integration between primary care and mental health providers likely improves positive health outcomes for the patient (Health, Romero & Reynolds, 2013).

Furthermore, Gjerdingen and Yawn (2007) state that for screening for maternal depression to positively impact clinical outcomes, it must be combined with care within a system that can identify women at risk, include collaborative relationships between medical providers and mental health providers (Framework for Levels of Integrated Healthcare), and connect women to appropriate treatment and follow up. Following the Framework for Levels of Integrated Healthcare proposed by Heath, Romero and Reynolds (2013), Myors et al., (2013) reviewed outcomes of various levels of collaboration and integrated services for perinatal mental health. For patients and families, benefits of integrated care models included individualized care, access to multidisciplinary services with various treatments, detailed assessment and planning, more choices for patients and averting distress to children and families (Myors et al., 2013). Authors also reported benefits to providers and the organizations, which included improved confidence and communication among providers and a reduction in wasted resources and redundancies in care (Myors et al., 2013).

CONCEPTUAL MODELS

Donabedian Quality-of-Care Framework

The Donabedian framework is arguably the most referenced quality of care framework (Ayanian & Markel, 2016). Consisting of three components, the Donabedian framework proposes a triad of structure, process and outcome to evaluate health care quality (Ayanian & Markel, 2016; Figure 1). Structure indicates the setting in which care is delivered and affects processes and outcomes. Process describes the components of care delivered. Outcome indicates the combined effects of structure and process and is chosen to measure performance or process. To impact outcome, structure and process should be manipulated.

As it relates to this proposed research, the Donabedian framework will serve as the theoretical framework to build upon aims 1 and 2. Aim 1 is to compare compliance with implementing universal postpartum depression *screening* among postpartum women within two distinct service delivery models. Structure includes the clinic, clinic location and staff that will be screening and workflow. Process encompasses the screening and referral process for postpartum depression, related to aim 2, which will compare compliance with implementing universal *referral* for postpartum women who screen at-risk for postpartum depression within two distinct service delivery models. Lastly, the outcome will be follow-through with treatment for postpartum depression at the women's reproductive mental health clinic.

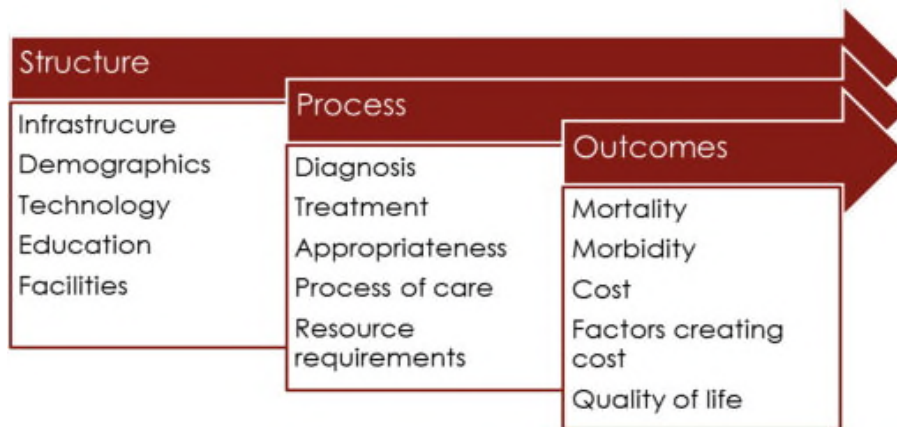


Figure 1. Donabedian Framework for Quality of Care (Lighter, 2015).

Framework for Levels of Integrated Healthcare

Heath, Romero, & Reynolds (2013) suggest that integration, the bringing together of healthcare components, is a key component of healthcare that is essential to improving a patient’s experience of care. Traditionally, integration has been used to reference various primary care and behavioral health service delivery models. Recently, Heath, Wise and Reynolds (2013) proposed an overarching framework for levels of integration that includes three categories: coordinated, co-located and integrated care. Within each level, there are two degrees that follow a continuum (Figure 2). Each of the three categories has a key element. The key element for coordinated care is communication, for co-location it is physical proximity and for integration it is behavioral change (Heath, Wise and Reynolds, 2013). Authors make a point to note that co-location does not guarantee more collaboration, but that it can provide some benefit as it may reduce the time spent travelling from one provider to

another (Health, Wise and Reynolds, 2013). Authors also point out that providing a single service within an integrated setting is considered integrated care because it is provided within the context of that integrated site's whole person care (Heath, Wise and Reynolds, 2013).

As it relates to this proposed research, the framework for levels of integrated healthcare will serve as the framework to build upon research aims 1, 2 and 3. Aims 1 and 2 were previously explained in the paragraph above. Aim 3 is to compare follow-through to *treatment* among at-risk postpartum women referred to women's reproductive mental health services within two distinct delivery models.

COORDINATED KEY ELEMENT: COMMUNICATION		CO LOCATED KEY ELEMENT: PHYSICAL PROXIMITY		INTEGRATED KEY ELEMENT: PRACTICE CHANGE	
LEVEL 1 Minimal Collaboration	LEVEL 2 Basic Collaboration at a Distance	LEVEL 3 Basic Collaboration Onsite	LEVEL 4 Close Collaboration Onsite with Some System Integration	LEVEL 5 Close Collaboration Approaching an Integrated Practice	LEVEL 6 Full Collaboration in a Transformed/ Merged Integrated Practice
Behavioral health, primary care and other healthcare providers work:					
In separate facilities, where they:	In separate facilities, where they:	In same facility not necessarily same offices, where they:	In same space within the same facility, where they:	In same space within the same facility (some shared space), where they:	In same space within the same facility, sharing all practice space, where they:
<ul style="list-style-type: none"> » Have separate systems » Communicate about cases only rarely and under compelling circumstances » Communicate, driven by provider need » May never meet in person » Have limited understanding of each other's roles 	<ul style="list-style-type: none"> » Have separate systems » Communicate periodically about shared patients » Communicate, driven by specific patient issues » May meet as part of larger community » Appreciate each other's roles as resources 	<ul style="list-style-type: none"> » Have separate systems » Communicate regularly about shared patients, by phone or e-mail » Collaborate, driven by need for each other's services and more reliable referral » Meet occasionally to discuss cases due to close proximity » Feel part of a larger yet non-formal team 	<ul style="list-style-type: none"> » Share some systems, like scheduling or medical records » Communicate in person as needed » Collaborate, driven by need for consultation and coordinated plans for difficult patients » Have regular face-to-face interactions about some patients » Have a basic understanding of roles and culture 	<ul style="list-style-type: none"> » Actively seek system solutions together or develop work-a-rounds » Communicate frequently in person » Collaborate, driven by desire to be a member of the care team » Have regular team meetings to discuss overall patient care and specific patient issues » Have an in-depth understanding of roles and culture 	<ul style="list-style-type: none"> » Have resolved most or all system issues, functioning as one integrated system » Communicate consistently at the system, team and individual levels » Collaborate, driven by shared concept of team care » Have formal and informal meetings to support integrated model of care » Have roles and cultures that blur or blend

Figure 2. Core descriptions for six levels of integration (Heath, Wise and Reynolds, 2013).

METHODS

Research Aims

1. To compare compliance with implementing universal postpartum depression **screening** among postpartum women within two distinct service delivery models.
2. To compare compliance with implementing universal **referral** for postpartum women who screen at-risk for postpartum depression within two distinct service delivery models.
3. To compare follow-through to **treatment** among at-risk postpartum women referred to women's reproductive mental health services within two distinct delivery models.

Study Design

A cross-sectional study design using historical data will be used for aims 1 and 2. A historical cohort will be used for aim 3.

1. To evaluate compliance with screening and referral, a descriptive analysis will be used.
2. To further evaluate referral follow-through by service delivery model (co-located versus integrated), a cohort study design will be used. Women who sought obstetric care at a trained obstetric clinic (exposure), completed the EPDS at the 6-week postpartum visit, were at high risk (defined as an EPDS score ≥ 10 or a response of "Yes, quite often" to question 10 on the EPDS), and accepted a referral for treatment from the obstetric provider will be tracked to determine the percentage (or rate) of seeking treatment at the women's reproductive mental health clinic within 60 days of referral (outcome). Trained obstetric clinics were educated and provided a validated tool to screen all women at the 6

week postpartum visit and trained on a standardized process. Women seeking treatment without a referral and women seeking treatment at a mental health clinic outside of the health system are excluded from this study.

Definitions and Measures

- Staff: any person supporting the clinic, but not a provider; can include a registered nurse, medical assistant or other non-providers
- Provider: any person licensed to provide direct medical care to patients in the clinic; includes a medical doctor, nurse practitioner, physician's assistant and/or certified nurse midwife
- Edinburgh Postnatal Depression Scale (EPDS): a validated screening instrument completed by new mothers to assess their risk of postpartum depression; consists of 10 self-reported items
- Universal postpartum depression screening: every woman completing a postpartum visit between 5-7 weeks after delivery is offered an EPDS to screen for postpartum depression. In this dissertation, the period is referred to as the "6-week postpartum visit".
- At-risk: an EPDS score ≥ 10 , or a response of "Yes, quite often" to question 10 regarding suicidality on the EPDS

- Compliance: Percentage of eligible women that are screened, referred and/or treated that meet the criteria at the 6 week postpartum visit
- Treatment / Rate of referral completion: completing at least one appointment for mental health services at the women's reproductive mental health clinic within 60 days of receiving the referral from their obstetric provider.
- Service delivery model: explanation of the infrastructure and relational location between the obstetric clinic and women's reproductive mental health clinic. This study includes 2 models: co-located and integrated.

Service Delivery Models

There are two levels of service integration within the obstetric clinics: co-located and integrated (Appendix E), and they are located in different geographic areas of Houston. The co-located refers to obstetric practices located within a single hospital where women who receive obstetrical care can also see a women's reproductive mental health provider located within the same building where they receive obstetric care (Appendix F). The integrated model refers to an obstetric practice that has a women's reproductive mental health provider embedded in the same clinic space; therefore, the women could receive both services within the same space.

Procedures

While the Women's Mental Health Delivery System Reform Incentive Payment (DSRIP) project trained pediatricians and obstetricians to implement universal screening for

maternal depression, this research will only include trained obstetrics clinics. Of the four trained obstetric clinics, three are located inside of a hospital in the Texas Medical Center and one clinic is located in the Greater Houston community, south of the Texas Medical Center (Appendix E). Two of the obstetric practices are privately managed and the other two have an academic affiliation with a medical school in Houston, Texas.

In 2014, a training team was formed that included a psychiatrist, practice supervisor for the women's reproductive mental health clinic and a project manager. A PowerPoint slide deck, handouts and an evaluation were developed to accompany the training. The training consisted of three sections: (1) an overview of postpartum depression, (2) the importance of screening and why the obstetrician is important in the screening process, (3) how to screen using the Edinburgh Postnatal Depression Scale (EPDS) (Appendix A and Appendix B) and (4) how to submit an order in the electronic medical record to refer mothers identified at-risk and wanting a referral for services to the women's mental reproductive health clinic.

The Edinburgh Postnatal Depression Scale (EPDS) was used to screen women for postpartum depression (Appendix A). The 10-item self-reported screening tool asks patients about their experience over the past week and usually takes less than five minutes to complete. The EPDS has been validated extensively for use during pregnancy and the postpartum period, is available in several languages, and has a sensitivity of 59%-100% and a specificity of 49%-100% (Cox, Holden & Sagovsky, 1987; Harris et al., 1989; Murray & Carothers, 1990; Adouard, Glangeaud-Freudenthal, Golse, 2005, de Albuquerque Moraes, et al., 2017). The original article validating the EPDS used a cut-point score of ≥ 10 (Cox et al., 1987). This cut-point was adopted for the project described.

Obstetric providers and clinic staff were trained to utilize the EPDS twice during pregnancy (at the first prenatal visit and in the third trimester of pregnancy), and at the “6 week” postpartum visit to assess a woman’s risk for maternal depression, since it is a sensitive period for both mother and baby. In the universal screening protocol provided during training, providers and staff are instructed to treat each new screening interval as unique. Because universal screening is standard of care within the clinics, newly hired providers and staff are trained on the screening processes during orientation as part of learning clinic procedures and processes.

A process map of the screening and referral workflow is located in Appendix B. The EPDS was self-administered by the patient and a staff member entered the patient’s responses into an EPDS flow sheet in the electronic medical record. The EPDS flow sheet scores the entered responses and populates a total score ranging from 0 – 30. Zero indicates low risk for maternal depression and 30 indicates significant risk. Clinic staff were trained to notify the obstetrician for any total EPDS scores ≥ 10 or for any patient selecting “Yes, quite often” to question ten, which asks about suicidality. For an EPDS score ≥ 10 and/or “yes, quite often” responses to question 10, the obstetric provider was trained to have a conversation with the patient about how she is feeling and to suggest and offer a referral to see a women’s mental reproductive mental health professional.

One referral and treatment option is the women’s reproductive mental health clinic within the hospital system. At the women’s reproductive mental health clinic, mental health experts offer consultation, evaluation, diagnosis and treatment for perinatal mood disorders and conditions related to a woman’s reproductive life cycle. Staffing at the women’s

reproductive mental health clinic includes four psychiatrists, one psychologist and one social worker. Other options for referral include mental health providers that are in the Houston community; however, because these providers are not within the same hospital system, the electronic medical record does not capture any external referrals in a discrete field. Some patients may have an established mental health provider and choose to continue seeking treatment from this provider, and the electronic medical record does not capture the information. If the patient is at-risk and accepts an internal referral for further care at the women's reproductive mental health clinic within the system, an order is entered into the electronic medical record and is electronically routed to the women's reproductive mental health clinic.

Once an order is received at the women's reproductive mental health clinic, staff contact the referred patient via telephone within 24 hours to verify patient information and to schedule an appointment with a mental health provider. Each electronic referral is worked by a member of the scheduling team and the outcome of the referral is captured within the electronic medical record. For patients that are scheduled, a reminder call is completed 1 day in advance of the scheduled appointment. Patients are defined as following-through with treatment if their appointment with a mental health provider at the women's reproductive mental health clinics is completed within 60 days of receiving the electronic referral. Though completing an appointment within 60 days was used for measurement in this study, the Women's Mental Health DSRIP Project's goal was to see any woman referred within 7-10 days of the referral.

The DSRIP project plan included the addition of community locations to improve access to services for women who are unable to travel to the Texas Medical Center for treatment. At the start of the project in 2013, there was one location for the women's reproductive mental health clinic, which was on the hospital's main campus in the Texas Medical Center. In January 2014, a second location was added and embedded into an OB/Gyn clinic in the community. The embedded model is referred to as "integrated" throughout this paper. Women's reproductive mental health providers are available at the co-located clinic Monday through Friday from 8am – 5pm and at the integrated clinic two days per week from 8am - 5pm.

Ascertainment

The study population includes female patients seen for a 6 week postpartum visit at the 4 trained obstetric clinics from October 1, 2014 – September 30, 2016. Inclusion and exclusion criteria are provided in Table 2.

Table 2. Inclusion and exclusion criteria for postpartum study population.

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none"> • Women of all ages • Women completing a “6 week” postpartum visit from October 1, 2014 – September 30, 2016 at one of the 4 trained obstetric clinics. For this research, the “6 week” visit includes any postpartum visit that occurs at 5-7 weeks postpartum. 	<ul style="list-style-type: none"> • Men • Women completing an appointment outside of the defined 6 week postpartum visit range (5-7 weeks postpartum)

1. Indication of presenting for a 6 week postpartum visit: Data provided on when a woman presented for a 6 week postpartum visit came from a Best Practice Advisory (BPA) alert that flags in the electronic medical record when a woman is at the clinic 5-7 weeks postpartum. The BPA alert data from a woman’s electronic medical record came from a Business Objects report and was exported into Excel. The Excel file provided data on the total number of BPA alerts that fired at the 6 week postpartum visit (5-7 weeks range) by a patient’s unique medical record. For duplicate medical record numbers in the dataset, the chronological first instance of the BPA flag was included in the dataset to assess the volume of unique patients seen during the 6 week postpartum period who were eligible to complete the EPDS. Other duplicate patients were removed from the dataset.
2. Indication of compliance with screening at the 6 week postpartum visit: Data entered into the woman’s electronic medical record came from a Business Objects report and was exported into Excel. The Excel file included the patient’s unique medical record number,

appointment date, clinic name, select demographic variables (race, date of birth, marital status, insurance type, gravidity) and a score for the EPDS if the woman was screened at the 6 week postpartum visit. A numerical value in the EPDS score field was considered as a woman being screened at the 6 week postpartum visit. Alternatively, a blank cell in the EPDS score field was considered as a woman not being screened at the 6 week postpartum visit.

3. Indication of compliance with referral: Data came from a QlikView dashboard and was exported into Excel. The dashboard displayed all referrals to the women's reproductive mental health clinic by medical record number from October 1, 2014 – September 30, 2016. The referral data was matched to the data of unique medical records of women that had an EPDS score ≥ 10 from the screening dataset. Only patients that had a referral to the women's reproductive mental health clinic within 1 day of an at-risk EPDS score at the 6 week postpartum visit were considered as referred. Alternatively, no referral or a referral to the women's reproductive mental health clinic outside of 1 day was considered as not referred at the 6 week postpartum visit.
4. Indication of follow-through with treatment by service delivery model: Data came from the Business and Financial Operations Team as an Excel file. Data displayed all completed appointments at the women's reproductive mental health clinic by medical record number from October 1, 2014 – November 30, 2016. October and November 2016 were included in the completed appointments data to ensure that women completing an appointment within 60 days were accurately captured in the treatment data. The completed appointment data was matched to the data of unique medical records of at-risk women that were referred to the women's reproductive mental health clinic. Only women

at-risk women that a completed appointment at the women's reproductive mental health clinic within 60 days of receiving a referral were considered as treated. Alternatively, no completed visit or a completed visit at the women's reproductive mental health clinic outside of 60 days was considered as not treated.

5. Outcomes for at-risk women that were not referred within 1 day and outcomes for at-risk women that did not complete an appointment at the women's reproductive mental health clinic within 60 days: unique medical record numbers for at-risk women were obtained from the existing at-risk dataset. Data on at-risk women that were not referred was obtained through chart review. Similarly, data on at-risk women that were referred and did not complete an appointment at the women's reproductive mental health clinic was obtained through chart review.

Sample Size

The necessary sample size for the study is 32 women per group based on sample size analysis specifying a power of .80, and an alpha level of .05 (Sit & Wisner, 2009; LaRocco-Cockburn, et al., 2013). The sample size for this study exceeded the minimum required with 2,729 women who were eligible to be screened and 1,462 woman that were screened. All women that presented for a 6 week postpartum visit and had a best practice advisory (BPA) alert flag from October 1, 2014 – September 30, 2016 at one of the 4 obstetric clinics participating in the project were included. A cascading diagram of data included and excluded is available in Appendix G.

Analysis

Descriptive statistics are used to describe characteristics of the four obstetric practices and include number of providers by type, number of staff and operational descriptors.

Descriptive statistics are also be used to detail sociodemographic characteristics of patients screened at the 6 week postpartum visit, identified as at-risk (scoring ≥ 10 on the EPDS or a response of “Yes, quite often” to question 10), referred for treatment within 1 day, and completing treatment at the women’s reproductive mental health clinic. A distribution of EPDS scores for all women screened at 6 week postpartum at trained obstetric clinics is included. Chart review was used to determine outcomes of at-risk women that were not referred within 1 day and at-risk women that were referred and not treated within 60 days.

Using OpenEpi, chi-square tests were used to assess compliance with screening women at the 6 week postpartum visit, referral within 1 day to the women’s reproductive mental health clinic and treatment by service delivery model to answer specific research aims 1, 2 and 3 (Dean, Sullivan, & Soe, 2013). Fisher exact test was used for cell values less than 5. For chi-square and Fisher Exact tests, two-tailed p-value less than 0.05 were considered statistically significant. To further detect any difference in risk between the two service delivery model types (co-located and integrated) for screening at the 6 week postpartum visit, at-risk, referral within 1 day and treatment within 60 days of referral, risk ratios with 95% confidence intervals were calculated with the co-located model as the reference group.

Using OpenEpi, stratified analysis was used to assess confounding and interaction between the service delivery models and sociodemographic variables (Dean, Sullivan, & Soe,

2013). Sociodemographic variables analyzed included race, age, gravidity, relationship status and insurance status because of its availability in the data provided and insight into the population of women within the models. For stratified analysis, sociodemographic variables were grouped accordingly:

- Race: Black / African American; Other (White, Native Hawaiian / Other Pacific Islander, American Indian / Alaska Native, Asian)
- Age: ≤ 29 years; ≥ 30 years
- Gravidity: Low (≤ 2 pregnancies); High (≥ 3 pregnancies)
- Relationship: Married; Other (single, divorced, separated, significant other, other)
- Insurance: Commercial; Government funded (Medicaid / Medicare, Children's Health Insurance Plan (CHIP))

To assess confounding between service delivery models and sociodemographic variables, the crude risk ratio was compared to the Mantel Haenszel adjusted risk ratio. Variables were considered as potential confounders if there was a difference between the crude and adjusted risk ratio that was greater than 10% (Szklo & Nieto, 2006). The percentage difference between the crude and adjusted risk ratios was calculated using the following formula:

$$\text{Potential confounder if } \frac{RR_1 - RR_2}{RR_1} > 10\%$$

To assess for interaction, the Breslow-Day Test of Interaction was computed in OpenEpi and a p-value less than 0.05 indicated the presence of interaction. For stratified analysis, any cell

values of zero (0) were transformed to 0.5 and 0.5 was added to all cell values within the strata (Dean, Sullivan, & Soe, 2013).

RESULTS

Service Delivery Model Characteristics

From October 1, 2015 – September 30, 2016, characteristics of the two service delivery models varied by staffing and operations (Table 3). The co-located model with 3 clinics completed more visits and deliveries than the integrated model with 1 clinic. Overall, a higher percentage of women that delivered in the integrated model completed a postpartum visit compared to women in the co-located model (220/232 versus 4,075/4,855).

The co-located service delivery model had more staff compared to the integrated model, with three levels of providers available to treat patients (Table 3). There were no certified nurse midwife providers in the integrated model. On average, there were 135 deliveries per provider in the co-located model compared to 58 deliveries per provider in the integrated model. About 2.9 nursing and clinical support staff were available per clinical FTE in the co-located model, compared to approximately 2.3 in the integrated model.

Population Characteristics

Demographic characteristics of women presenting for a 6 week postpartum visit, those who were screened using the EPDS, those who scored at-risk for postpartum depression on the EPDS, those who were referred to the women's reproductive mental health clinic within 1 day and those who completed an appointment at the women's reproductive mental health clinic with 60 days are described in Table 9. High fidelity of screening existed for nearly all population characteristics examined in the integrated model, while the co-located model had more variation among screening by population characteristics. From October 1, 2014 – September 30, 2016, 2,494 women presented for a 6 week postpartum visit in the co-located model, compared to 235 in the integrated model (Table 9). White women

represented the largest proportion in the co-located model and were most likely to be screened in the co-located model (51.2%). There was high compliance of screening by race within the integrated model. Native Hawaiians / Other Pacific Islanders, American Indians / Alaska Natives and Asians were all universally screened (100%), followed by Whites and Blacks / African Americans (98.3% and 93.2%, respectively). In both service delivery models, co-located and integrated, patients presenting for the 6 week visit postpartum were generally married (81.2% vs. 80.0%) women who identified as white (76.1% vs. 74.0%) between 30-34 years of age (40.3% vs. 37.0%) with commercial insurance (83.0% vs. 97.0%) that had one pregnancy (38.9% vs. 31.5%). The distribution of EPDS scores was skewed positive in both service delivery models indicating that most EPDS scores were low risk and on the lower end of the 0-30 range (Figure 3). The mode and median for the distribution was the same in both models (0 and 3, respectively). Mean and range EPDS scores varied slightly by service delivery model: 4.0 mean, 0 – 24 range in the integrated model and 4.3 mean and 0 – 28 range in the co-located model.

Among all races screened and in both models, Black / African American women had the highest prevalence of scoring at-risk for postpartum depression (Table 9). Overall, 19.4% of Black / African American women scored at-risk in the co-located model compared to 17.1% in the integrated model. In both models, Asian women had the second highest prevalence of scoring at-risk for postpartum depression (13.1% co-located; 16.7%, integrated) and White women had the lowest prevalence (8.3% co-located; 6.4% integrated). In both models, married women were least likely to score at-risk (8.5% co-located; 7.1% integrated), while single and divorced women were most likely to score at-risk. The proportion of women scoring at-risk for postpartum depression by insurance type was

greatest for those with Medicaid / Medicare and Children's Health Insurance Plan (CHIP) in the co-located model (17.9% and 18.2%, respectively). This outcome was not observed in the integrated model in which 97% of women at the 6 week postpartum visit had commercial insurance; instead, the highest proportion of women scoring at-risk for postpartum depression were those with commercial insurance (9.0%).

Specific Aim 1

Screening compliance varied by service delivery model (Table 4). Overall 97.4% of women that completed a 6 week postpartum visit in the integrated model were screened for postpartum depression using the EPDS, compared to 49.4% of women in the co-located model ($p < 0.001$). Postpartum women seen in the integrated service delivery model for a 6 week visit were nearly two times more likely to be screened using the EPDS than women in the co-located model (RR = 1.97, 95% CI: 1.89, 2.06).

Among women screened for postpartum depression at the 6 week postpartum visit, 10% scored at-risk for postpartum depression in the co-located model, while 8.7% scored at-risk in the integrated model (Table 4). No women selected "yes, quite often" to question 10 on the EPDS which inquires about thoughts of harming oneself. No significant relationship was found between service delivery model and the rate of women scoring at-risk for postpartum depression on the EPDS ($p = 0.55$). Postpartum women seen in the integrated service delivery model for a 6 week visit were 13% less likely to score at-risk on the EPDS compared to women in the co-located model (RR = 0.87, 95% CI: 0.55, 1.36).

Specific Aim 2

Compliance with referring women at-risk for postpartum depression to the women's reproductive mental health clinic varied by service delivery model (Table 4). Thirty percent

(n = 6) of the 20 women who scored at-risk for postpartum depression in the integrated model were referred to the women's reproductive mental health clinic, compared to 18.5% (n = 23) in the co-located model (p = 0.24). Postpartum women that scored at-risk at the 6 week postpartum visit in the integrated service delivery model were 62% more likely to receive a referral to the women's reproductive mental health clinic within 1 day of an at-risk EPDS score compared to women in the co-located model (RR = 1.62, 95% CI: 0.75, 3.47).

Specific Aim 3

At-risk women that received a referral in the integrated model were 36% less likely to complete an appointment at the women's reproductive mental health clinic than women in the co-located model (RR = 0.64, 95% CI: 0.19, 2.12). Of the six at-risk women referred for mental health services within the healthcare system from the integrated clinic, two (33.3%) completed an appointment within 60 days of receiving the referral (Table 4), while 52.2% (12/23) of women referred to the women's reproductive mental health clinic completed an appointment within 60 days of receiving the referral in the co-located model (p = 0.72).

Confounding and Interaction

Stratified analysis for women who were screened at the 6 week postpartum visit and sociodemographic characteristics showed that regardless of the characteristic, screening occurred approximately twice as often in the integrated service delivery model as in the co-located (Table 5). For each sociodemographic characteristic analyzed, the crude risk ratio and the adjusted risk ratio were similar, showing no confounding effects between the service delivery model and the stratified characteristic. The Breslow Day test for interaction showed no interaction.

Stratified analysis of women at-risk for postpartum depression and sociodemographic characteristics showed that regardless of the characteristic, women in the co-located model were at higher risk for postpartum depression compared to women in the integrated model (Table 6). Women with commercial insurance in the integrated and co-located service delivery models were equally at-risk for postpartum depression (RR = 1.02, 95% CI: 0.64, 1.61). For all sociodemographic characteristics analyzed for women at-risk, the crude risk ratio and the adjusted risk ratio were similar, indicating no confounding effects between the service delivery model and the stratified characteristic. The Breslow Day test for interaction showed no interaction.

Stratified analysis of women who scored at-risk at the 6 week postpartum visit and were referred within 1 day and sociodemographic characteristics showed that regardless of the characteristic, at-risk women in the integrated model were more likely to be referred to the women's reproductive mental health clinic compared to women in the co-located model, except for at-risk Black /African American women and at-risk women ≤ 29 years of age (Table 7). Black/African American women at-risk of postpartum depression in the integrated model were 38% less likely to be referred to the women's reproductive mental health clinic compared to Black / African American women at-risk of postpartum depression in the co-located model (RR = 0.62, 95% CI: 0.09, 4.21). Women ≤ 29 years of age at-risk of postpartum depression in the integrated model were 10% less likely to be referred to the women's reproductive mental health clinic compared to women ≤ 29 years of age at-risk of postpartum depression in the co-located model (RR = 0.90, 95% CI: 0.31, 2.59). For all sociodemographic characteristics analyzed for women at-risk of postpartum depression that were referred to the women's reproductive mental health clinic within 1 day, the crude risk

ratio and the adjusted risk ratio were similar, indicating no confounding effects between the service delivery model and the stratified characteristic, with the exception of age. The 10.2% difference between the crude risk ratio and the adjusted risk ratio for age group is suggestive of a confounding variable. The Breslow Day test for interaction showed no statistically significant interaction.

Lastly, stratified analysis of women who scored at-risk at the 6 week postpartum visit, were referred within 1 day and completed an appointment at the women's reproductive mental health clinic within 60 days and sociodemographic characteristics showed that regardless of the characteristic, women in the integrated model were less likely to complete a visit within 60 days of referral, except for women with high gravidity and women with government funded insurance (Table 8). At risk women with high gravidity that received a referral in the integrated model were 2.5 times more likely to complete an appointment at the women's reproductive mental health clinic within 60 days of referral compared to women with high gravidity in the co-located model (RR = 2.50, 95% CI: 0.27, 23.36). Though stratified analysis showed that at risk women with government funded insurance that received a referral in the integrated model were 2 times more likely to complete an appointment at the women's reproductive mental health clinic within 60 days of referral compared to women with government funded insurance in the co-located model (RR = 2.00, 95% CI: 0.15, 26.73), it should be noted that this calculation is unstable due to small cell values. For each sociodemographic characteristic analyzed for screening, the crude risk ratio and the adjusted risk ratio were similar, showing no confounding effects between the service delivery model and the stratified characteristic. The Breslow Day test for interaction showed no interaction.

Further Evaluation

Chart review findings showed that women in both service delivery models who were at-risk of postpartum depression and did not receive a referral to the women's reproductive mental health clinic within 1 day of scoring positive on the EPDS according to the protocol, were referred for mental health care in some other way (Table 10). Of the 14 women that were at-risk of postpartum depression in the integrated model and did not receive a referral to the women's reproductive mental health clinic within 1 day of scoring positive on the EPDS, 30% (n=6) were referred off protocol to a mental health provider. Chart review revealed that four (4) women were established patients at the women's reproductive mental health clinic and two (2) women had received a referral to the women's reproductive mental health clinic prior to scoring positive at 6 week postpartum visit. Similarly, of the 101 women that were at-risk of postpartum depression in the co-located model and did not receive a referral to the women's reproductive mental health clinic within 1 day of scoring positive on the EPDS, 11.3% (n=14) were referred off protocol to a mental health provider. Six (6) women were referred to the women's reproductive mental health clinic before scoring at-risk on the EPDS at the 6 week postpartum visit, five (5) women were established patients at the women's reproductive mental health clinic, two (2) women had received a referral to the women's reproductive mental health clinic more than one day after screening positive at her 6 week postpartum visit, and one (1) woman in the co-located model reported being under psychiatric care by an outside psychiatrist. (Appendix H).

Chart review findings showed that women in both service delivery models completed an appointment with a mental health provider, but off protocol (Table 11). Of the 4 women that were at-risk for postpartum depression at the 6 week postpartum visit and referred to the

Commented [S1]: Having the "off protocol" here makes it sound like the provider was "off protocol".

women's reproductive mental health clinic but did not complete an appointment within 60 days in the integrated model, one (1) patient was triaged to the internal pediatric mental health clinic due to an age of < 18 years and completed an appointment within 60 days at the pediatric mental health clinic. Of the 11 women in the co-located model that were at-risk of postpartum depression at the 6 week postpartum visit and referred to the women's reproductive mental health clinic but did not complete an appointment within 60 days in the integrated model, one (1) patient declined to schedule an appointment during initial contact from the women's reproductive mental health clinic, but did complete an appointment after 60 days. (Appendix I)

Table 3. Staffing and operational characteristics of trained obstetric practices by service delivery model, October 1, 2015 – September 30, 2016.

		Staffing							Operations			
		Providers			Support				All Visits Completed (n)	Deliveries (n)	Postpartum Visits Completed (n)	Distinct Patients Completing Postpartum Visit (n)
Service Delivery Model	Clinic Type	Obstetricians (n)	Clinical FTE* for Obstetricians	Mid-level (n)	Certified Nurse Midwives (n)	Nursing (n)	Clinical (n)	Administrative (n)				
Co-located												
Practice A	Private	10	10.00	0	5	9	16	8	54,779	2,286	3,228	2,218
Practice B	Private	4	3.85	0	0	1	10	3	25,888	769	1,240	824
Practice C	Academic	16	7.49	1	0	13	12	14	23,248	1,800	1,245	1,033
Subtotal		30	21.34	1	5	22	39	25	103,915	4,855	5,713	4,075
Integrated												
Practice D	Academic	3	1.33	1	0	1	2	2	4,719	232	275	220

* FTE = full time equivalent

Table 4. Comparison of outcomes of interest (screened at 6 week postpartum visit, at-risk of postpartum depression (PPD), referred to women's reproductive mental health clinic within 1 day, completed an appointment at the women's reproductive mental health within 60 days of referral), by service delivery model, October 1, 2014 - September 30, 2016.

Category	Service Delivery Model	Compliance n (%)	Risk Ratio	95% CI	χ^2 p-value
Screened at 6 week postpartum visit					
Presenting at 6 week postpartum visit with BPA alert	Integrated (n = 235)	229 (97.4)	1.97	1.89, 2.06	<0.001
	Co-located (n = 2,494)	1,233 (49.4)	Ref		
At-risk of postpartum depression					
Screened	Integrated	20 (8.7)	0.87	0.55, 1.36	0.55
	Co-located	124 (10.0)	Ref		
Referral of at-risk within 1 day					
At-risk	Integrated	6 (30.0)	1.62	0.75, 3.47	0.24
	Co-located	23 (18.5)	Ref		
Treatment within 60 days for the at-risk referred within 1 day					
Referred	Integrated	2 (33.3)	0.64	0.19, 2.12	0.72*
	Co-located	12 (52.2)	Ref		

Notes.

Mantel Haenszel chi-square

* Fisher Exact test used for cell values < 5

Ref = Reference group for risk ratio calculations

Table 5. Stratified analysis to assess confounding and interaction between service delivery model and sociodemographic characteristics for screening at the 6 week postpartum visit, October 1, 2014 – September 30, 2016.

Characteristic	Group	Service Delivery Model	Screened at		Stratum-specific Risk Ratio (95% CI)	Crude Risk Ratio (95% CI)	Adjusted* Risk Ratio (95% CI)	Test for Interaction p-value**
			6 week Postpartum Visit (n)	6 week Postpartum Visit (%)				
Race	Black / AA	Integrated	44	93.2	2.08 (1.81, 2.40)	1.97 (1.89, 2.06)	1.98 (1.89, 2.07)	0.44
		Co-located	346	44.8	Ref			
	Other	Integrated	189	98.4	1.96 (1.88, 2.05)			
		Co-located	2143	50.2	Ref			
Age	≤ 29 years	Integrated	102	98.0	2.01 (1.86, 2.17)	1.97 (1.89, 2.06)	1.98 (1.89, 2.07)	0.54
		Co-located	801	48.8	Ref			
	≥ 30 years	Integrated	133	97.0	1.95 (1.85, 2.07)			
		Co-located	1693	49.7	Ref			
Gravidity	Low (≤ 2)	Integrated	154	98.1	2.00 (1.91, 2.11)	1.96 (1.88, 2.06)	1.96 (1.88, 2.05)	0.33
		Co-located	1725	49.2	Ref			
	High (≥ 3)	Integrated	80	96.3	1.90 (1.75, 2.07)			
		Co-located	712	50.7	Ref			
Relationship	Married	Integrated	188	97.9	1.94 (1.84, 2.03)	1.97 (1.89, 2.06)	1.97 (1.89, 2.06)	0.10
		Co-located	2024	50.6	Ref			
	Other	Integrated	47	95.7	2.15 (1.91, 2.41)			
		Co-located	470	44.5	Ref			
Insurance	Commercial	Integrated	228	97.8	1.92 (1.83, 2.01)	1.97 (1.88, 2.06)	1.92 (1.84, 2.02)	0.78
		Co-located	2071	50.9	Ref			
	Government funded	Integrated	7	85.7	2.01 (1.46, 2.78)			
		Co-located	406	42.6	Ref			

Excluded "Unable to obtain" and "Patient refused".

* Mantel Hantzel Adjusted Risk Ratio

** Breslow Day Test for Interaction

Table 6. Stratified analysis to assess for confounding and interaction between service delivery model and sociodemographic characteristics for scoring at-risk at the 6 week postpartum visit, October 1, 2014 – September 30, 2016.

Characteristic	Group	Service Delivery Model	Screened at 6 week Postpartum Visit (n)	At-risk for Postpartum Depression (%)	Stratum-specific Risk Ratio (95% CI)	Crude Risk Ratio (95% CI)	Adjusted* Risk Ratio (95% CI)	Test for Interaction p-value**
Race	Black / AA	Integrated	41	17.1	0.88 (0.42, 1.86)	0.87 (1.56, 1.37)	0.83 (0.53, 1.29)	0.84
		Co-located	155	19.4	Ref			
	Other	Integrated	186	7.0	0.80 (0.46, 1.40)			
		Co-located	1075	8.7	Ref			
Age	≤ 29 years	Integrated	100	11.0	0.94 (0.50, 1.74)	0.87 (0.55, 1.36)	0.84 (0.53, 1.32)	0.64
		Co-located	391	11.8	Ref			
	≥ 30 years	Integrated	129	7.0	0.75 (0.39, 1.46)			
		Co-located	842	9.3	Ref			
Gravidity	Low (≤ 2)	Integrated	151	8.6	0.89 (0.51, 1.56)	0.88 (0.56, 1.39)	0.88 (0.56, 1.38)	0.95
		Co-located	848	9.7	Ref			
	High (≥ 3)	Integrated	77	9.1	0.86 (0.56, 2.89)			
		Co-located	361	10.5	Ref			
Relationship	Married	Integrated	184	7.1	0.83 (0.47, 1.46)	0.87 (0.55, 1.36)	0.85 (0.54, 1.33)	0.91
		Co-located	1,024	8.5	Ref			
	Other	Integrated	45	15.6	0.88 (0.55, 1.36)			
		Co-located	209	17.7	Ref			
Insurance	Commercial	Integrated	223	9.0	1.02 (0.64, 1.61)	0.88 (0.57, 1.37)	0.97 (0.62, 1.53)	0.50
		Co-located	1,054	8.8	Ref			
	Government funded	Integrated	6***	0.0	0.39 (0.03, 5.81)			
		Co-located	173	17.9	Ref			

Excluded "Unable to obtain" and "Patient refused".

* Mantel Hantzel Adjusted Risk Ratio

** Breslow Day Test for Interaction

***used for cell values of 0

Table 7. Stratified analysis to assess for confounding and interaction between service delivery model and sociodemographic characteristics for referral within 1 day, October 1, 2014 – September 30, 2016.

Characteristic	Group	Service Delivery Model	At-risk for Postpartum Depression (n)	Referred within 1 day (%)	Stratum-specific Risk Ratio (95% CI)	Crude Risk Ratio (95% CI)	Adjusted* Risk Ratio (95% CI)	Test for Interaction p-value**
Race	Black / AA	Integrated	7	14.3	0.62 (0.09, 4.21)	1.62 (0.75, 3.47)	1.59 (0.75, 3.39)	0.22
		Co-located	30	23.3	Ref			
	Other	Integrated	13	38.5	2.26 (1.00, 5.13)			
		Co-located	94	17.0	Ref			
Age	≤ 29 years	Integrated	11	27.3	0.90 (0.31, 2.59)	1.62 (0.75, 3.47)	1.41 (0.67, 2.98)	0.13
		Co-located	46	30.4	Ref			
	≥ 30 years	Integrated	9	33.3	2.89 (0.95, 8.76)			
		Co-located	78	11.5	Ref			
Gravidity	Low (≤ 2)	Integrated	13	30.8	8.41 (2.12, 33.36)	6.00 (2.54, 14.15)	5.75 (2.52, 13.12)	0.45
		Co-located	82	3.7	Ref			
	High (≥ 3)	Integrated	7	57.1	4.34 (1.54, 12.27)			
		Co-located	38	13.2	Ref			
Relationship	Married	Integrated	13	30.8	1.79 (0.70, 4.55)	1.62 (0.75, 3.47)	1.60 (0.75, 3.44)	0.72
		Co-located	87	17.2	Ref			
	Other	Integrated	7	28.6	1.32 (0.35, 4.96)			
		Co-located	37	21.6	Ref			
Insurance	Commercial	Integrated	20	30.0	1.47 (0.74, 3.16)	1.65 (0.79, 3.39)	1.55 (0.74, 3.25)	0.45
		Co-located	93	20.4	Ref			
	Government funded	Integrated	0***	0.0	3.56 (0.42, 30.18)			
		Co-located	31	12.9	Ref			

Notes.

Excluded "Unable to obtain" and "Patient refused".

* Mantel Hantzel Adjusted Risk Ratio

** Breslow Day Test for Interaction

*** 0.5 used for cell values of zero

Table 8. Stratified analysis to assess for confounding and interaction between service delivery model and sociodemographic characteristics for completing an appointment at the women's reproductive mental health clinic within 60 days of referral, October 1, 2014 – November 30, 2016.

Characteristic	Group	Service Delivery Model	Referred within 1 day (n)	Treated within 60 days (%)	Stratum-specific Risk Ratio (95% CI)	Crude Risk Ratio (95% CI)	Adjusted* Risk Ratio (95% CI)	Test for Interaction p-value**
Race	Black / AA	Integrated	1***	0.0	0.58 (0.06, 6.13) Ref	0.74 (0.26, 2.10)	0.74 (0.26, 2.13)	0.81
		Co-located	7	57.1				
	Other	Integrated	5	40.0	0.80 (0.25, 2.60)			
		Co-located	16	50.0	Ref			
Age	≤ 29 years	Integrated	3	33.3	0.78 (0.14, 4.30) Ref	0.64 (0.19, 2.12)	0.61 (0.19, 2.12)	0.72
		Co-located	14	42.9				
	≥ 30 years	Integrated	3	33.3	0.50 (0.09, 2.64) Ref			
		Co-located	9	66.7				
Gravidity	Low (≤ 2)	Integrated	4	25.0	0.41 (0.07, 2.32) Ref	0.64 (0.19, 2.12)	0.67 (0.18, 2.47)	0.21
		Co-located	18	61.1				
	High (≥ 3)	Integrated	2	50.0	2.50 (0.27, 23.36) Ref			
		Co-located	5	20.0				
Relationship	Married	Integrated	4	50.0	0.94 (0.32, 2.78) Ref	0.74 (0.26, 2.10)	0.74 (0.26, 2.10)	0.55
		Co-located	15	53.3				
	Other	Integrated	2***	0.0	0.40 (0.03, 5.25) Ref			
		Co-located	8	50.0				
Insurance	Commercial	Integrated	6	33.3	0.58 (0.17, 1.90) Ref	0.68 (0.24, 2.00)	0.68 (0.23, 1.98)	0.39
		Co-located	19	57.9				
	Government funded	Integrated	0***	0.0	2.00 (0.15, 26.73) Ref			
		Co-located	4	25.0				

* Mantel Hantzel Adjusted Risk Ratio

** Breslow Day Test for Interaction

*** 0.5 used for cell values of zero

Table 9. Sociodemographic characteristics of unique women at the 6 week postpartum visit that received a best practice advisory (BPA) alert and were screened the first time the BPA alert fired at 6 weeks postpartum visit, were screened at-risk for postpartum depression on the EPDS, were referred within 1 day of scoring at-risk on the EPDS and were treated at the women's reproductive mental health clinic within 60 days of referral, by service delivery model, October 1, 2014 – September 20, 2016.

A.

Characteristic	Co-located										Integrated									
	Patients presenting for a 6-week postpartum visit with BPA alert		Screened		EPDS At-risk*		Referrals Received		Unique Patients Treated		Patients presenting for a 6-week postpartum visit with BPA alert		Screened		EPDS At-risk*		Referrals Received		Unique Patients Treated	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	2,494	100.0	1,233	49.4	124	10.0	23	18.5	12	52.2	235	100.0	229	97.4	20	8.7	6	30.0	2	33.3
Race																				
White	1,897	76.1	972	51.2	81	8.3	15	18.5	8	53.3	174	74.0	171	98.3	11	6.4	5	45.5	2	40.0
Black / African American	346	13.9	155	44.8	30	19.4	7	23.3	4	57.1	44	18.7	41	93.2	7	17.1	1	14.3	0	0.0
Native Hawaiian / Other Pacific Islander	4	0.2	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	1	100.0	0	0.0	0	0.0	0	0.0
American Indian / Alaska Native	13	0.5	4	30.8	0	0.0	0	0.0	0	0.0	2	0.9	2	100.0	0	0.0	0	0.0	0	0.0
Asian	229	9.2	99	43.2	13	13.1	1	7.7	0	0.0	12	5.1	12	100.0	2	16.7	0	0.0	0	0.0
Unable to Obtain	5	0.2	3	60.0	0	0.0	0	0.0	0	0.0	2	0.9	2	100.0	0	0.0	0	0.0	0	0.0
Age Group (in years)																				
<20	29	1.2	8	27.6	4	1.0	2	50.0	0	0.0	4	1.7	4	100.0	2	1.0	1	50.0	0	0.0
20-24	201	8.1	96	47.8	15	15.6	3	20.0	1	33.3	22	9.4	22	100.0	2	9.1	1	50.0	0	0.0
25-29	571	22.9	287	50.3	27	9.4	9	33.3	5	55.6	76	32.3	74	97.4	7	9.5	1	14.3	1	100.0
30-34	1,006	40.3	509	50.6	37	7.3	5	13.5	2	40.0	87	37.0	85	97.7	3	3.5	1	33.3	0	0.0
35-39	559	22.4	273	48.8	35	12.8	4	11.4	4	100.0	41	17.4	39	95.1	6	15.4	2	33.3	1	50.0
40-44	118	4.7	55	46.6	5	9.1	0	0.0	0	0.0	5	2.1	5	100.0	0	0.0	0	0.0	0	0.0
45-49	8	0.3	5	62.5	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
>49	2	0.1	0	0.0	0	2.0	0	0.0	0	0.0	0	0.0	0	0.0	0	2.0	0	0.0	0	0.0

Table 9. (Continued). Sociodemographic characteristics of unique women at the 6 week postpartum visit that received a best practice advisory (BPA) alert and were screened the first time the BPA alert fired at 6 weeks postpartum visit, screened at-risk for postpartum depression on the EPDS, were referred within 1 day of scoring at-risk on the EPDS and were treated at the women's reproductive mental health clinic within 60 days of referral, by service delivery model, October 1, 2014 – September 20, 2016.

B.

Characteristic	Co-located										Integrated									
	Patients presenting for a 6-week postpartum visit with BPA alert		EPDS				Referrals		Unique Patients		Patients presenting for a 6-week postpartum visit with BPA alert		EPDS				Referrals		Unique Patients	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	2,494	100.0	1,233	49.4	124	10.0	23	18.5	12	52.2	235	100.0	229	97.4	20	8.7	6	30.0	2	33.3
Gravity**																				
0	93	3.7	43	46.2	4	9.3	2	50.0	2	100.0	14	6.0	14	100.0	3	21.4	1	33.3	0	0.0
1	969	38.9	486	50.2	47	9.7	8	17.0	4	50.0	74	31.5	71	95.9	6	8.5	3	50.0	1	33.3
2	663	26.6	319	48.1	31	9.7	8	25.8	5	62.5	66	28.1	66	100.0	4	6.1	0	0.0	0	0.0
3	392	15.7	214	54.6	24	11.2	3	12.5	0	0.0	43	18.3	42	97.7	2	4.8	0	0.0	0	0.0
4	183	7.3	89	48.6	9	3.0	1	11.1	0	0.0	27	11.5	26	96.3	3	3.0	2	66.7	1	50.0
5	80	3.2	35	43.8	2	5.7	0	0.0	0	0.0	6	2.6	5	83.3	1	20.0	0	0.0	0	0.0
≥6	57	2.3	23	40.4	3	13.0	1	33.3	1	100.0	4	1.7	4	100.0	1	25.0	0	0.0	0	0.0
Unable to obtain	57	2.3	24	42.1	4	16.7	0	0.0	0	0.0	1	0.4	1	100.0	0	0.0	0	0.0	0	0.0
Relationship Status																				
Married	2,024	81.2	1,024	50.6	87	8.5	15	17.2	8	53.3	188	80.0	184	97.9	13	7.1	4	30.8	2	50.0
Single	428	17.2	191	44.6	35	18.3	8	22.9	4	50.0	44	18.7	42	95.5	7	16.7	2	28.6	0	0.0
Divorced	9	0.4	5	55.6	1	20.0	0	0.0	0	0.0	2	0.9	2	100.0	0	0.0	0	0.0	0	0.0
Separated	9	0.4	4	44.4	0	0.0	0	0.0	0	0.0	1	0.4	1	100.0	0	0.0	0	0.0	0	0.0
Significant other	23	0.9	9	39.1	1	11.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Other	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Type of Insurance																				
Commercial	2,071	83.0	1,054	50.9	93	8.8	19	20.4	11	57.9	228	97.0	223	97.8	20	9.0	6	30.0	2	33.3
Medicaid / Medicare	384	15.4	162	42.2	29	17.9	4	13.8	1	25.0	7	3.0	6	85.7	0	0.0	0	0.0	0	0.0
Children's Health Insurance Plan (CHIP)	22	0.9	11	50.0	2	18.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Unable to obtain	17	0.7	6	35.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Notes.

Treated is defined as a patient completing an appointment at The Women's Place within 60 days of receiving a referral.

* At-risk is an EPDS score ≥ 10 and/or a response of "Yes, quite often" to question 10.

** Gravity is the total number of pregnancies.

Table 10. Referral rates and outcomes for women at-risk women of postpartum depression at the 6 week postpartum visit, comparing two service delivery models, October 1, 2014 – September 30, 2016.

Service delivery model	Referred within 1 day per protocol n (%)	Referred some other way to mental health	Total Referred n (%)	No information in EMR* or declined referral ²	Total at-risk and need referral n (%)
		care ¹ n (%)		n (%)	
Integrated	6 (30.0)	6 (30.0)	12 (60.0)	8 (40.0)	20 (100.0)
Co-located	23 (18.5)	14 (11.3)	37 (29.9)	87 (70.2)	124 (100.0)

1 Includes women that a) were established patients at the women's reproductive mental health clinic at the time of the EPDS screening at the 6-week postpartum visit, b) were referred to the women's reproductive mental health clinic before or after the 6 week postpartum visit, and c) self-reported being under the care of a mental health provider at the time of screening at the 6 week postpartum visit.

2 One (1) woman in each service delivery model is recoded in the electronic medical record as declining a referral to the women's reproductive mental health clinic.

* Electronic medical record

Table 11. Treatment rates and outcomes for women at-risk of postpartum depression at the 6 week postpartum visit that received a referral to the women's reproductive mental health clinic, comparing service delivery models, October 1, 2014 – November 30, 2016.

Service delivery model	Completed an appointment within 60 days per protocol n (%)	Completed an appointment but off protocol ¹ n (%)	Total Completing an appointment n (%)	No known completion of a visit to a mental health provider in EMR** ² n (%)	Total at-risk and referred for mental health care n (%)
Integrated	2 (33.3)	1 (16.7)	3 (50.0)	3 (50.0)	6 (100.0)
Co-located	12 (52.2)	1 (4.3)	13 (56.5)	10 (43.5)	23 (100.0)

¹ Includes women that a) were triaged to the pediatric mental health clinic due to age < 18 years (n=1, integrated), and b) declined to schedule appointment at time of initial contact by scheduling team at women's reproductive mental health clinic, but later completed an appointment (n=1, co-located)

² Includes women that a) scheduled an appointment but did not complete, b) did not return phone calls to the women's reproductive mental health clinic to schedule an appointment, and c) declined to schedule an appointment at the women's reproductive mental health clinic.

* Electronic medical record

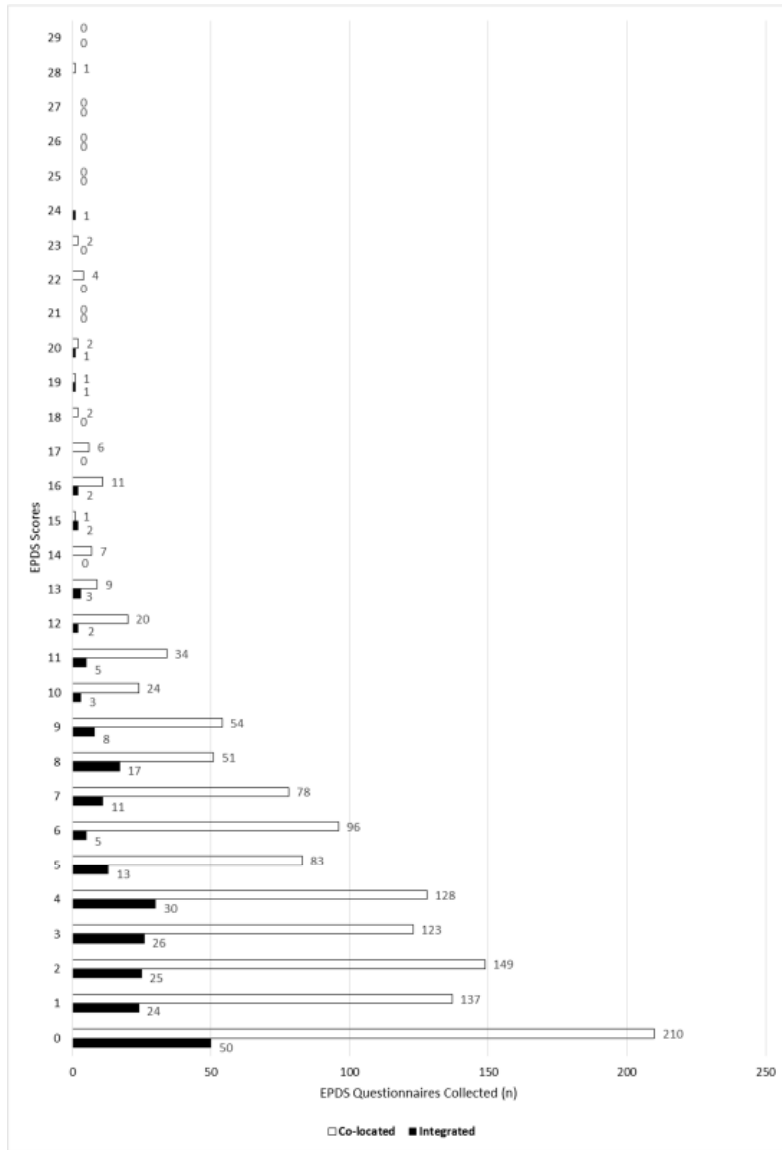


Figure 3. Distribution of EPDS scores for all women screened at 6 week the postpartum visit, comparing service delivery model.

DISCUSSION

The purpose of this study was to compare compliance with implementing universal postpartum depression screening at the 6 week postpartum visit, referral to the women's reproductive mental health clinic within 1 day for women at-risk, and follow-through with an appointment within 60 days of referral for women at-risk between co-located and integrated service delivery models. Because women's reproductive mental health services were provided in the same clinical space that women received their obstetric care in the integrated model, it was hypothesized that the integrated model would have higher compliance adhering to the prescribed protocol compared to the co-located service delivery model. In general, the outcomes of this study support this hypothesis.

Overall, the integrated service delivery model was significantly more compliant with implementing universal postpartum depression screening at the 6 week postpartum visit to identify women at-risk of postpartum depression. The integrated model also referred women at-risk for postpartum depression to treatment at the women's reproductive mental health clinic at a higher rate than the co-located model. There was not a significant difference in the percentage of women referred for treatment who completed a visit at the women's reproductive mental health clinic within 60 days between the co-located and integrated service delivery models.

There are a few considerations that may help explain the higher screening and referral rates within the integrated service delivery model. First, the close proximity of medical providers and clinical staff to the women's reproductive mental health providers may increase the likelihood of screening, referring and adhering to the prescribed protocol. With a smaller clinic and more proximate working environment, it's plausible that the clinic team

responsible for screening has more interaction and collaboration with the women's reproductive mental health provider embedded in the clinic, resulting in improved screening and referral. In addition, the lower patient volume and activity in the integrated model may result in easier adoption of the protocol when compared to the busier, higher volume clinics in the co-located model.

Though not a significant difference, women in the co-located model had a higher prevalence of at-risk compared to women in the integrated model. The geographic location of the models along with the insurance type of the population within the model may lend some explanation to the variation. The co-located model is located in the city center of Houston, Texas while the integrated model is in a suburban area. Given that populations in urban areas tend to experience more poverty, this may explain the higher proportion of at-risk women found in the co-located model in the urban core of a major metropolitan city. In addition, 25% of the women at-risk for postpartum depression in the co-located model had government funded insurance, which can be used as an indicator of income since it provides healthcare coverage based on low-income status. The high prevalence of women at-risk for postpartum depression with government funded insurance in the co-located model should be noted given that more than 50% of births in Texas are to women on Medicaid (Smith, et al., 2016). Given the well-documented potential long-term effects that postpartum depression has on the child, and the high risk of postpartum depression among women with government funded insurance, getting this population of women into care should be a focus because of its potential to positively impact a significant segment of the population in Texas for generations to come (Bernard-Bonnin, 2004).

While referral rates were higher in the integrated model, reasons that every at-risk woman is not referred should more thoroughly explored in further research. Some potential reasons that all at-risk women were not referred should be considered. Potential reasons include: some at-risk women may have refused a referral because they have a mental health provider they are already seeing as demonstrated by one patient in the co-located model through chart review, inability to afford the additional cost of mental health care, refusal of treatment due to stigma associated with seeking treatment for mental health, lack of interest in seeking treatment and / or delaying a referral until later. Considering the operational flow of a practice, it is also possible that some women that screened at-risk at the six week postpartum visit were not offered a referral to the women's mental health clinic. Another plausible explanation may be that the women's reproductive mental health provider that is embedded in the integrated model may initiate treatment at the time of screening, bypassing the referral process within the protocol and negating the ability to track in the electronic medical record.

Sociodemographic characteristics did not change the strength of the association between service delivery model and getting screened for postpartum depression at a 6 week postpartum visit, scoring at-risk on the EPDS or for getting treatment within 60 days of referral. One challenge of this study was small sample sizes as the protocol progressed and women fell out of the sample. Small sample sizes can affect confounding, creating instability and making it difficult to draw conclusions about a population. Age was considered a potential confounder for being referred to the women's reproductive mental health clinic; however, it is difficult to draw conclusions given the small cell values.

Though this study aimed to evaluate the prescribed universal screening protocol implemented in two service delivery models, chart review findings demonstrated that women at-risk of postpartum depression were getting referred and treated off protocol. These findings demonstrate that implementing such a prescribed protocol into clinical practice may have additional benefits to women at risk of postpartum depression, outside of the specified time frames within the protocol. Based on the data, strict definitions within the protocol and small numbers, rates of treatment appear to be higher in the co-located model; yet, when evaluating all outcomes including what occurred off protocol using available information in the electronic medical record, it appears that the integrated model may have been equally successful at getting women into care for postpartum depression. In the co-located model, there was a significant lack of available data in the electronic medical record.

Compared to previous studies that evaluated getting women at-risk for postpartum depression into treatment, when considering the combined outcomes of the protocol and off-protocol experiences, the integrated and co-located service delivery models got more women into care. Rowan et al. (2012) reported that 17.9% (N=28) of women screened and referred for postpartum depression sought treatment, while Horowitz and Cousins (2006) reported that 12.0% (N=122). This study found that 50.0% (N=6) and 56.5% (N=23) of women at risk for postpartum depression that were referred followed through with treatment.

Limitations

The Women's Mental Health DSRIP project, the basis for this study, was developed as a quality improvement initiative to increase screening for postpartum depression among obstetric providers and to improve access to women's reproductive mental health services

and not designed as a research study. For this reason, several limitations should be considered.

First, the electronic medical record (EMR) used to capture patient-level data for the healthcare system does not track any mental health related treatment that occurs outside of the health system. Anything documented about a patient's mental health care outside of the system is self-reported and entered into the EMR as free text which must be extracted by chart review; therefore, only referrals from internal obstetric providers to the internal women's reproductive mental health providers were included for all study subjects. Any referrals to external mental health providers were not captured in a discrete field within the EMR and were not considered in this study. In addition, patients that screened at-risk on the EPDS and were offered a referral to the internal women's reproductive mental health clinic may have refused an internal referral for reasons unknown and which were not considered in this study (e.g., patient has an established mental health provider, patient does not want to seek treatment at the time referral is offered, etc.). If any such patient(s) existed, they were categorized (erroneously) as not following through with treatment.

Second, there were large differences in clinic staffing and operational volumes between the two service delivery models. Since only one clinic was included in the integrated service delivery model, compared to three clinics in the co-located model, variation likely exists between the three clinics included in the co-located model which was not accounted for in this study.

Third, outcomes for screening, at-risk for postpartum depression, referral within 1 day and treatment within 60 days *during pregnancy* are not taken into account in this study, only the postpartum period. Because the training protocol also included screening during the first

and third trimesters of pregnancy, women may have been screened for depression during pregnancy and refused the EPDS at the 6-week visit for a variety of reasons, including that they accepted a referral and sought treatment earlier in their pregnancy episode. These possible outcomes are not accounted for collectively in this study and were only evaluated for women at-risk.

Fourth, only the first two years of data post-training are included which does not allow for large sample sizes in the at-risk, referral and treatment categories, particularly for the integrated service delivery model. Ramp-up time for staff to fully adopt the new process into clinical flow was included and may have led to erroneously excluding patients that were referred. For example, prior to implementing this universal screening protocol, obstetric clinic staff would call, send an internal instant message, or walk a patient to the women's reproductive mental health clinic, all of which were methods of referral. It is possible that some women scoring at-risk on the EPDS at the 6 week postpartum visit were referred via phone, instant message, or walked over, especially during the initial time period after training which was included in this study. Excluding a few of the initial months after implementation and adding more years of data would increase the sample size of the patient population that was screened, which would lead to increases in the data set to include more patients that fall into the at-risk, referral and treatment groups, allowing for more stable and accurate conclusions.

Fifth, data on the volume of postpartum patients that should have been screened is subject to error. Postpartum patients that should have been screened (patients presenting for a 6-week postpartum visit in Table 9), is based on a best practice advisory (BPA) alert that signals clinical staff to screen the patient for postpartum depression using the EPDS at the 6

week postpartum visit. The BPA alert is driven by the gestational age data field in the electronic medical record, which is entered into the patient's electronic medical record by the obstetric provider during the first prenatal visit. If this field is not updated based on the patient's true pregnancy episode experience (i.e., fetal demise, preterm birth, etc.), it is possible that the number of postpartum patients that should have been screened is inaccurate.

Future Research

Additional research on service delivery models and their impact on getting women at-risk of depression into treatment should be considered. The potential to design healthcare that delivers improved outcomes for women, infants, children and their families has the potential to positively impact population health.

Since the training protocol included screening women for depression during pregnancy, future research should evaluate universal screening, at-risk, referral and follow-through with treatment during pregnancy, which may provide further insight into the outcomes found in this study that isolated the 6 week postpartum period. Outcomes from the pregnancy period may have an impact on postpartum screening, referral and treatment outcomes since, in theory, the same patients should have experienced the screening process twice while pregnant.

Next, future research should measure outcomes for all women that were screened (pregnant and postpartum), referred and treated. Although providers and staff at the 4 obstetric clinics were trained to follow a protocol with prescribed timing intervals at which to screen, there are likely quantifiable outcomes associated with getting women into treatment by introducing and educating women on maternal depression and introducing the EPDS tool at visits, which was not completely analyzed in this study. Instead of matching patients

across the continuum, analyzing the data so that all outcomes are considered, regardless of when the patient was screened, may yield different results. Information from the chart review demonstrated that that women are screened and referred, or simply referred to the women's reproductive mental health clinic outside of the prescribed timing intervals in the protocol.

There was stark variation between staffing and operational characteristics of the co-located and integrated models. Even within the co-located model, there were 3 obstetric clinics that exhibit variation. For future comparison of service delivery models, including only one obstetric clinic in the co-located model may result in a more equitable comparison. In addition, matching on clinic type, for example using one academic clinic in each model, may help to control for factors across both models.

Last, comparing differences in screening and referral rates by level of provider, nursing staff and clinical staff should be evaluated. The role of the person that introduces the EPDS to the woman being screened may influence whether or not she completes the screening tool. For this protocol, a nurse or medical assistant was trained to introduce the EPDS to the women being screened and the provider would offer a referral to women at-risk.

Future Program Design

Though outcomes revealed a significant difference between the co-located and integrated service delivery models for screening, there was not a significant difference in the prevalence of women scoring at-risk for postpartum depression at the 6 week visit, referral or follow-through with treatment between service delivery models. Given that women were at-risk in both service delivery models that did not receive a referral or get treatment, using qualitative methods to observe clinic staff screening women, providers offering a referral and

interviewing or conducting focus groups to learn from their experiences may be insightful to aid in improving the process and future program design.

In addition, exploring additional methods to deliver treatment that meets women where they are is suggested. When designing the service delivery models, the project team hypothesized that the integrated model would reduce stigma associated with seeking mental health treatment and result in a higher rate of at-risk women being treated. The integrated model was designed so that the psychiatrist shared the same clinical space where women received their routine obstetric care throughout their pregnancy episode. We hypothesized that the patients' familiarity with clinic - the same clinic space, waiting room, check-in/out staff, rooming staff, seeing the psychiatrist working in the clinic - would reduce stigma and increase referrals and follow-through with treatment. For both service delivery models, instead of having new mothers return to the clinic on a different day for an appointment with a provider at the women's reproductive mental health clinic, women scoring at-risk could 1) see a women's reproductive mental health provider for a brief evaluation before leaving the appointment at which they screen at-risk to establish a patient-provider relationship, and/or 2) have an option for a telemedicine visit scheduled at their convenience from any location, including the comfort of their home. Telemedicine may be an option that facilitates more follow-through with treatment, especially for new mothers that are healing and adjusting to motherhood.

Lastly, future continuous improvement for the program should include improving data capture at each step of the protocol, with a focus on accurately identifying women that should be screened at the 6 week postpartum visit. When comparing the volume of BPA alerts signaled at the 6 week postpartum visit used in this study (Table 9) to the volume of

postpartum visits completed and deliveries from the operational data (Table 3), it is clear that there is a large discrepancy and likely an error with the BPA alert data. The BPA alert algorithm should be reassessed, corrected to signal staff at the correct screening time period, tested and once verified with reference to the medical record, the last step should be to correct and re-test the algorithm for accuracy with the medical record data. Alternatively, instead of relying on the BPA alert to signal based on an algorithm, using the visit type “postpartum” to train staff when to screen women for postpartum depression may yield improved and more accurate screening.

CONCLUSION

This study evaluated differences in implementing a universal postpartum depression screening protocol within two service delivery models – co-located and integrated – to determine if one design was superior at getting women at-risk for postpartum depression into treatment. There was not a significant difference in getting women into treatment between the two service delivery models; however, when considering outcomes of the protocol and off protocol findings, the rate of women getting into treatment is higher in both models compared to what has been reported in the literature (Rowan P. , Greisinger, Brehm, Smith, & McReynolds, 2012) (Horowitz & Cousins, 2006).

APPENDICES

Appendix A. Edinburgh Postnatal Depression Scale

Name:
Date:
Address:
Baby's Age:

As you have recently had a baby, we would like to know how you are feeling. Please UNDERLINE the answer which comes closest to how you have felt IN THE PAST 7 DAYS, not just how you feel today.

Here is an example, already completed.

I have felt happy:
Yes, all the time
Yes, most of the time
No, not very often
No, not at all

This would mean "I have felt happy most of the time" during the past week. Please complete the other questions in the same way.

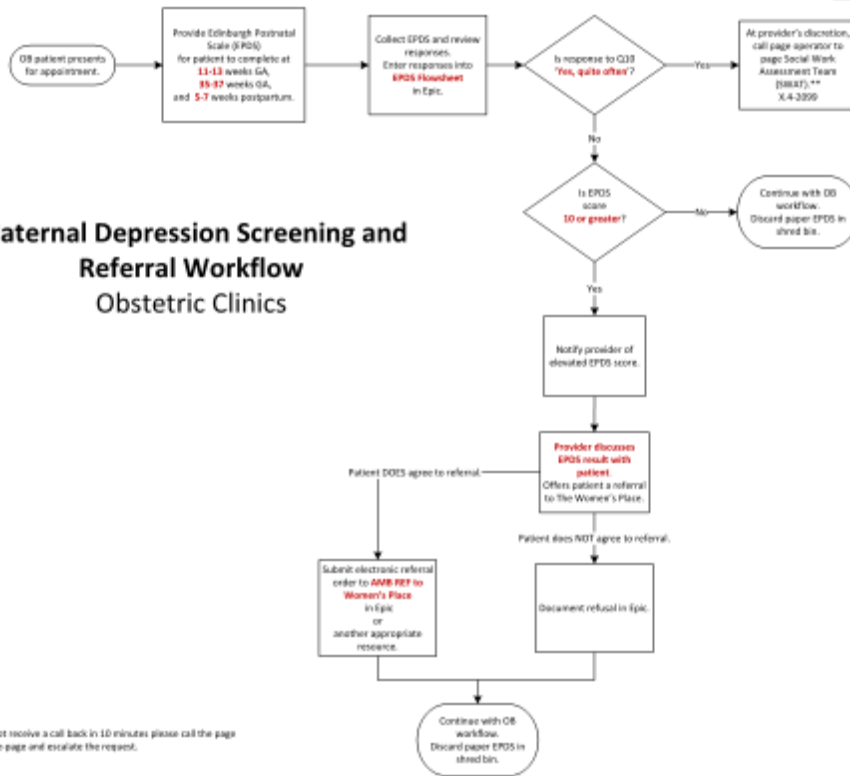
In the past 7 days:

- | | |
|---|--|
| 1. I have been able to laugh and see the funny side of things
As much as I always could
Not quite so much now
Definitely not so much now
Not at all | *6. Things have been getting on top of me
Yes, most of the time I haven't been able to cope at all
Yes, sometimes I haven't been coping as well as usual
No, most of the time I have coped quite well
No, have been coping as well as ever |
| 2. I have looked forward with enjoyment to things
As much as I ever did
Rather less than I used to
Definitely less than I used to
Hardly at all | *7. I have been so unhappy that I have had difficulty sleeping
Yes, most of the time
Yes, sometimes
Not very often
No, not at all |
| *3. I have blamed myself unnecessarily when things went wrong
Yes, most of the time
Yes, some of the time
Not very often
No, never | *8. I have felt sad or miserable
Yes, most of the time
Yes, quite often
Not very often
No, not at all |
| 4. I have been anxious or worried for no good reason
No, not at all
Hardly ever
Yes, sometimes
Yes, very often | *9. I have been so unhappy that I have been crying
Yes, most of the time
Yes, quite often
Only occasionally
No, never |
| *5. I have felt scared or panicky for no very good reason
Yes, quite a lot
Yes, sometimes
No, not much
No, not at all | *10. The thought of harming myself has occurred to me
Yes, quite often
Sometimes
Hardly ever
Never |

EDINBURGH POSTNATAL DEPRESSION SCALE (EPDS)
J. L. Cox, J. M. Holden, & Sagovsky
From: *British Journal of Psychiatry* (1987), 150, 782-786.

Appendix B. Screening and Referral Process Map for Obstetric Clinics

**Maternal Depression Screening and Referral Workflow
Obstetric Clinics**



**If you do not receive a call back in 10 minutes please call the page operator to re-page and escalate the request.
10/2014

Appendix C. Results from published literature on outcomes from screening for postpartum depression (Exposure A: Sit & Wisner, 2009; Exposure B: LaRocco-Cockburn, et al., 2013).

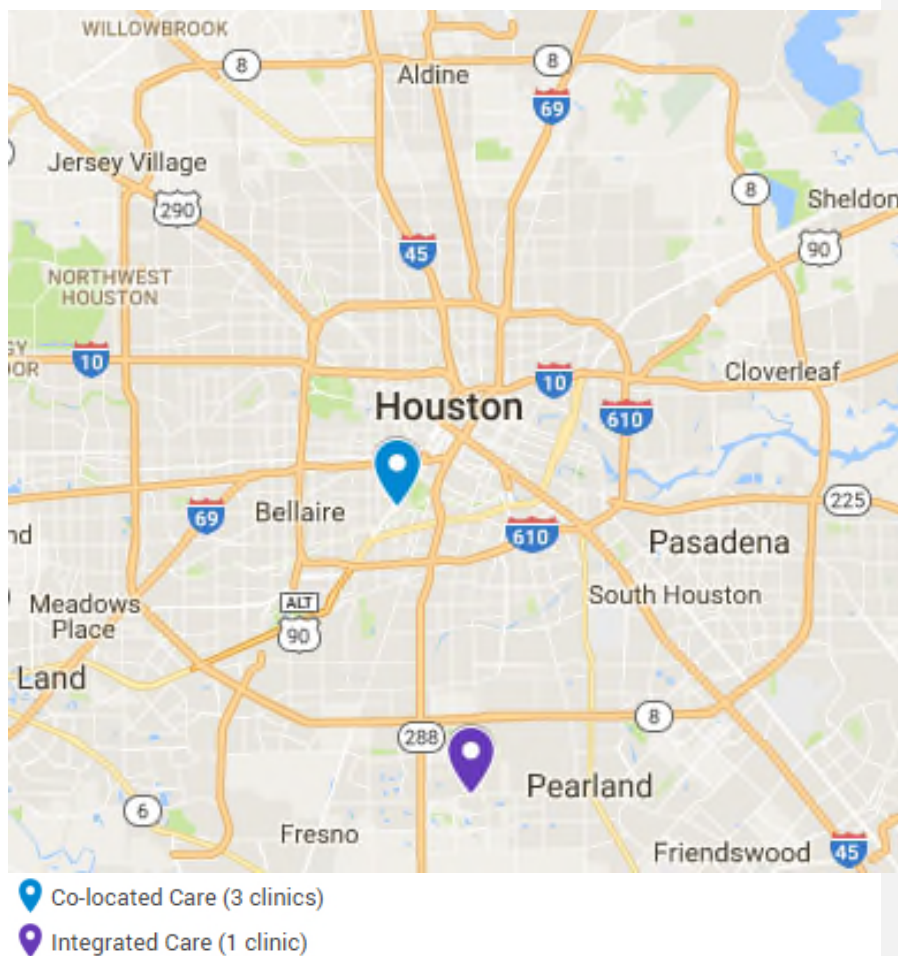
Exposure	Time of Screening	Screening		Positive Screens		Treatment Rates	
		N	%	N	%	N	%
A	Postnatal	-	-	29	-	16	55.2
B	Postnatal	-	-	102	-	91	89.2

Appendix D. Screenshot of sample size calculation from nQuery.

The screenshot shows the nQuery Advisor interface with a table of results for a two-group continuity corrected χ^2 test of equal proportions (odds ratio = 1) (equal n's). The table has four columns: a label column and three numerical columns labeled 1, 2, and 3. The rows include test parameters, proportions, odds ratio, power, and sample size per group.

Two group continuity corrected χ^2 test of equal proportions (odds ratio = 1) (equal n's)			
	1	2	3
Test significance level, α	0.050	0.050	0.050
1 or 2 sided test?	2	2	2
Group 1 proportion, π_1	0.179	0.179	0.552
Group 2 proportion, π_2	0.552	0.892	0.892
Odds ratio, $\psi = \pi_2 (1 - \pi_1) / [\pi_1 (1 - \pi_2)]$	5.651	37.882	6.703
Power (%)	80	80	80
n per group	31	9	32

Appendix E. Map of trained obstetric clinics and women's reproductive mental health services by location and service delivery model type.



Appendix F. Stacking diagram of co-located service delivery model and floor plan for integrated service delivery model.

Co-located Service Delivery Model:

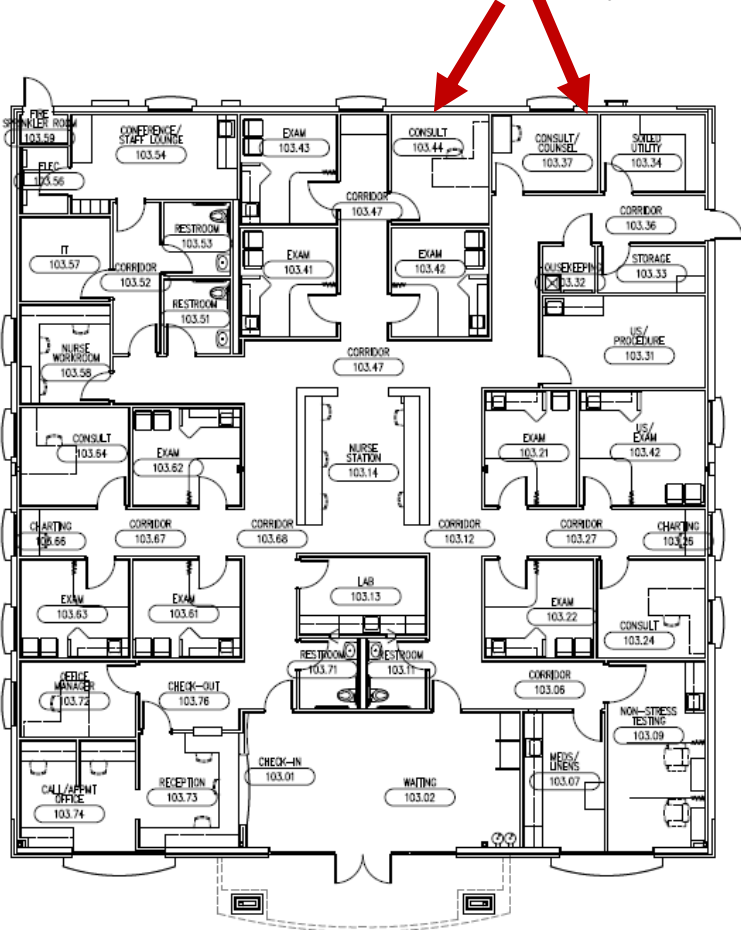
Single building (15 floors) with 3 outpatient obstetric clinics that are co-located with a women’s reproductive mental health clinic.

		Floor
Obstetric Clinic C		15
		14
		13
		12
		11
		10
		9
Obstetric Clinic B		8
		7
		6
		5
		4
Obstetric Clinic A	Mental Health Clinic	3
		2
		1

Integrated Service Delivery Model:

Single outpatient obstetric clinic (1 floor) with a women's reproductive mental health clinic in the same clinical space as obstetric care.

Women's reproductive mental health services provided in 2 consult rooms that are adjacent



Appendix H. Detailed information on referral rates and outcomes for women at-risk of postpartum depression at the 6 week postpartum visit, comparing service delivery models, October 1, 2014 – September 30, 2016.

Service Delivery Model	At-risk of Postpartum Depression		Outcome
	n	%	
Integrated	20	100	
	14	70.0	Did not have an order to the women's mental health clinic in Epic within 1 day of scoring at-risk on the EPDS
	7	35.0	No additional evidence in Epic
	4	20.0	Established patient prior to scoring at risk on the EPDS
	2	10.0	Referred prior to scoring at risk on the EPDS
	1	5.0	Declined a referral
	6	30.0	Had an order to the women's reproductive mental health clinic in Epic within 1 day of scoring at-risk on the EPDS
Co-located	124	100	
	101	81.5	Did not have an order to the women's mental health clinic in Epic within 1 day of scoring at-risk on the EPDS
	84	67.7	No additional evidence in Epic
	6	4.8	Referred prior to scoring at risk on the EPDS
	5	4.0	Established patient prior to scoring at risk on the EPDS
	2	1.6	Referred more than 1 day after scoring at risk on the EPDS
	2	1.6	Provided information on the clinic and available services
	1	0.8	Under psychiatric care of an outside psychiatrist
	1	0.8	Declined a referral
	23	18.5	Had an order to the women's reproductive mental health clinic in Epic within 1 day of scoring at-risk on the EPDS

Appendix I. Detailed information on treatment rates and outcomes for women at-risk of postpartum depression at the 6 week postpartum visit, comparing service delivery models, October 1, 2014 – September 30, 2016.

Service Delivery Model	At-risk of postpartum depression and referred		Outcome
	n	%	
Integrated	6	100	
	4	66.7	Did not complete an appointment at the women's reproductive mental health clinic within 60 days of the order date
	2	33.3	Scheduled an appointment, but did not complete an appointment
	1	16.7	Triaged to pediatric mental health clinic due to age < 18 years and completed an appointment within 60 days of the order date
	1	16.7	Did not return call to schedule an appointment
	2	33.3	Completed an appointment at the women's reproductive mental health clinic within 60 days of the order date
Co-located	23	100	
	11	47.8	Did not complete an appointment at the women's reproductive mental health clinic within 60 days of the order date
	4	17.4	Declined to schedule
	3	13.0	Scheduled an appointment, but did not complete an appointment
	3	13.0	Did not return the call to schedule an appointment
	1	4.3	Declined to schedule an appointment during initial contact by scheduling team, but completed an appointment at a later date beyond 60 days from order date
	12	52.2	Completed an appointment at the women's reproductive mental health clinic within 60 days of the order date

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