Breastfeeding initiation, duration and exclusivity in New York State: impact of hospital maternity care practices, hospital characteristics and individual/socio-demographic factors

Eileen Mary Fitzpatrick
University at Albany, State University of New York, fitzpe@sage.edu

The University at Albany community has made this article openly available. Please share how this access benefits you.

Follow this and additional works at: https://scholarsarchive.library.albany.edu/legacy-etd

Part of the Public Health Commons

Recommended Citation

This Dissertation is brought to you for free and open access by the The Graduate School at Scholars Archive. It has been accepted for inclusion in Legacy Theses & Dissertations (2009 - 2024) by an authorized administrator of Scholars Archive. Please see Terms of Use. For more information, please contact scholarsarchive@albany.edu.
BREASTFEEDING INITIATION, DURATION AND EXCLUSIVITY IN NEW YORK STATE: IMPACT OF HOSPITAL MATERNITY CARE PRACTICES, HOSPITAL CHARACTERISTICS AND INDIVIDUAL/SOCIO-DEMOGRAPHIC FACTORS

By

Eileen M. FitzPatrick

A Dissertation submitted to the University of Albany, State University of New York
In Partial fulfillment of the Requirements for the Degree of
Doctor of Public Health

School of Public Health
Department of Epidemiology and Biostatistics

2015
Abstract

Prevalence of breastfeeding initiation in New York State (NYS) nearly meets Healthy People 2020 goals. Improvements in breastfeeding duration and exclusive breastfeeding (EBF) have lagged behind those achieved for initiation. Implementation of Ten Steps to Successful Breastfeeding in hospital maternity care has improved breastfeeding initiation, duration and exclusivity; but data on the independent association with specific Steps have been equivocal. Utilizing NYS-linked data from the Maternity Practices in Infant Nutrition and Care (mPINC) and the Pregnancy Risk Assessment Monitoring System (PRAMS), the associations of individual maternity care practices/Steps with breastfeeding behaviors were evaluated. Analyses included mothers who participated in PRAMS and gave birth to a healthy infant in a NYS hospital that participated in mPINC in 2007. The weighted sample represented 116,198 new mothers, 15.9% of whom did not initiate breastfeeding. For mothers who initiated breastfeeding, 75% breastfed for eight weeks or longer and 36.8% breastfed exclusively eight weeks or longer. Mothers giving birth in a hospital reporting incomplete achievement of Step 7 ‘practice rooming-in’ had twice the odds (AOR=2.14 (95% CI:1.19,3.88 ) of not initiating breastfeeding, after adjustment for maternal demographic and hospital characteristics. Mothers who gave birth in a hospital that reported achieving Step 5 ‘Show mothers’ how to breastfeed’ had a RR=1.77 (95% CI: 1.42-2.20) for EBF eight weeks or longer, after adjustment for maternal demographic and hospital characteristics. Mothers at hospitals fully implementing Step 5 were 50% more likely to breastfeed for at least 2 months (RR=1.54, 95% CI: 1.18-2.02). No other separate maternity care practices/Steps were significantly associated with these breastfeeding outcomes. Full implementation of ‘rooming-in’ by
hospitals serving populations at higher risk for non-initiation may reduce disparities in breastfeeding initiation. Among women who initiate breastfeeding, levels of EBF and recommended duration are substantially below 50%. Ensuring mothers are shown how to breastfeed by trained providers during their hospital stay is especially warranted since Step 5 predicted EBF and duration. The socio-ecological model of breastfeeding suggests the importance of other maternity care practices/Steps may be revealed by analyses of interactions representing interdependent influences on breastfeeding decisions.
Overview

Breastfeeding, especially exclusive breastfeeding (EBF), is the optimal feeding method for infant growth and development. Breastfeeding reduces risk of infectious disease in infancy as well as reducing the risk of chronic diseases, including obesity, later in life. The American Academy of Pediatrics, The American Congress of Obstetrics and Gynecologists, American Academy of Family Physicians, the World Health Organization (WHO) and the US Department of Health and Human Services all recommend exclusive breastfeeding during the first six months of life.2-6

Protection, promotion, and support of breastfeeding are important public health goals.7 Healthy People 20108 and 20209 targets for breastfeeding are listed below.

<table>
<thead>
<tr>
<th>Measure</th>
<th>HP2010</th>
<th>HP2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early postpartum</td>
<td>75%</td>
<td>81.9%</td>
</tr>
<tr>
<td>At 6 months</td>
<td>50%</td>
<td>60.6%</td>
</tr>
<tr>
<td>At 12 months</td>
<td>25%</td>
<td>34.1%</td>
</tr>
<tr>
<td>Exclusively through 3 months</td>
<td>40%</td>
<td>46.2%</td>
</tr>
<tr>
<td>Exclusively through 6 months</td>
<td>17%</td>
<td>25.5%</td>
</tr>
<tr>
<td>Formula supplementation</td>
<td>--------</td>
<td>14.2%</td>
</tr>
</tbody>
</table>

In New York State (NYS), breastfeeding initiation for the 2011 birth cohort is close to meeting the Healthy People 2020 goal of 81.9%.10 For NYS birth cohorts 2007, 2008, 2009, 2010, 2011 the prevalence was, 81.4, 78.2, 80.8, 82.6, and 80.5 percent respectively.10 Breastfeeding duration measured at 6 and 12 months for the 2011 NYS birth cohort was 55.8 and 31.3 percent respectively.10 This has improved since the 2007
birth cohort which was 47.4 and 24.9 percent respectively.\textsuperscript{10} For breastfeeding exclusivity, prevalence in the US is generally low. In NYS, the birth cohorts 2007, 2008, 2009, 2010, 2011 had prevalence of EBF at three months of age of 32.0, 32.7, 34.0, 32.8, 37.0 percent, respectively.\textsuperscript{10} Although NYS meets the \textit{Healthy People 2020} goals for breastfeeding initiation, numbers for duration and exclusivity fall below the goals. Because the benefits from breastfeeding are dose dependent\textsuperscript{11} the low levels of breastfeeding duration and exclusivity in NYS are of public health concern. Closely associated with exclusive breastfeeding is the supplementation with formula of breastfed infants prior to two days of age. For births in 2006, the prevalence of formula supplementation of breastfeeding infants prior to 2 days of age, was 38.3 percent for NYS.\textsuperscript{10} This level of formula supplementation of breastfed infants at 2 days was one of the highest for any state in the US. For 2007 births in NYS, there was some improvement with a prevalence of 33.2 percent.\textsuperscript{10} The most recent data available is for 2011 births, and 28.8 percent of NYS breastfed infants were supplemented with formula prior to two days of age.\textsuperscript{10}

Determinants of breastfeeding behavior are multi-faceted. Breastfeeding initiation, duration, and exclusivity are the result of socio-demographic, individual, and environmental influences. Socio-demographic factors have been estimated to account for 25-30\% of variation in breastfeeding initiation and duration,\textsuperscript{12} and up to 60\% of variation in exclusive breastfeeding at hospital discharge.\textsuperscript{13} The remaining variation is due to environmental factors which include institutional and public support for breastfeeding. Numerous studies have shown that hospital maternity practices are an important environmental exposure associated with breastfeeding initiation, duration, and
Hospital maternity practices that encourage and support breastfeeding are outlined in the *Ten Steps to Successful Breastfeeding* (Table 1), the basis for the *Baby Friendly Hospital Initiative* developed by the United Nations Children’s Fund (UNICEF)/WHO. Hospital maternity practices inconsistent with the *Ten Steps* have been shown to be detrimental to breastfeeding.

The CDC conducted the National Survey of Maternity Practices in Infant Nutrition and Care (mPINC) in 2007 to evaluate the degree to which maternity hospital practices are aligned with the *Ten Steps* and therefore the extent to which they are supportive of breastfeeding. These data have been made available to individual states.

This study is designed to identify factors that may impact the extent to which maternity hospital practices in NYS are consistent with the *Ten Steps*. To achieve this, the hypothesis below will be tested.

**Hypothesis I:** Hospital maternity service practices in NYS are not associated with hospital characteristics such as total number of births, Cesarean section rate, geographic location (Health Services Area (HSA)) or payer mix (proportion of public versus private insurance coverage).

Secondly, this study will identify the degree to which maternity hospital practices in NYS impact breastfeeding initiation, duration, and exclusivity, while also accounting for maternal socio-demographic variables. By using NYS mPINC data to determine hospital maternity practices, and using NYS Pregnancy Risk Assessment and Monitoring System (PRAMS) data from 2007 to obtain maternal socio-demographic variables, the
independent effects of both categories on breastfeeding behavior will be determined. Specifically, the hypothesis to be tested is as follows:

**Hypothesis II:** Among women giving birth, levels of breastfeeding initiation, duration, and exclusivity, are increased when hospital maternity service practices are consistent with the *Ten Steps to Successful Breastfeeding.*

**Literature Review: Determinants and Outcomes of Breastfeeding Behavior**

**Introduction**

Human milk is accepted as the best source of nutrition for infants. Breastfeeding can provide health and psychological benefits for both mother and baby. Breastfed infants have lower morbidity and mortality from infectious disease and are likely to be protected from certain chronic diseases as the result of persistence of breast milk effects into older childhood and adulthood. The majority of women (79.2%) in the United States (US) attempt breastfeeding immediately postpartum, defined as initiation of breastfeeding. However, duration of breastfeeding, indicating the length of time an infant is breastfed, typically does not meet the public health goal of one year. In addition, breastfeeding exclusivity, or feeding breast milk only, is at suboptimal levels in the US. Breastfeeding exclusivity, for the recommended six months is associated with the greatest health benefits. Determinants of initiation, duration and exclusivity of breastfeeding behavior are multi-faceted and include demographic, individual, and social/environmental factors.
Impact of breastfeeding on health

Breastfeeding decreases the risk of childhood morbidity, due to the immunological and other bioactive components found in human milk. Breastfed infants have lower rates of infectious diseases, such as otitis media. Those breastfed for six months have lower rates of respiratory illness, gastroenteritis, and fewer cases of necrotizing enterocolitis. The protective effect of breast milk has been shown to be dose dependent as increasing levels of exclusivity and duration of breastfeeding result in increased protection from infectious disease. Additionally, the protection from infectious disease provided by breastfeeding has been shown to persist into later childhood. Li et al., reported significant decreases in risk of ear (31%), throat (32%) and sinus (53%) infections, at age six for those children breastfed nine months or longer.

There is also evidence indicating that breastfeeding is associated with decreased postnatal death. Debes et al, reported that early initiation of breastfeeding reduced risk of infection related neonatal mortality by 45%. Other reductions in postnatal death for breastfed infants is likely due to a decrease in Sudden Infant Death Syndrome (SIDS). SIDS is the 4th leading cause of infant death in the US. There is biological support for the protective effect of breastfeeding on SIDS. Decreased arousability is associated with SIDS and breastfed babies have greater arousability when compared to formula fed babies, at 2-3 months of age, the peak time for SIDS deaths. In a case control study, breastfeeding reduced SIDS deaths by 50% with exclusive breastfeeding showing the greatest reduction. Additionally, a meta-analysis by Hauk et al., reported reduction of 73% in SIDS for those infants exclusively breastfed for any duration. In 2011 the American Academy of Pediatrics published a statement recommending breastfeeding as
one of the components of comprehensive SIDS prevention. Those recommendations also included not bed sharing with infants for prevention of SIDS. Since higher levels of bed sharing are associated with increased breastfeeding, some researchers have voiced concerns regarding the potential negative impact on breastfeeding if this recommendation is not communicated appropriately.

Breastfeeding is also protective against certain chronic diseases, which includes asthma, atopic dermatitis, type 1 and type 2 diabetes, and childhood leukemia. An inverse relationship between asthma and breastfeeding has been reported. Results of a meta-analysis demonstrated a 22% decreased odds of ever having asthma for those breastfed compared to those never breastfed. Also for prevention of atopic disease, the American Academy of Pediatrics, Section on Allergy and Immunology in their review, concluded that for those infants at elevated risk for disease, exclusive breastfeeding for at least 4 months significantly reduced occurrence of atopic disease when compared to formula fed infants. Diabetes is another disease impacted by breastfeeding and according to multiple reviews, breastfeeding reduces incidence of both type 1 and type 2 diabetes mellitus. Owen et al. reported a 39% reduced risk of type 2 diabetes for those breast fed compared to those exclusively formula fed.

Childhood obesity has also been shown to be related to infant feeding. For infants predominantly fed formula, obesity at age 2 was 2.5 times greater than infants fed only breast milk. Mode of delivery is important since bottle feeding has been shown to be related to rapid weight gain compared to infants fed at the breast. When formula fed infants with other risk factors for obesity, such as maternal obesity, maternal smoking during pregnancy and excess gestational weight gain were reported to show more rapidly
increasing weight patterns than breastfed infants.\textsuperscript{54,55} Unhealthy feeding habits, which includes bottle feeding formula, early introduction of solid food (by 4 months)\textsuperscript{52} and provision of sugar-sweetened beverages\textsuperscript{56} cluster among low socioeconomic parents and contribute to higher levels of obesity in those populations.\textsuperscript{52} In early work in this area, Grummer-Strawn and Mei, reported that among young children from low-income families, the protective effect of breastfeeding on obesity was strongest among non-Hispanic whites, and dependent on breastfeeding dose.\textsuperscript{57} The protective effect remains for older children and adolescents.\textsuperscript{58,59} In a large meta-analysis, which evaluated studies from 12 developed countries including the US, breastfeeding was associated with a significantly reduced risk of obesity in children (AOR = 0.78; 95% CI: 0.74, 0.81) for children ranging from 1-18 years old. A US study, evaluated sibling pairs in late childhood and early adolescence who had been fed differentially, one formula fed and one breastfed.\textsuperscript{60} Findings of this study demonstrated significantly higher BMIs in the overweight and obese categories for those who were formula fed.\textsuperscript{60} In contrast to this evidence, in a controlled trial in Belarus, despite breastfeeding promotion utilizing the Baby Friendly Hospital Initiative that improved breastfeeding exclusivity and duration, measures of overweight and obesity for children born during the trial, were not affected.\textsuperscript{61} The degree to which breastfeeding reduces overweight/obesity is likely small but significant and associated with other socio-demographic factors.

Quantification of the healthcare costs associated with not breastfeeding was completed by Bartick and Reinhold.\textsuperscript{62} The authors included, otitis media, gastroenteritis, hospitalization for lower respiratory tract infections, atopic dermatitis, sudden infant death syndrome, childhood asthma, childhood leukemia, type 1 diabetes mellitus and
childhood obesity in their cost estimates. Up to $13 billion health care dollars and 911 deaths could be avoided if 90% of American mothers breastfed exclusively for 6 months.\textsuperscript{62}

Another f health issue impacted by infant feeding is cognitive development. The developmental advantages such as small increases in cognitive and intelligence measures (e.g. Intelligence Quotient (IQ)), may be a consequence of breastfeeding. In a Polish study following children for seven years, those children exclusively breastfed for more than six months, had mean IQ scores that were 3.8 points higher than those formula fed.\textsuperscript{63} Results from the large Promotion of Breastfeeding Intervention Trial (PROBIT) in Belarus, with follow up to age 6.5 years of age, demonstrated a 5-7 point increase in intelligence measures.\textsuperscript{64} Also, in a large British study of white children breastfeeding duration was reported to be associated with higher cognitive ability compared to formula fed, and this effect was greater for preterm infants than term.\textsuperscript{65} Belfort et al. reported increased breastfeeding exclusivity and duration resulted in higher cognitive scores measured at age 3 and 7.\textsuperscript{66} Interestingly, this effect also seemed to be positively associated with maternal fish intake. Recently however a large US cohort study reported neither breastfeeding exclusivity or duration was associated with cognitive or motor skills at age 2 or 4.\textsuperscript{67} Although the majority of observational studies report an association between breastfeeding and improved cognitive performance, appropriately controlling for potential confounders has been a persistent concern.

There are also consequences of breastfeeding for maternal health. Postpartum bleeding is reduced due to enhanced uterine contractions associated with breastfeeding.\textsuperscript{68} Risk of breast and ovarian cancers have been shown to be reduced due to breastfeeding.\textsuperscript{1}
Lactation also reduces risk of type 2 diabetes. Women who formula fed their infants were significantly more likely to develop type 2 diabetes than those that exclusively breastfed for 1-3 months (OR=1.52, 95% CI: 1.11, 2.10). For women who experienced gestational diabetes during pregnancy, breastfeeding resulted in improved glucose tolerance and insulin levels. If the associations between breastfeeding and maternal health are causal, suboptimal breastfeeding potentially costs $17.4 billion in healthcare, loss of productivity and premature death.

Breastfeeding and maternal weight has also been a productive area of research. Return to pre-partum weight may be enhanced by breastfeeding. Sharma et al., report that obese women who breastfed retained significantly less weight than obese women who never breastfed. Additionally in African Americans, pre-pregnancy BMI appears to modify the impact of breastfeeding on postpartum weight, with those of normal weight, increased breastfeeding duration results in less weight gain postpartum whereas for those obese mothers’ breastfeeding duration resulted in greater weight gain.

**Determinants of breastfeeding behavior**

**Demographic Determinants**

Factors determining breastfeeding rates are demographic, individual, and social/environmental. Important demographic factors include maternal age, race, education, and income. Based on NHANES (1999-2006) data, breastfeeding rates have been shown to “increase significantly with increasing maternal age overall and for all race-ethnicity groups.” The breastfeeding rate of mothers under the age of 20 is 43%, for mothers 20-29, 55%, and for mothers 30 years and older, 75%. Mothers’ age has
also been reported as the primary determinant of exclusive breastfeeding\textsuperscript{76} and breastfeeding duration\textsuperscript{77}.

Race/ethnicity is a strong predictor of breastfeeding. Hispanic women have the highest rates of breastfeeding. For Hispanic infants born in the US in 2012 rates for ever breastfed, breastfeeding at 6 months and 12 months were 82.4\%, 51.4\%, and 27.9\% respectively.\textsuperscript{10} For non-Hispanic white infants born in the US in 2012, rates for ever breastfed, and breastfeeding at 6 and 12 months were 83.0\%, 55.8\% and 32.8\% respectively.\textsuperscript{10} Breastfeeding is lowest for non-Hispanic blacks. For non-Hispanic black infants born in the US in 2012, rates for ever breastfed, breastfeeding at 6 and 12 months were 66.4\%, 35.3\% and 16.9\% respectively.\textsuperscript{10} In the decade prior to this survey, rates of initiation and duration of breastfeeding improved for all racial/ethnic groups and the disparity between whites and blacks was reduced, while non-Hispanic blacks still had the lowest prevalence of breastfeeding.\textsuperscript{78} Odds for breastfeeding initiation were 0.40 (95\% CI: 0.31-0.52) for African-American women compared to other races.\textsuperscript{79} It has been suggested that access to maternity care practices that support breastfeeding is lower in areas with a higher percent of black residents.\textsuperscript{80}

Educational attainment impacts breastfeeding. Being at least college educated was found to be protective against early formula feeding or formula supplementation of breastfed babies with an adjusted OR=0.28 (95\% CI: 0.10, 0.79).\textsuperscript{81} Sutherland et al\textsuperscript{82} reported that college-educated women were two times more likely to have breastfed than women with a high school education or less. In addition, this study noted decreased initiation of breastfeeding with increasing birth order.\textsuperscript{82}
Income has also been shown to be predictive of breastfeeding. Data from the Pediatric Nutrition Surveillance System (PedNSS) for infants born to low income families (<185% poverty level) in the US in 2007, breastfeeding prevalences were 59.8% of infants ever breastfed, 25.4% breastfed for at least 6 months, and 17.5% breastfed for at least 12 months. In a Canadian study, although breastfeeding initiation for birth cohorts 1988-2011 (n=316,027) increased, socio-economic inequalities for breastfeeding initiation remained relatively unchanged. The negative impact of WIC participation (an indicator of low income) on breastfeeding, due to provision of formula has been documented.

*Individual Attitudinal and Behavioral Determinants*

Decisions regarding infant feeding method are typically made prior to, or early in, pregnancy. Intention to breastfeed is positively associated with initiation and duration of breastfeeding while negative individual attitudes toward breastfeeding are associated with not breastfeeding. A woman’s intention to breastfeed exclusively was also associated with the degree to which she was comfortable with breastfeeding in social situations. Duration can also be affected by individual perceptions of the breastfeeding experience. One of the primary reasons given for cessation of breastfeeding is the perception of insufficient4(333,649),(776,788) There is a demonstrated correlation between parenting self-efficacy and the perception of insufficient breast milk. The perception of insufficient breast milk is also correlated with the feeling that the baby is not satiated by breastfeeding. Nearly half of mothers reported that the baby not being satisfied by breast milk was the reason they stopped breastfeeding.
Another important individual factor impacting breastfeeding is maternal weight. Maternal overweight or obesity is associated with less successful breastfeeding. Obese women are significantly less likely to breastfeed ever compared to normal weight women. This lack of breastfeeding success by overweight and obese women has been attributed to delayed lactogenesis.

Parity status of the mother has also been identified as being associated with breastfeeding. Women tend to choose the same feeding method that they have used for the previous infants. Primiparous mothers (who have no breastfeeding experience) are more likely than multiparous mothers to not meet their breastfeeding intentions. In addition, birth characteristics may impact breastfeeding success as women experiencing Cesarean section delivery have been shown to be less likely to breastfeed successfully.

Certain individual habits may also impact breastfeeding. Maternal smoking is negatively associated with breastfeeding initiation and duration. Women who smoked during pregnancy were reported to be twice as likely to fail to breastfeed their infants at birth while non-smokers were twice as likely to be exclusively breastfeeding their infants at 6 months of age.

Maternal employment status also impacts breastfeeding. Working full-time during pregnancy has been shown to decrease the odds of exclusive breastfeeding one week postpartum by 50%. Returning to work full time versus part time is negatively associated with initiation of breastfeeding. The length of maternity leave from employment is associated with establishment of breastfeeding. Women with less than six weeks maternity leave were four times less likely to establish breastfeeding than those who did not return to work. Returning to work 13 weeks or later postpartum,
compared to earlier, resulted in odds of predominantly breastfeeding of 2.54 (95% CI: 1.51, 4.27).\textsuperscript{110} Pumping breast milk at work is the most common strategy women use for maintaining breastfeeding after returning to work.\textsuperscript{111} In 2010, the \textit{Affordable Care Act} included a provision for “reasonable break time” to pump.\textsuperscript{112} Despite this, women returning to work, still may find lack of support in the workplace to be an impediment to continuation of breastfeeding.\textsuperscript{113} Employers may have limited experience with breastfeeding and often do not recognize the benefit of supporting it in the workplace. For this reason, the \textit{Business Case for Breastfeeding} was developed to highlight benefits to employers such as reduced maternal absenteeism and lower health care costs for breastfeeding mothers when compared to those who formula feed.\textsuperscript{114} With appropriate workplace accommodation, breastfeeding can be successfully continued when mothers return to work. For many workplaces, significant change in organizational culture is necessary to achieve this goal.\textsuperscript{115}

\textit{Social and Environmental Determinants}

The influence of ‘significant others’ plays an important role in a woman’s decision to breastfeed. The opinion of infant’s grandmother\textsuperscript{116,117} and father\textsuperscript{118} on feeding method has been shown to be important. For women’s intentions to exclusively breastfeed, the perception that the grandmother preferred that choice resulted in an OR=2.45 (95% CI: 2.01, 2.99) and for the father preferring that choice the odds were \textit{7.44} (95% CI: 6.20, 8.92). According to Kornides and Kitsantas\textsuperscript{119} prenatal family support of breastfeeding choice resulted in an AOR= 8.2 (95% CI: 5.12, 13.2) for women initiating breastfeeding. Smaller but still significant results were found for any breastfeeding at two months (AOR= 3.2 (95% CI: 2.51, 4.11) and exclusive breastfeeding
at two months (AOR= 3.27 (95% CI: 2.58, 4.15)). For women choosing to bottle feed, the father’s preference for bottle feeding of the infant has been shown to be a primary deciding factor. Associated with this is the question as to whether or not women experiencing intimate partner violence (IPV) are more or less likely to breastfeed. One study found that women who experienced IPV were overrepresented in the group of mothers, who did not breastfeed or breastfed for short duration. A more recent study found no difference in breastfeeding between women who reported that they did or did not experience IPV.

Peer support, either individual or in the form of support groups, has been shown to be an effective mechanism for increasing breastfeeding duration and exclusivity. In a Toronto study, breastfeeding mothers were randomly assigned to conventional care, or to a mother-to-mother peer telephone support group. Individuals in the peer support group were 2.5 times more likely to be breastfeeding at 4, 8, and 12 weeks postpartum and significantly more likely to be exclusively breastfeeding at 4 and 12 weeks postpartum. Reeder et al., also reported that telephone peer counseling was effective at improving any breastfeeding at three months post-partum. Evaluation of in-person, telephone or other (text or email) peer counseling, demonstrated that discontinuation of any breastfeeding by six months or exclusive breastfeeding by three months was significantly decreased 7-10%. For that study, in person contact for peer counseling was most effective. The US Preventive Services Task Force concluded that breastfeeding interventions that have a peer support aspect increase short-term breastfeeding rates, compared to usual care. This may be especially true for minority women.
Breastfeeding is “a social behavior and as such must be learned like any other social behavior in supportive integrated systems. Even after it has been learned a woman needs to be in a socially supportive situation if she is to be successful.” In the broader societal view, living in certain areas of the US is more conducive to breastfeeding. Rural areas tend to have lower breastfeeding prevalence than urban areas. Regarding laws that protect breastfeeding women, the Northeast has the highest proportion of laws and the Midwest the lowest. Historically regional variations exist in public breastfeeding support with “the Pacific and mountain regions of the US having a consistently positive public opinion about health benefits of breastfeeding, breastfeeding in public, breastfeeding support at work and breastfeeding duration.” In general in the US, breastfeeding is not the cultural norm. This is clear from qualitative data that relates the way breastfeeding is portrayed in the media in a narrow and sometimes negative way that is partially responsible for the lack of normalization of breastfeeding in American culture.

Determinants in the health care system: Program

WIC

The Special Supplemental Nutrition Program for Women, Infants and Children (WIC) provides assistance to half of all infants born in the US, and over half of all formula in this country is purchased through the WIC program. Efforts of the WIC program to promote breastfeeding account for 0.6% of total budget whereas formula expenses account for 11.6% of the WIC budget. If all mother/infant dyads breastfed for one year, it has been estimated that WIC food package costs would be reduced by
Breastfeeding mothers in the WIC program receive lactation counseling from WIC staff, peer counseling, extended participation eligibility, enhanced food packages (implemented in 2009), and breast pumps if needed (http://www.fns.usda.gov/wic/wic-benefits-and-services). Improvement in prevalence of breastfeeding in WIC participants appears not to be associated with changes in the WIC food packages.\textsuperscript{135}

\textit{Determinants in the health care system: Practitioners}

\textbf{Lactation Consultants}

The role of the lactation consultant, and the higher level credentialed professional, the International Board-Certified Lactation Consultant (IBCLC), is to promote, support, and protect breastfeeding through individual education. Breastfeeding rates have been shown to increase after the implementation of lactation services in hospitals.\textsuperscript{136} In another study, women delivering in a hospital that employed an IBCLC had increased odds of breastfeeding at hospital discharge (OR=2.28, 95\% CI: 1.98, 2.62), and for women receiving Medicaid the OR was 4.13 (95\% CI: 3.22, 4.80).\textsuperscript{137} Average number of IBCLCs/1000 births in the US is 3.48, a variable used to measure breastfeeding support,\textsuperscript{10} however, consistent health insurance recognition and reimbursement of IBCLCs for lactation services has been reported to be relatively low in a national survey.\textsuperscript{138} Contact with lactation consultants or IBCLCs can occur both pre- and post-natally. Interestingly, social media has been identified as a way to market IBCLC services.\textsuperscript{139}

\textbf{Physicians}

Prenatal recommendations from clinicians (Pediatrics, Obstetrics, Family Practice) positively impact breastfeeding.\textsuperscript{119} Support for breastfeeding only resulted in
increased odds of initiation of breastfeeding (OR 1.95, 95% CI: 1.31–2.88) in patients. Racial disparities may exist in the provision of infant feeding information or in the way the information is perceived. In a study of Black, non-Hispanic WIC participants (n=130), the women reported receiving little support for breastfeeding prenatally, in-hospital, or postnatally, and indicated distrust of the nurses and physicians treating them.

It is important to note that although Obstetric, Pediatric and Family Practice physician organizations recognize that human milk is nutritionally superior to formula, practitioners may be insufficiently prepared to provide guidance. While many issues may contribute to the deficit of knowledge among physicians regarding breastfeeding, one significant problem has been obstetrics/gynecology and pediatric textbooks breastfeeding content, which when included at all, was frequently highly variable, inaccurate, and inconsistent. Studies have reported pediatricians have significant educational deficits regarding breastfeeding. Additionally, in a study of pediatric offices waiting rooms in Arizona, only 18% had breastfeeding support information while 81% had formula promotion material readily available. In New York State, efforts to reduce marketing of formula through provider offices resulted in development of state criteria and designation for Breastfeeding Friendly Practices.

Maternity Nurses

Hospital maternity nurses have the greatest contact time with new mothers. In a small study of hospital maternity nurses positive intentions of nurses to be supportive of breastfeeding was limited by their lack of knowledge of and education on evidence based
Members of The American Academy of Nursing Expert Panel on Breastfeeding concluded that nursing curricula across the US lacked comprehensive breastfeeding content. This correlates to the finding that of six major nursing textbooks reviewed, accurate breastfeeding content was either missing or inconsistent. Breastfeeding education of health care providers, predominantly nurses, working in Massachusetts hospitals was found to increase breastfeeding initiation. In a qualitative Colorado study, most nurses reported knowledge of evidence-based best practices related to breastfeeding initiation. However, when hospitals were stratified by Baby Friendly Hospital Initiative (BFHI) status, those nurses employed in a non-Baby Friendly facility, reported knowledge and practices that were not consistent with evidence based best practices for support of breastfeeding initiation. Identified barriers to providing nursing care most conducive to breastfeeding initiation “included hospital lactation policies (formal and informal), nurses' limited education in breastfeeding initiation best practices, high rates of surgical delivery, and lack of continuity of care during the transition of responsibility from one nurse to another from labor and delivery to transition care to postpartum care.”

**Determinants in the health care system: Hospitals**

Successful breastfeeding depends on a successful start. The *Ten Steps to Successful Breastfeeding*, breastfeeding best practices, are the tenet of the Baby Friendly Hospital Initiative (BFHI) and are listed in Table 1. The BFHI developed by the World Health Organization (WHO) and the United Nations Children’s Fund (UNICEF) debuted in 1991. The program “is a global effort for improving the role of maternity services to enable mothers to breastfeed babies for the best start in life.” There are approximately
20,000 maternity facilities worldwide that have been awarded the Baby-Friendly Hospital designation. Currently 306 hospitals in the US are designated Baby-Friendly, nine of which are in NYS (https://www.babyfriendlyusa.org/find-facilities/designated-facilities--by-state).

There have been two randomized controlled trials that have tested the components of the BFHI. The first was a large trial (n=17,046) conducted in hospitals in Belarus called the Promotion of Breastfeeding Intervention Trial (PROBIT). The BFHI increased duration and exclusivity of breastfeeding and decreased gastrointestinal infection and atopic eczema during the first 12 months of life. In a second trial by Coutinho et al., Brazilian hospitals utilizing the BFHI increased in-hospital exclusive breastfeeding to 70%. In 2007, Perez-Escamilla concluded that globally the BFHI improves breastfeeding prevalence, especially exclusive breastfeeding. Internationally, there is extensive evidence supporting the efficacy of each of the Ten Steps for the enhancement of breastfeeding.

During the past 15 years, there has been increased research in the US on evaluation of the Ten Steps implementation, BFHI designation and their impact on breastfeeding prevalence. Hospital implementation of the Ten Steps practices, and acquiring the BFHI designation in US hospitals, significantly increased breastfeeding initiation rates that were sustained over time. BFHI designation at Boston Medical Center in Massachusetts significantly improved breastfeeding initiation, from 58% to 87%, for all races with greater improvement, 34% to 74% for African-Americans. Overall exclusivity also increased significantly, from 5.5% to 33.5%. In a follow-up report, these changes in initiation and exclusivity were shown to be sustained for the
three years following BFHI accreditation. Interestingly, in US hospitals, the *Baby Friendly* label achieved through BFHI may not be clearly understood. In a recent survey of staff at 2,851 US hospitals only 3% were designated BFHI yet staff at 62% responded that their facility was “baby friendly”.  

BFHI designation alone does not significantly impact breastfeeding initiation or exclusivity when breastfeeding initiation is high and best practices are implemented. Without BFHI designation, full implementation of the *Ten Steps* is rare and tremendous variability exists in the extent to which hospital maternity services utilize these practices. In a survey of the majority of hospital maternity services in Massachusetts, Gizzard et al. reported that implementation of the *Ten Steps* was moderately high for 58%, partial for 40% and non-existent for 2% of hospitals. The National Survey of Maternity Practices in Infant Nutrition and Care (mPINC) is conducted by Center for Disease Control and Prevention to evaluate maternity care and feeding practices in hospitals and birth centers in the US. The survey originally completed in 2007 has been done biennially since then. The 2009 mPINC survey revealed that most hospitals provided prenatal breastfeeding education (Step 3, 93%) and showed mothers how to breastfeed (Step 5, 89%) and encouraged feeding on demand (Step 8, 82%). However, few hospitals had breastfeeding policies (Step 1, 14%), limited supplementation with formula (Step 6, 22%), or supported mothers post-discharge (Step 10, 27%). Longitudinal mPINC data showed that hospitals implementing more than half of the *Ten Steps* increased from 28.7% in 2007 to 53.9% in 2013.

Impact of various combinations of the *Ten Steps* on breastfeeding duration has been documented. Significant improvement in breastfeeding duration was realized when
five of the Ten Steps were practiced in the hospital, specifically: breastfeeding within the first hour, feeding breast milk only, infant rooming-in, no pacifier use, and receipt of a phone number for questions after discharge (Steps 4, 6, 7, 9 and 10 respectively). In Colorado, Pregnancy Risk Assessment and Monitoring System (PRAMS) data were utilized to measure impact of these five Steps. All five of the Steps were experienced by only 18.7% of the women surveyed. At 16 weeks, 68% of those experiencing all five Steps were still breastfeeding, compared to 53% of those who did not experience all five Steps, an effect that was independent of maternal socioeconomic status. Exposure to the five Steps improved breastfeeding duration for those mothers receiving Medicaid to a greater extent than those mothers in higher socio-economic categories. DiGirolamo et al. evaluated these same five Steps, with the addition of breastfeeding on demand (Step 8), using Infant Feeding Practices (IFPS) II data. They found that 8.1% of the women surveyed experienced all six Steps, and that women who had no exposure to any of the Steps were almost 13 times more likely to stop breastfeeding before six weeks, compared to those who experienced all six Steps. Furthermore, with increasing number of Steps experienced, breastfeeding increased in a dose-dependent manner. They identified three Steps that were significantly protective against early cessation of breastfeeding (breastfeeding for less than six weeks): breastfeeding initiation within an hour of birth (Step 4; AOR=0.63 (95% CI: 0.48, 0.83), giving breast milk only (Step 6; AOR=0.43 (95% CI: 0.32, 0.58), and no pacifier use (Step 9; AOR=0.63 (95% CI: 0.48, 0.84)).

The importance of the implementation of individual Steps has been highlighted in the literature. One of the original studies that analyzed each Step individually found that
having written hospital policy (Step 1) was independently associated with breastfeeding percent.\textsuperscript{19} The importance of this Step is illustrated by development of model policies,\textsuperscript{162,163} as well as regulatory initiatives to improve hospital compliance.\textsuperscript{164}

A number of studies evaluating training of hospital staff (Step 2) have reported significant increases in breastfeeding initiation and exclusivity.\textsuperscript{165} Utilizing 2009 mPINC data, Li et al. reported that training, specifically for new nurses AOR = 1.30 (95% CI: 1.01-1.69) and current nurses within the past year (AOR = 1.35 (95% CI: 1.04-1.75), was significantly associated with increased ‘any’ breastfeeding.\textsuperscript{166}

Helping mothers initiate breastfeeding within the first hour (Step 4) by reducing the degree of processing of the newborn has been shown to improve both breastfeeding initiation and exclusivity. An intervention that delayed newborns bathing from an average of two hours post-natal to an average of 13 hours post-natal achieved AOR = 2.66 (95% CI: 1.29-5.46) for initiation and AOR = 1.39 (95% CI: 1.02-1.91) for exclusive breastfeeding.\textsuperscript{167}

Breastfeeding exclusivity is also influenced by Step 6 (Give infants no food or drink other than breast-milk) which prohibits supplementing breastfeeding babies with formula or additional nourishment unless medically indicated. Formula supplementation of breastfeeding infants in the hospital was negatively associated with exclusively breastfeeding at 6 months (AOR=0.27, (95% CI: 0.13, 0.56)).\textsuperscript{14} Based on data from the IFPS II, 52% of breastfeeding mothers reported that formula was provided to their infants while in the hospital.\textsuperscript{168} For women with exclusive breastfeeding intentions, in-hospital formula supplementation resulted in almost twice the risk of not fully breastfeeding between one and two months and nearly three times the risk of breastfeeding cessation by
2 months post-partum. However, while this specific Step addresses exclusivity, maternal perception of degree of implementation of all Ten Steps increases exclusive breastfeeding in the hospital and immediately postpartum. Additionally Holmes et al. reported that race/ethnicity is associated with combination breast milk and formula feeding with Hispanics (AOR=3.71 (95% CI: 2.51, 5.77)) and blacks (AOR=2.59 (95% CI: 1.66, 4.06)) more likely to combination feed.

Provision of formula to new mothers through hospital formula discharge packs is common practice. Despite the International Code for Marketing Breast Milk Substitutes which was adopted by WHO in 1981, there has been no mode of enforcement developed in the US. In 2007, the National Survey of Maternity Practices in Infant Nutrition and Care (mPINC) found that 70% of all US hospitals reported providing formula discharge packs to breastfeeding mothers. Based on PRAMS data from Oregon, women who received formula packs, compared to women who did not, were more likely to exclusively breastfeed for less than 10 weeks, AOR=1.39 (95% CI: 1.04, 1.84; ). Kaplan and Graff have competently reviewed the detrimental effect of formula industry marketing through hospitals on breastfeeding exclusivity and duration, as well as the challenges to changing the hospital practices which condone and promote the use of formula as equivalent to breast milk. In an intervention to evaluate the impact of hospital sponsored discharge bags without formula, on breastfeeding prevalence, Feldman-Winter et al, found that despite ensuring the hospital sponsored discharge bags did not contain formula at the source, 36% of women receiving them reported having received formula from the hospital. A recent report using data from the IFPS II evaluated distribution of bags. Type/content of bags received by new mothers varied.
Overall, 1,868 (81.4%) of women received formula bags, 96 (4.2%) received coupon bags, 46 (2.0%) received breastfeeding supplies bags, and 284 (12.4%) received no bag. Those mothers that received breastfeeding supplies bags/no bag were significantly more likely to be exclusively breastfeeding at 10 weeks (AOR = 1.77 (95% CI, 1.29-2.41), and 6 months (AOR = 1.58 (95% CI 1.06-2.36)) when compared to formula containing bag recipients.\textsuperscript{177}

\textit{Step 7} practice rooming-in has been reported to be significantly associated with any breastfeeding (OR=5.0 (95% CI: 1.5, 16.9)).\textsuperscript{178} Hospital implementation of rooming-in has also been a \textit{Step} for which greater barriers to implementation exist for some facilities.\textsuperscript{179,180} For \textit{Step 9}, give no pacifiers, a 2012, Cochrane Database Systematic Review by Jaafar et al stated,

\begin{quote}
“Pacifier use in healthy term breastfeeding infants, started from birth or after lactation is established, did not significantly affect the prevalence or duration of exclusive and partial breastfeeding up to four months of age. However, evidence to assess the short-term breastfeeding difficulties faced by mothers and long-term effect of pacifiers on infants' health is lacking.”\textsuperscript{181}
\end{quote}

In a Brazilian study however, pacifier use was significantly associated with interruption of exclusive breastfeeding AOR=2.77 (95% CI: 2.63, 2.91).\textsuperscript{182} An important study by Kair et al\textsuperscript{183} revealed that eliminating pacifier use without restricting access to formula supplementation resulted in “decreased exclusive breastfeeding, increased supplemental formula feeding and increased exclusive formula feeding.”

Individual \textit{Steps} likely influence different aspects of successful breastfeeding initiation, exclusivity and duration. However Chien et al.\textsuperscript{16} reported a dose-dependent effect between increasing number of the \textit{Ten Steps} women experienced and increased initiation and duration of breastfeeding, up to 3 months. It is also important to note that
the number of baby friendly hospital practices in place has been shown to not be significantly associated with birth costs.\(^{184}\)

Hospital practices clearly have an impact on breastfeeding rates and hospital characteristics may also play a role. In NYS hospitals, designated perinatal level 1(basic care) (http://www.health.ny.gov/community/pregnancy/health_care/perinatal/regionalization_d escrip.htm) was significantly positively associated with exclusive breastfeeding in-hospital.\(^{185}\) Additionally hospital characteristics influence degree of implementation of best practices. Implementation of maternity care practices vary by region and facility size.\(^{160}\) Analyzing data from the mPINC survey, Allen et al reported that hospital practice scores were lowest for facilities in least urbanized, least populated areas.\(^{186}\) Also, access to maternity care practices supportive of breastfeeding may be influenced by demographics of the facility location. Facilities in areas with higher than the national average of black residents compared to those below the national average of black residents, were less likely to implement Steps related to “early initiation of breastfeeding (46.0% compared to 59.9%), limited use of breastfeeding supplements (13.1% compared to 25.8%), and rooming-in (27.7% compared to 39.4%).”\(^{80}\)

**Conclusion**

Kruse et al.,\(^{13}\) reported that “60% of the variation in hospital specific rates of exclusive breastfeeding at discharge” was due to socio-demographic variables, with significant proportion of the unexplained variation (40%) likely due to hospital practices. “…it is the maternity hospitals and subsequently in the community health services where
both the biggest obstacles and the greatest opportunities are presented for improvement in breastfeeding rates.”

Breastfeeding behavior is multi-faceted in nature and therefore requires multivariate analysis of data, allowing for interpretation of associations and interactions between many variables. The determinants of breastfeeding initiation, duration, and exclusivity are most likely not the same and it is clear that further research is needed to provide greater conceptual clarity.

Increasing breastfeeding initiation, duration, and exclusivity by new mothers is a crucial strategy for improving child health and reducing health-care costs. Further reductions in racial/ethnic differences in breastfeeding rates will contribute to reducing health disparities. Improving hospital maternity practices has been shown to have a beneficial effect on breastfeeding. Identifying specific maternity care practices that are most influential for breastfeeding initiation, duration and exclusivity among underserved populations should continue to be an important public health focus.

Methods

Data Sources:

Hospital Practices and Characteristics

The National Survey of Maternity Practices in Infant Nutrition and Care (mPINC) was initiated in 2007 by CDC to evaluate maternity care and feeding practices in hospitals and birth centers in the US. The survey was developed in response to evidence demonstrating that certain practices in maternity-care settings significantly impact breastfeeding behaviors including initiation, exclusivity, and duration. The survey contained 52 questions regarding the birth facility’s maternity practices, training,
personnel, policy, and facility characteristics.”^{21} Thirty-three of the questions were related to hospital/birth center practices, 13 related to training personnel and policy, and 6 pertained to characteristics of the hospital/birth center.^{21} Surveys were completed using either a paper or web-based version. All hospitals (n=3,143) and birth centers (n=138) providing intra-partum care in the US and territories were surveyed. The overall response rate was 82%. For NYS, data was collected from 110 hospitals; a response rate of 75%. Data were analyzed utilizing a scoring system with scores ranging from 1 to 100, higher scores represented better maternity practices. Scores by state have been reported.^{173}

**Maternal Characteristics**

The Pregnancy Risk Assessment Monitoring System (PRAMS) is a population-based survey of new mothers designed to measure maternal experiences and behaviors before, during, and after pregnancy. “The goal of the PRAMS project is it to improve the health of mothers and infants by reducing adverse outcomes such as low birth weight, infant mortality and morbidity and maternal morbidity.”^{22} PRAMS, which began in 1987 is an ongoing surveillance program developed by CDC, and implemented by participating states. Currently, PRAMS is conducted in 37 states, the South Dakota Sioux Tribal Nation, and New York City, representing 75% of all births in the United States.^{22} New York State began collecting PRAMS data in 1993 and New York City joined the program in 2001. Data are reported annually.

PRAMS participants are selected from state birth certificate files with 1,300 to 3,400 women surveyed in each state yearly.^{22} In 2007, 1,685 and 2,269 women were sampled by NYS and NYC respectively. For women with multiple births, only one infant
is sampled. Certain high risk populations are oversampled. NYS and NYC oversample women giving birth to low birth weight (LBW) infants (<2500 grams). In 2007, approximately 30% of the NYC PRAMS sample, and 40% of the NYS PRAMS sample were mothers of LBW infants.

The PRAMS questionnaire has two parts; a set of core questions asked by all participating entities and additional state-specific questions. The state questions are drawn from a list of 185 standard questions, or states can develop additional questions if a topic of interest is not covered by the standard questions. The total number of questions typically ranges from 75 to 90. In addition, PRAMS survey data include birth certificate variables for maternal demographics, infant birth weight, and gestational age.

The PRAMS questionnaire is completed via two possible mechanisms. The questionnaire is mailed for self-administration with multiple follow-up attempts, or is administered by telephone follow-up. Telephone contact may be attempted up to 15 times. Participation incentives are used by both NYS and NYC PRAMS programs. With the initial mailing of the survey NYS PRAMS includes a 30 minute prepaid phone card and NYC includes a $20.00 Metrocard. In addition, upon completion/submission of the survey NYS PRAMS program provides participants with a music CD. Mailings are initiated 2 to 4 months post-partum. A 70% response rate is required by the CDC for the public release of the data.

PRAMS datasets are weighted for sample design, nonresponse and non-coverage. Maternal recall of breastfeeding initiation and duration has been shown to be valid and reliable when interviews are completed within three years of breastfeeding cessation.
Study Population:

*Hospitals*

Hospital is a unit of observation for this study. According to the NYS Hospital Profile there are 140 hospitals in NYS that are certified obstetrical facilities; 100 in NYS (excluding NYC) and 40 in NYC. Utilizing data from the mPINC survey, which contains data for 110 hospitals in NYS, hospital-level analysis will be completed. All hospital identities in this data set are confidential. The mPINC data set was processed using designated codes to allow hospital-level analysis while maintaining hospital confidentiality as outlined by Dr. Grummer-Strawn from CDC (personal communication).

*Women giving birth in NYS*

Women giving birth, in NYS is a second unit of observation. NYS PRAMS data is weighted to be representative of all women giving birth in NYS (excluding NYC). For reasons of temporality, the 2007 PRAMS data sets are most appropriate to use for analysis of the mPINC survey, which was also collected in 2007. NYS and NYC PRAMS data sets for 2007 were combined to increase sample size. Statistical methods detailed below will be used to verify the appropriateness of combining these data sets.

Definition of Variables:

*Hospital Characteristics*

were used as part of set of variables to define hospital characteristics. Also included in this set of variables will be question A8, section A, “hospital practices” from the mPINC survey, which identifies the percent cesarean section in the previous year.

Another is Health Services Area (HSA), of which there are 8 in NYS (See Figure below).

This data will be used to provide a crude geographic identification for hospitals without threat to their anonymity. Also included will be urban/suburban/rural designation (based on the Rural Urban Commuting Area (RUCA) code for the hospital zip code). Perinatal level will also be used to assess hospital characteristics. Level of care provided by hospital differs by perinatal designation in NYS.
Hospitals are designated as follows: Level 1 (basic care), level 2 (specialty care), Level 3 (sub-specialty care) and Regional Perinatal Centers (RPC).

In addition, percent public insurance coverage of births by year and by hospital is also available publicly, and was used to provide a crude measure of income level of the population served by individual hospitals. Three levels of payment from public insurance will be used; low (0-33%), medium (34-66%) and high (67-100%). If the number of hospitals in the high group is too small, the data will be dichotomized to (1-50%) and (50-100%).

**Hospital Maternity Practices**

The mPINC survey includes 52 questions: section A, hospital practices; section B, training, personnel and policy, and section C, hospital characteristics. Table 2 provides the mPINC questions that correspond to the individual *Ten Steps to Successful Breastfeeding*. These questions were used to create variables representing the *Ten Steps*. These variables, in addition to the scoring algorithm variables in the data set, were used for analysis of hospital maternity practices in NYS.

**Maternal Characteristics**

have the same core questions. Variables used for analysis include demographic information from the birth certificate as well as survey questions. Questions on the PRAMS survey cover issues associated with breastfeeding including: prenatal care, prenatal advice on breastfeeding, WIC participation, health insurance coverage intimate partner violence, smoking behavior, whether the infant was born premature and/or low birth weight, and infant stay in the neonatal intensive care unit (NICU). Specific questions on breastfeeding are numbers 52-58 on the NYS PRAMS survey and numbers 50-55 in the NYC PRAMS survey. These questions were used to create variables for breastfeeding initiation (yes/no), breastfeeding duration in two categories (≤2 weeks, >8 weeks), breastfeeding exclusivity (yes/no) and also, levels of breastfeeding exclusivity (≤2 weeks, >8 weeks). NYS and NYC PRAMS breastfeeding questions differ only in the additional breastfeeding question (55a-j) contained in the NYC survey that asks about hospital practices (Ten Steps) experienced by the mother while in the hospital.

Plan for Data Analysis:

All data was analyzed using SAS (version 9.2 or 9.4 SAS Institute Inc, Cary, NC). PROC SURVEY will be used for the analysis of all weighted data. Univariate and bivariate analysis will be performed. Multiple logistic regression analysis was conducted using SAS or SAS-callable SUDAAN (version 11.0.1, Research Triangle Institute (RTI), Research Triangle Park, NC). This research was approved by the Institutional Review Board of the NYS Department of Health

Hypothesis I: Hospital maternity practices in NYS are not impacted by hospital characteristics such as total number of births, Cesarean section rate, geographic location (Health Services Area (HSA)) or payer mix (proportion of public versus private insurance coverage).
Univariate analysis was completed for each variable in the data sets. The mPINC scoring algorithm variables were used. These variables are included in the mPINC data set. Continuous variables were analyzed using analysis of variance or dichotomized. In addition, multi-level categorical variables were also dichotomized as appropriate. Bivariate analysis was completed and multiple logistic regression analysis for independent effects of hospital characteristics on hospital maternity practices was conducted. Those variables that are indicated in effect-modification or confounding will be identified and tested in the model. Variables that are found to be significant will be retained in the model. The final regression model was assessed for goodness-of-fit.

**Hypothesis II:** Among women giving birth, rates of breastfeeding initiation, duration, and exclusivity, are increased when hospital maternity practices are consistent with the *Ten Steps to Successful Breastfeeding.*

Univariate analysis was completed for all PRAMS data set variables for questions directly measuring breastfeeding and those variables for questions on topics associated with breastfeeding which include: health insurance coverage, maternal BMI, prenatal care, prenatal advice on breastfeeding, WIC participation, intimate partner violence, smoking behavior, whether the infant was born premature and/or low birth weight, and infant stay in the neonatal intensive care unit (NICU). Some continuous variables were converted to multi-level categorical or dichotomized as appropriate for logistic regression. In addition, multi-level categorical variables were also be dichotomized as appropriate for analysis.

Bivariate analysis was used to evaluate the relationship between the exposure/independent variable (hospital maternity practices) and the outcome/dependent variable (breastfeeding initiation, duration, and exclusivity). Hospital maternity practices
refers to those variables from the CDC mPINC survey which include both the individual items representing the *Ten Steps* (Table 2), as well as the 7 categories or sub-scores defined in the scoring algorithm


and the overall score. Breastfeeding initiation, duration and exclusivity are as defined previously (breastfeeding initiation (yes/no), breastfeeding duration in two categories (≤2 weeks, ≥8 weeks), and breastfeeding exclusivity (yes/no, ≤2 weeks, ≥8 weeks). For the multi-categorical variables for breastfeeding duration and exclusivity, it was necessary to combine levels when sample size was found to be insufficient.

The crude odds ratios or prevalence ratios for the exposure/independent variable (hospital maternity practices) and the outcome/dependent variable (breastfeeding initiation, duration, and exclusivity), with 95% confidence intervals, will be calculated. Odds or prevalence ratios for this relationship in two strata of variables identified as associated with breastfeeding, listed above, were generated to identify potential effect modifiers. Associations between covariates and the exposure/independent variable (hospital maternity practices) and covariates and the outcome/dependent variable (breastfeeding initiation, duration, and exclusivity) were used to identify potential confounders. Those variables that had been indicated in the literature and/or in bivariate analysis to potentially participate in effect-modification or confounding were tested by statistical modeling. Analysis generated logistic regression models. The models were built stepwise. Individual variables and interaction terms that were found to be significant were retained in the model. Final models were assessed for goodness-of-fit.
**Journals appropriate for this research content:**

Title: Impact of Hospital Maternity Care Practices on Exclusive Breastfeeding in New York State

Author(s):
Eileen FitzPatrick,1,2 MPH, RD
Barbara A. Dennison,2,3 MD
Trang Nguyen,4 MD, DrPH,
Marilyn A. Kacica,2,5 MD, MPH,
David Strogatz,2,6 PhD

1Nutrition Science Department, The Sage Colleges, Troy, New York
2School of Public Health, University at Albany, Rensselaer, New York
3Division of Chronic Disease Prevention, New York State Department of Health, Albany, New York
4Office of Public Health Practice, New York State Department of Health, Albany, New York
5Division of Family Health, New York State Department of Health, Albany, NY
6Center for Rural Community Health, Bassett Healthcare Network, Cooperstown, NY

对应作者:
Eileen FitzPatrick, MPH, RD
The Sage Colleges
65 First Street
Troy, NY 12180
Phone: 518-244-2048
Email: fitzpe@sage.edu

Acknowledgements:

Abbreviations
NYS – New York State
EBF- Exclusive Breastfeeding
mPINC – Maternity Practices in Infant Nutrition and Care
PRAMS – Pregnancy Risk Assessment and Monitoring System

Word count abstract: 244
Word count text: 3,157
Well established: The Baby Friendly Hospital Initiative’s *Ten Steps to Successful Breastfeeding*, when implemented has been shown to improve breastfeeding support. Hospitals that have implemented individual *Ten Steps* or combinations of *Steps* have been shown to have higher percentage of infants exclusively breastfed primarily during the early postpartum period.

Newly Expressed: Of the *Ten Steps to Successful Breastfeeding*, Step 5 (Show mothers how to breastfeed) was significantly associated with breastfeeding exclusively eight weeks or longer. This should encourage best practices for populations at higher risk for not exclusively breastfeeding.

**Abstract**

Improvements in the prevalence of exclusive breastfeeding (EBF) have lagged behind those achieved for breastfeeding initiation. Implementation of the evidence based *Ten Steps to Successful Breastfeeding* in hospital maternity care has been instrumental in improvements in breastfeeding initiation, duration and exclusivity. Utilizing New York State linked data from the Maternity Practices in Infant Nutrition and Care (mPINC) and the Pregnancy Risk Assessment Monitoring System (PRAMS), the association of individual maternity practices/*Steps* to breastfeeding exclusivity was evaluated. The study sample included mothers who gave birth in 2007 to a healthy infant born in a NYS hospital that participated in mPINC. Weighted multiple logistic regression analysis was conducted to determine the association between individual hospital maternity care practices/*Steps* and EBF for eight weeks or longer. The weighted study sample was n=97,682. Among mothers who initiated breastfeeding, 36.8% exclusively breastfed for eight weeks or longer. Mothers who gave birth in a hospital that reported implementation of *Step 5* ‘Show mothers’ how to breastfeed’ had a RR=1.77 (95% CI: 1.42-2.20) for EBF eight weeks or longer, after adjustment for maternal demographic variables and hospital characteristics. No other maternity practices/*Steps* were significantly associated
with EBF. Meeting EBF goals is a public health priority. Evidence-based maternity practices demonstrated to improve EBF should be fully implemented in hospitals. Teaching mothers how to breastfeed during their hospital stay, by competently trained health care providers will contribute to improved breastfeeding success and increased prevalence of EBF in the hospital and postpartum period.

**Background**

Breastfeeding, especially exclusive breastfeeding (EBF), is the optimal feeding option for infant growth and development. Breastfeeding reduces the risk of infectious disease in infancy as well as reducing the risk of chronic diseases, including obesity, later in life.\(^1\) Breastfeeding also has benefits to maternal health by reducing chronic disease including cancer and type 2 Diabetes.\(^1\) Consequently, large economic benefits would be expected from reduction in health care costs for both infant and mother, if optimal levels of breastfeeding were achieved.\(^2,3\) The American Academy of Pediatrics, the American Congress of Obstetricians and Gynecologists, the American Academy of Family Physicians, the World Health Organization (WHO) and the US Department of Health and Human Services all recommend EBF during the first six months of life.\(^4-8\)

In the past decade, the prevalence of breastfeeding initiation has increased, although the prevalence of EBF still remains relatively low.\(^9\) Perrine et al, (2012) found that only 34% of mothers who planned prenatally to exclusively breastfeed actually met their intention at three months postpartum.\(^10\) For breastfeeding exclusively at three months of age, *Healthy People 2010* and *2020* goals were 40% and 46%, respectively.\(^11,12\) For NYS birth cohorts 2007, 2008, 2009, 2010, 2011 the prevalence of EBF at three months of age was 32.0, 32.7, 34.0, 32.8, 37.0 percent, respectively.
Because the benefits from breastfeeding are dose dependent\textsuperscript{13} the low prevalence of EBF in NYS is of public health concern.

Determinants of breastfeeding behavior are multi-faceted and include socio-demographic, individual, and environmental influences. Socio-demographic factors have been estimated to account for up to 60\% of variation among hospitals in EBF at hospital discharge.\textsuperscript{14} The remaining variation is likely due to in part to environmental factors such as institutional and public support for breastfeeding. Numerous studies have shown that hospital maternity practices are an important environmental determinant associated with breastfeeding success.\textsuperscript{15-25} Hospital maternity practices that encourage and support breastfeeding are outlined in the \textit{Ten Steps to Successful Breastfeeding}, the basis for the \textit{Baby Friendly Hospital Initiative} developed by the United Nations Children’s Fund and the World Health Organization.\textsuperscript{8,26} Hospital maternity practices inconsistent with the \textit{Ten Steps} have been shown to be detrimental to breastfeeding success.\textsuperscript{27}

Research on hospital practices related to overall implementation of the \textit{Baby Friendly Hospital Initiative} and specifically on \textit{Step 6} ‘Give new born infants no food or drink other than breast milk’, has primarily focused on the impact on EBF in the early postpartum period.\textsuperscript{28,29} Study of the impact of individual maternity care practices/\textit{Steps} on EBF extended beyond the early postpartum period has been limited. The purpose of this study was to evaluate whether implementation of individual hospital maternity care practices/\textit{Steps} was related to EBF for eight weeks or longer, after adjustment for maternal socio-demographic and hospital variables.
Methods

Data Sources:

The national survey of Maternity Practices in Infant Nutrition and Care (mPINC) was first conducted in 2007 by the Centers for Disease Control and Prevention to evaluate maternity care and infant feeding practices in hospitals and birth centers in the US. The survey contains 52 questions regarding the birth facility’s maternity practices, training, personnel, policy, and facility characteristics. Detailed information on survey methodology is available (http://www.cdc.gov/breastfeeding/data/mpinc/scoring.htm). The NYS 2007 mPINC data set included surveys from 110 NYS hospitals (75% response rate).

The Pregnancy Risk Assessment Monitoring System (PRAMS) is a population-based survey of new mothers designed to measure maternal experiences and behaviors before, during, and after pregnancy. PRAMS participants are randomly selected from state birth certificate files. NYS PRAMS datasets are weighted for sample design, non-response and non-coverage. PRAMS data are weighted to be representative of all women giving birth in NYS. In 2007, 1,492 and 1,123 women participated in the NYC and NYS (excluding NYC) PRAMS, respectively. Detailed information on PRAMS methodology can be found elsewhere (www.cdc.gov.prams/methodology.htm). The mPINC and PRAMS data sets were linked by hospital, however, no individual hospital results were analyzed or presented due to confidentiality and small sample sizes.

Hospital characteristics

Publically available hospital data, including annual number of births, Cesarean section (% of births), Medicaid payment for deliveries (%), midwife present at deliveries
(%), urban/suburban/rural designation (based on the Rural Urban Commuting Area (RUCA) code for the hospital zip code), and NYS perinatal level designation (http://www.health.ny.gov/community/pregnancy/health_care/perinatal/regionalization_descrip.htm), were obtained. These hospital variables were added to the NYS PRAMS dataset and merged by hospital.

**Merging of Datasets**

As hospital identities in the mPINC data set were confidential, the NYS mPINC and NYS PRAMS data sets were merged by hospital with assistance from the CDC’s mPINC data manager, and hospital identifiers were later removed to maintain confidentiality. Infant exclusion criteria included any infant who was deceased, admitted to a neonatal intensive care unit (NICU), or did not initiate breastfeeding.

**Definition of variables**

**Dependent/Outcome variable**

The primary outcome of this study was EBF for eight or more weeks. This was the result of the dichotomized PRAMS analytical variable for the age of an infant (in weeks) the first time food or drink was provided. The analytical variable was generated utilizing specific PRAMS questions: “How many weeks or months did you breastfeed or pump milk to feed your baby?” and “How old was your baby the first time you fed him or her anything besides breast milk? Include formula, baby food, juice, cow’s milk, water, sugar water, or anything else you fed your baby.” EBF at eight weeks is the time point evaluated since PRAMS surveys are sent to mothers 2 to 4 months after delivery. Eight weeks is also in close proximity to the 3 months exclusive HP Goals\textsuperscript{11,12} and is just prior to the time most women may return to work, which is associated with reductions or cessation of EBF.\textsuperscript{33}
Independent/Exposure variables

The mPINC survey included a series of questions evaluating hospital practices. Questions addressing practices from each of the *Ten Steps to Successful Breastfeeding* and whether formula gift packs were provided at hospital discharge were selected. Response variables for these questions and the corresponding scores were used to determine if each practices/Steps were fully implemented. The scoring algorithm utilized in mPINC resulted in numerical categories, with the range of scores 0-100. For Steps 1 and Steps 3-10, the scores were dichotomized to 90-100 representing implementation of the Step/practice versus <90 representing not fully implementing the practice/Step. For Step 2, the staff training variable, a score of 75-100 was designated as implementing the step and a score of <75 as not fully implementing the step due to few hospitals in the 90-100 range. Additionally, the variable for provision of formula gift packs, yes/no, was also included.

Maternal socio-demographic variables

Questions on the PRAMS survey cover factors previously published to be associated with breastfeeding behavior. These included maternal age, education, race, ethnicity, weight status and marital status. Also utilized were variables for type of delivery (vaginal or Cesarean-section), WIC participation, health insurance coverage, intimate partner violence, smoking behavior and infant stay in the NICU.

Data Analysis:

Weighted analyses were conducted. Univariate analysis was completed to assess the overall EBF percentage among the study population and the distributions of
independent variable sub-groups. Bivariate analysis was used to evaluate the un-adjusted association between EBF at eight weeks and the exposure/independent variable.

The crude prevalence ratios for EBF at eight weeks with 95% confidence intervals were calculated among the exposure/independent variables (hospital maternity practices). Variables indicated in the literature and/or in bivariate analysis to be important for EBF were selected for modeling. Prior to modeling, Pearson correlation coefficients (r) were generated for independent variables proposed for the full model. For those variables with r=0.65 or higher, one variable of the highly correlated pair was removed. Variables retained were those judged to be more strongly related to the outcome, EBF in published literature.

Weighted multiple logistic regression analysis to determine the association between, hospital maternity practices and EBF was conducted. A full model included all variables identified through the bivariate analyses. Those variables found to be significant (p≤0.05) were retained in the model and stepwise elimination of independent variables from the least significant/highest p-value was conducted until a reduced model was generated. The final regression model was assessed for goodness-of-fit using the Wald statistic.

All data were analyzed using SAS (version 9.2 or 9.4, SAS Institute, Inc., Cary, NC). PROC SURVEY was used for the analysis of all weighted data. Multiple logistic regression analysis was conducted using SAS-callable SUDAAN (version 11.0.1, Research Triangle Institute (RTI), Research Triangle Park, NC). This research was approved by the Institutional Review Board of the NYS Department of Health.
Results

The merged NYS data from the PRAMS and the mPINC datasets included PRAMS participants who gave birth at those hospitals which had submitted a completed 2007 mPINC survey (n=95, 86% of mPINC participating hospitals). After excluding mothers whose infant was admitted to the NICU or deceased or mothers who delivered in hospitals that did not participate in the 2007 mPINC survey, 1,032 completed PRAMS surveys were used for analyses. Most mothers in this study sample (84.1%) initiated breastfeeding (weighted n=97,682).

Of those mothers who initiated breastfeeding, 36.8% breastfed exclusively for eight weeks or longer. Distribution of the study population by maternal characteristics is presented in Table 1. Approximately half of mothers were white, 21-30 years old, and the majority were married and had educational attainment beyond high school. Fifty-four percent of the women had a pre-pregnancy BMI in the normal range based on self-reported weight and height. Ninety-seven percent reported not smoking during pregnancy.

Table 2 displays the hospital characteristics that potentially associate with breastfeeding practices. The majority of hospitals, had greater than 1,000 deliveries annually and were urban. More than a third of their deliveries were paid for by Medicaid. Seventy of the hospitals had Cesarean section rates greater than 25%. Scores on questions measuring the practices/Steps in the mPINC hospital survey utilized a point scale from 0-100. The final grade total score for overall maternity care in NYS had a mean score of 67 (out of 100). Among hospitals included in this sample, the mean total score was 66, ranging from 35-88. For individual practices/Steps full implementation of
the *Step* was defined as a score of 90-100. A score of less than 90 was defined as not fully implementing the *Step*. The percent of hospitals implementing each of the *Ten Steps* is provided in Figure 1. The most prevalent *Step* was 3 ‘inform pregnant women about the benefits of breastfeeding’ which was fully implemented by 87% of hospitals in the study sample. The least implemented *Step* was 7 ‘rooming-in’ which was fully implemented by only 20% of hospitals in the study sample.

Table 3 provides the crude prevalence ratios for the association between hospital *Steps/practices* and EBF of eight weeks or longer. ‘Showing mothers how to breastfeed’ (Step 5) is the only *Step* that was significantly associated with EBF, crude PR=1.23 (95% CI: 1.02, 1.53).

As can be seen in Table 4, in the full multivariate model (model 1) the association between full implementation of step 5, ‘showing mothers how to breastfeed’ and EBF for eight weeks or longer persists (PR=1.48 (95% CI: 1.33, 1.63)). The complete implementation of *Step* 3, ‘inform all pregnant women about the benefits of breastfeeding’ was also significantly associated with EBF eight weeks or longer, PR=1.20 (95% CI: 1.06, 1.74), while practice/ *Step* 9, ‘give no artificial teats or pacifiers’ was inversely related to EBF at eight weeks (PR=0.64, (95% CI: 0.49, 0.84). Mothers’ characteristics associated with lower likelihood of EBF eight weeks or longer include being of black race PR=0.69 (95% CI: 0.59, 0.88), being overweight (BMI ≥25 Kg/M$^2$) or obese (BMI≥30 Kg/M$^2$) PR=0.75 (95% CI: 0.67, 0.83) and having an education attainment of high school or more PR=0.70 (95% CI: 0.60, 0.83).

After the stepwise elimination of non-significant variables, the results from the reduced logistic regression model (model 2) are displayed in Table 4. The positive
association between the practice/Step 5, of showing mothers how to breastfeed and EBF feeding eight weeks or longer continues to persist, PR=1.77 (95% CI: 1.42, 2.20). Also associated with EBF for eight weeks or longer is being married PR= 1.35 (95% CI: 1.02, 1.79). The only hospital characteristic significantly associated with EBF is total annual number of deliveries. Among hospitals with fewer than 500 births the PR=1.25 (95% CI: 1.16, 1.34), whereas hospitals with 500-999 births PR=0.46 (95% CI: 0.27, 0.80) when compared to hospitals with more than 2,000 births annually. Those maternal characteristics negatively associated with EBF eight weeks or longer include being of black race PR=0.75 (95% CI: 0.61, 0.92), of other race PR=0.64 (95% CI: 0.57, 0.72) and an educational attainment of high school or more PR=0.77 (95% CI: 0.60, 0.99).

Discussion

The present study aimed to evaluate the association of hospital maternity care practices with EBF at eight weeks or longer. In this study, only full implementation of Step 5 of the Ten Steps to Successful Breastfeeding: ‘show mothers how to breastfeed’, was significantly associated with EBF eight weeks or longer. Women who gave birth at hospitals that reported full implementation of Step 7 were 1.77 times more likely to EBF for eight weeks or longer. This is consistent with the findings of Declercq et al, (2009) who reported a significant increase in the odds a woman would meet her prenatal intention to breastfeed exclusively when hospital staff helped mothers’ breastfeed.24

In this study hospitals with the fewest deliveries, (<500 per year) were positively associated (PR=1.25 (95% CI: 1.16, 1.34)) with EBF longer than eight weeks. The number of annual deliveries may reflect other hospital characteristics including geographic location and catchment area or designated perinatal level. In NYS, an
assessment of hospital practices resulted in significantly higher EBF during hospital stay in Level 1 (basic care) perinatal designated hospitals when compared to the highest level of care, regional perinatal centers (RPCs). Total annual hospital births and perinatal designation/level of care are correlated, with perinatal level 1 hospitals typically having fewer annual births and the RPCs typically having the largest number of births. It is likely that mothers and newborns experience fewer interruptions at smaller hospitals with fewer births and basic maternity care. These interruptions may negatively impact establishment of breastfeeding and therefore success with EBF.

The only maternal socio-demographic variable significantly and positively-associated with EBF was being married. Age less than 20 years old was negatively associated with EBF eight weeks or longer. These findings are consistent with those reported by others. Also reported here is that women who self-identified as black race were 25 percent less likely to exclusively breastfeed for eight weeks or longer. Again this finding is consistent with a substantial number of studies demonstrating lower levels of breastfeeding initiation, duration and exclusivity in women of black race. These findings provide further evidence that select populations may benefit from targeted interventions to improve EBF. Higher levels of educational attainment were also negatively associated with EBF in this data. Women with an educational attainment above a high school degree were 23% less likely to EBF for eight weeks or more. Although this is not consistent with some research, it has been suggested that women with professional employment requiring high educational attainment may be less likely to breastfeed exclusively after returning to work. Issues of maternity leave and returning to work while still breastfeeding, have well documented challenges. One
explanation for our findings is that in 2007 there was very limited worksite support for breastfeeding in NYS. The NYS labor law ‘Nursing Mothers in the Workplace Act’ was not enacted until 2007. Whether recent state and federal laws ensuring worksite provision of time as well as place to pump have reduced the impact of return to work on EBF is yet to be determined. As stated previously, socio-demographic factors have been estimated to account for up to 60% of variation in EBF at hospital discharge. From the results reported here, it is apparent that improving hospital maternity care practices only without consideration of the maternal and hospital characteristics may not be sufficient to improve EBF rates.

This study has numerous strengths. First, most hospitals that provide maternity care in NYS were included in this study (n=95) which is more hospitals than any other study evaluating maternity care practices on state specific breastfeeding rates. Secondly, utilizing both NYS (excluding NYC) and NYC PRAMS data which are weighted to represent the entire state population of women giving birth in NYS, provided a large sample size which enhances precision of estimates. Thirdly, this study included only mothers with infants who did not receive NICU care, thus decreasing variations in EBF due to medically necessary formula supplementation.

This study has several limitations. The data are self-reported. In the case of PRAMS, the data are self-reported by the mother. Three indicators (including breastfeeding) collected by PRAMS were found to be valid and reliable. Additionally, reporting error is not likely to differ by outcome (EBF) because respondents were asked a large number of questions regarding prenatal and postnatal experiences other than breastfeeding so they would be unlikely to identify breastfeeding as a specific outcome.
A number of complex maternal characteristics that have been reported in the literature to be significantly associated with EBF at six months include postpartum maternal mental and emotional health. Several PRAMS questions could serve as proxies for these measures, however inclusion and assessment of these was beyond the scope of the present study.

The mPINC data were also self-reported. The survey “was to be completed by a key informant on behalf of his or her institution in their capacity as the person most knowledgeable about the relevant practices (http://www.cdc.gov/breastfeeding/data/mpinc/survey.htm).” It is possible that not all responses accurately reflect true hospital practices since individuals may have felt obligated to report more favorable practices. Lastly, not all NYS hospitals providing maternity care in 2007 completed the mPINC survey and those hospitals where staff did not complete the survey may differ from those that did, in an undetermined way.

Conclusion

The mPINC survey was initially conducted in 2007 and has continued biennially. This study provides baseline data on the impact of hospital practices, characteristics and maternal socio-demographics on EBF in NYS that can be followed longitudinally. The finding that Step 5 ‘Show mothers how to breastfeed’ is associated with EBF eight weeks or longer supports the importance of ensuring that hospital staff providing direct care for new mother/infant dyads have the skills and knowledge to competently provide basic breastfeeding support. This study also confirms previously reported socio-demographic disparities in EBF. In addition to improving hospital maternity care practices, specifically tailored strategies and interventions may be needed for at-risk
populations to achieve their EBF goals.\textsuperscript{10} Since 2007, there have been many staff education opportunities, hospital quality improvement efforts, and policy changes designed to improve hospital breastfeeding support in NYS.\textsuperscript{46,47} Future research is needed to assess the impact of these efforts on hospital maternity care practices and breastfeeding support.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References


Figure 1. Percent of hospitals with mPINC scores for full implementation (score 90-100) of the Ten Steps and formula gift
### Table 1: Characteristics for study population (weighted n = 97,682)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Weighted n</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclusive breastfeeding &gt;8 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>35,993</td>
<td>36.85</td>
</tr>
<tr>
<td>No</td>
<td>61,690</td>
<td>63.15</td>
</tr>
<tr>
<td>Maternal age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 20</td>
<td>6,306</td>
<td>9.93</td>
</tr>
<tr>
<td>21-30</td>
<td>31,489</td>
<td>49.58</td>
</tr>
<tr>
<td>31-40</td>
<td>24,178</td>
<td>38.07</td>
</tr>
<tr>
<td>40 or above</td>
<td>1,534</td>
<td>2.41</td>
</tr>
<tr>
<td>Maternal race/ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>45,764</td>
<td>47.30</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>16,244</td>
<td>16.79</td>
</tr>
<tr>
<td>Hispanic</td>
<td>23,416</td>
<td>24.20</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>10,792</td>
<td>11.15</td>
</tr>
<tr>
<td>Native American</td>
<td>327</td>
<td>0.34</td>
</tr>
<tr>
<td>Other</td>
<td>204</td>
<td>0.21</td>
</tr>
<tr>
<td>Maternal educational attainment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greater than High School</td>
<td>54,532</td>
<td>56.17</td>
</tr>
<tr>
<td>High school or less</td>
<td>42,558</td>
<td>43.83</td>
</tr>
<tr>
<td>Maternal marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>64,791</td>
<td>66.33</td>
</tr>
<tr>
<td>Not married</td>
<td>32,891</td>
<td>33.67</td>
</tr>
<tr>
<td>Maternal pre-pregnancy weight status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(BMI kg/m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight (&lt;18.5)</td>
<td>13,288</td>
<td>14.74</td>
</tr>
<tr>
<td>Normal (18.5-&lt;25)</td>
<td>49,125</td>
<td>54.48</td>
</tr>
<tr>
<td>Overweight (25-&lt;30)</td>
<td>10,677</td>
<td>11.84</td>
</tr>
<tr>
<td>Obese (&gt;30)</td>
<td>17,076</td>
<td>18.94</td>
</tr>
<tr>
<td>Maternal smoking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>95,414</td>
<td>97.67</td>
</tr>
<tr>
<td>Yes</td>
<td>2,269</td>
<td>2.32</td>
</tr>
<tr>
<td>Maternal history of physical abuse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>95,471</td>
<td>98.07</td>
</tr>
<tr>
<td>Yes</td>
<td>1,883</td>
<td>1.93</td>
</tr>
<tr>
<td>WIC while pregnant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>52,350</td>
<td>54.34</td>
</tr>
<tr>
<td>Yes</td>
<td>43,984</td>
<td>45.66</td>
</tr>
<tr>
<td>Medicaid before pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>78,060</td>
<td>80.25</td>
</tr>
<tr>
<td>Yes</td>
<td>19,209</td>
<td>19.75</td>
</tr>
<tr>
<td>Delivery type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaginal</td>
<td>67,785</td>
<td>69.64</td>
</tr>
<tr>
<td>C-section</td>
<td>29,555</td>
<td>30.36</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Number (n)</td>
<td>Percent</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Annual deliveries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;500</td>
<td>22</td>
<td>23.40</td>
</tr>
<tr>
<td>500-999</td>
<td>11</td>
<td>11.70</td>
</tr>
<tr>
<td>1000-1999</td>
<td>23</td>
<td>24.47</td>
</tr>
<tr>
<td>2000-5000+</td>
<td>38</td>
<td>40.43</td>
</tr>
<tr>
<td><strong>C-section rate</strong> (%% of deliveries)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25%</td>
<td>23</td>
<td>24.47</td>
</tr>
<tr>
<td>&gt;=25%</td>
<td>71</td>
<td>75.53</td>
</tr>
<tr>
<td><strong>Births paid by Medicaid</strong> (% of deliveries)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;=33%</td>
<td>39</td>
<td>41.49</td>
</tr>
<tr>
<td>34-66%</td>
<td>35</td>
<td>37.23</td>
</tr>
<tr>
<td>67-100%</td>
<td>20</td>
<td>21.28</td>
</tr>
<tr>
<td><strong>Delivery attended by midwife</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>29</td>
<td>30.85</td>
</tr>
<tr>
<td>Yes</td>
<td>65</td>
<td>69.15</td>
</tr>
<tr>
<td><strong>Rural/Urban</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>71</td>
<td>75.53</td>
</tr>
<tr>
<td>Town/Large rural</td>
<td>15</td>
<td>15.96</td>
</tr>
<tr>
<td>Small/Isolated rural</td>
<td>8</td>
<td>8.51</td>
</tr>
<tr>
<td><strong>Perinatal Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1 (Basic Care)</td>
<td>37</td>
<td>39.36</td>
</tr>
<tr>
<td>Level 2 (Specialty Care)</td>
<td>18</td>
<td>19.15</td>
</tr>
<tr>
<td>Level 3 (Sub-specialty Care)</td>
<td>29</td>
<td>30.85</td>
</tr>
<tr>
<td>Level 4 Regional Perinatal Center (RPC)</td>
<td>10</td>
<td>10.64</td>
</tr>
</tbody>
</table>
Table 3: Distribution of mothers by hospital mPINC scores and unadjusted prevalence ratios (PR) for implementation of each of the Ten Steps and exclusive breastfeeding eight weeks or longer

<table>
<thead>
<tr>
<th>Ten Steps to Successful Breastfeeding</th>
<th>mPINC score</th>
<th>Weighted n</th>
<th>%</th>
<th>Exclusively breastfed (%)</th>
<th>PR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have a written breastfeeding policy</td>
<td>90-100</td>
<td>54,741</td>
<td>56.04</td>
<td>35.71</td>
<td>0.93</td>
<td>0.77, 1.13</td>
</tr>
<tr>
<td>&lt;90</td>
<td>42,941</td>
<td>43.96</td>
<td>38.29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Train all health care staff</td>
<td>75-100</td>
<td>28,105</td>
<td>28.77</td>
<td>35.66</td>
<td>0.96</td>
<td>0.75, 1.21</td>
</tr>
<tr>
<td>&lt;75</td>
<td>69,578</td>
<td>71.23</td>
<td>37.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Inform all pregnant women about the benefits and management of breastfeeding</td>
<td>90-100</td>
<td>13,402</td>
<td>13.93</td>
<td>36.34</td>
<td>0.94</td>
<td>0.80, 1.11</td>
</tr>
<tr>
<td>&lt;90</td>
<td>82,812</td>
<td>86.07</td>
<td>38.60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Help mothers initiate early breastfeeding after birth</td>
<td>90-100</td>
<td>46,324</td>
<td>48.22</td>
<td>37.64</td>
<td>1.05</td>
<td>0.87, 1.28</td>
</tr>
<tr>
<td>&lt;90</td>
<td>49,734</td>
<td>51.78</td>
<td>37.64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Show mothers how to breastfeed</td>
<td>90-100</td>
<td>70,308</td>
<td>73.14</td>
<td>38.68</td>
<td>1.23</td>
<td>1.02, 1.50</td>
</tr>
<tr>
<td>&lt;90</td>
<td>25,750</td>
<td>26.81</td>
<td>31.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Give breastfeeding newborn infants no food or drink other than breast milk</td>
<td>90-100</td>
<td>22,940</td>
<td>24.69</td>
<td>35.81</td>
<td>1.00</td>
<td>0.83, 1.19</td>
</tr>
<tr>
<td>&lt;90</td>
<td>69,967</td>
<td>75.31</td>
<td>35.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Practice rooming in</td>
<td>90-100</td>
<td>21,687</td>
<td>22.86</td>
<td>32.70</td>
<td>0.86</td>
<td>0.65, 1.15</td>
</tr>
<tr>
<td>&lt;90</td>
<td>73,191</td>
<td>77.14</td>
<td>38.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Encourage breastfeeding on demand</td>
<td>90-100</td>
<td>41,113</td>
<td>43.85</td>
<td>37.82</td>
<td>1.10</td>
<td>0.91, 1.33</td>
</tr>
<tr>
<td>&lt;90</td>
<td>52,639</td>
<td>56.15</td>
<td>34.39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Give no artificial teats or pacifiers</td>
<td>90-100</td>
<td>31,074</td>
<td>33.26</td>
<td>36.93</td>
<td>0.98</td>
<td>0.79, 1.23</td>
</tr>
<tr>
<td>&lt;90</td>
<td>62,361</td>
<td>66.74</td>
<td>37.59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Discharge support</td>
<td>90-100</td>
<td>26,508</td>
<td>30.20</td>
<td>37.23</td>
<td>0.97</td>
<td>0.79, 1.19</td>
</tr>
<tr>
<td>&lt;90</td>
<td>61,271</td>
<td>69.80</td>
<td>38.43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge formula gift provided</td>
<td>No</td>
<td>39,183</td>
<td>40.11</td>
<td>34.47</td>
<td>0.90</td>
<td>0.74, 1.09</td>
</tr>
<tr>
<td>Yes</td>
<td>58,499</td>
<td>59.89</td>
<td>38.44</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4: Adjusted association of mPINC scores and other characteristics with exclusive breastfeeding at least eight weeks

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level</th>
<th>Model 1&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Model 2&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PR</td>
<td>95% CI</td>
<td>PR</td>
</tr>
<tr>
<td>1. Have a written breastfeeding policy</td>
<td>90-100</td>
<td>0.95</td>
<td>0.80, 1.14</td>
</tr>
<tr>
<td></td>
<td>&lt;90</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>2. Train all health care staff</td>
<td>75-100</td>
<td>1.04</td>
<td>0.90, 1.22</td>
</tr>
<tr>
<td></td>
<td>&lt;75</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>3. Inform all pregnant women about the benefits and management of breastfeeding</td>
<td>90-100</td>
<td>1.20</td>
<td>1.06, 1.36</td>
</tr>
<tr>
<td></td>
<td>&lt;90</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>4. Help mothers initiate early breastfeeding after birth</td>
<td>90-100</td>
<td>0.86</td>
<td>0.66, 1.11</td>
</tr>
<tr>
<td></td>
<td>&lt;90</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>5. Show mothers how to breastfeed</td>
<td>90-100</td>
<td>1.48</td>
<td>1.33, 1.63</td>
</tr>
<tr>
<td></td>
<td>&lt;90</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>6. Give breastfeeding newborn infants no food or drink other than breastmilk</td>
<td>90-100</td>
<td>0.86</td>
<td>0.66, 1.11</td>
</tr>
<tr>
<td></td>
<td>&lt;90</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>7. Practice rooming in</td>
<td>90-100</td>
<td>0.97</td>
<td>0.60, 1.58</td>
</tr>
<tr>
<td></td>
<td>&lt;90</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>8. Encourage breastfeeding on demand</td>
<td>90-100</td>
<td>0.96</td>
<td>0.80, 1.15</td>
</tr>
<tr>
<td></td>
<td>&lt;90</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>9. Give no artificial teats or pacifiers</td>
<td>90-100</td>
<td>0.64</td>
<td>0.49, 0.84</td>
</tr>
<tr>
<td></td>
<td>&lt;90</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>10. Discharge support</td>
<td>90-100</td>
<td>0.86</td>
<td>0.42, 1.75</td>
</tr>
<tr>
<td></td>
<td>&lt;90</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Discharge formula gift provided</td>
<td>No</td>
<td>1.16</td>
<td>0.96, 1.40</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Maternal age</td>
<td>Less than 20 years</td>
<td>0.91</td>
<td>0.82, 1.00</td>
</tr>
<tr>
<td></td>
<td>21-50 years</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>0.72</td>
<td>0.72, 1.17</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>No.</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Maternal Hispanic Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>0.69</td>
<td>0.59,0.88</td>
<td>0.75, 0.92</td>
</tr>
<tr>
<td>Other</td>
<td>0.71</td>
<td>0.42,1.20</td>
<td>0.64, 0.72</td>
</tr>
<tr>
<td>Maternal educational attainment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greater than High School</td>
<td>0.70</td>
<td>0.60,0.83</td>
<td>0.77, 0.99</td>
</tr>
<tr>
<td>High school or less</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>1.29</td>
<td>0.89,1.86</td>
<td>1.35, 1.79</td>
</tr>
<tr>
<td>Not married</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal pre-pregnancy BMI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight (&lt;18.5) and Normal Weight (18.5-&lt;25)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight (25-&lt;30) and Obese (&gt;30)</td>
<td>0.75</td>
<td>0.67,0.83</td>
<td>0.73, 0.99</td>
</tr>
<tr>
<td>Maternal smoking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0.98</td>
<td>0.3,3.18</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital annual deliveries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;500</td>
<td>1.03</td>
<td>0.79,1.36</td>
<td>1.25, 1.34</td>
</tr>
<tr>
<td>500-999</td>
<td>0.32</td>
<td>0.22,0.47</td>
<td>0.46, 0.80</td>
</tr>
<tr>
<td>1000-1999</td>
<td>1.20</td>
<td>1.03,1.39</td>
<td>1.37, 1.47</td>
</tr>
<tr>
<td>2000-5000+</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

58
<table>
<thead>
<tr>
<th>Hospital Perinatal level</th>
<th>Regional Perinatal Center (RPC)</th>
<th>Level 1 (Basic care)</th>
<th>Level 2 (Specialty care)</th>
<th>Level 3 (Sub-specialty care)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.00</td>
<td>1.40</td>
<td>1.23, 1.59</td>
<td>0.94, 1.27</td>
</tr>
</tbody>
</table>

*Model 1. Logistic regression model for weighted survey data includes all variables identified as significant in bivariate analysis. Wald statistic for model = 64.18 (p=0.0153)*

*Model 2. Logistic regression model for weighted survey data was generated from a stepwise elimination of non-significant variables from model 1. Wald statistic for model 1671 = (p=0.0006)*
**Paper #2**

**Title:** Breastfeeding non-initiation: The role of hospital practices and maternal socio-demographic factors in New York State

**Author(s):**
Eileen FitzPatrick,\textsuperscript{1,2} MPH, RD
Barbara A. Dennison,\textsuperscript{2,3} MD
Trang Nguyen,\textsuperscript{4} MD, DrPH,
Marilyn Kacica,\textsuperscript{2,5} MD,MPH,
David Strogatz,\textsuperscript{2,6} PhD

\textsuperscript{1}Nutrition Science Department, The Sage Colleges, Troy, New York
\textsuperscript{2}School of Public Health, University at Albany, Rensselaer, New York
\textsuperscript{3}Division of Chronic Disease Prevention, New York State Department of Health, Albany, New York
\textsuperscript{4}Office of Public Health Practice, New York State Department of Health, Albany, New York
\textsuperscript{5}Division of Family Health, New York State Department of Health, Albany, NY
\textsuperscript{6}Center for Rural Community Health, Bassett Healthcare Network, Cooperstown, NY

**Corresponding author:**
Eileen FitzPatrick, MPH, RD
The Sage Colleges
65 First Street
Troy, NY 12180
Phone: 518-244-2048
Email: fitzpe@sage.edu

**Acknowledgements:**

**Abbreviations**
NYS – New York State
EBF- Exclusive Breastfeeding
mPINC – Maternity Practices in Infant Nutrition and Care
PRAMS – Pregnancy Risk Assessment and Monitoring System
BFHI- Baby Friendly Hospital Initiative
AOR – Adjusted odds ratio

**Word count abstract:** 237
**Word count text:** 3,154
**Well established:** Hospital maternity care practices consistent with the *Ten Steps to Successful Breastfeeding* improve breastfeeding initiation. The impact of individual Steps on breastfeeding initiation remains unclear. The prevalence of non-initiation of breastfeeding is low, but contributes to racial/ethnic disparities in breastfeeding.

**Newly Expressed:** When not fully implemented in hospitals, *Step 7* of the *Ten Steps to Successful Breastfeeding*, ‘practice rooming-in’, doubles the odds of a woman not initiating breastfeeding. Other hospital and maternal characteristics also increase the odds of a woman not initiating.

**Abstract**

The prevalence of breastfeeding initiation in New York State (NYS) nearly meets *Healthy People 2020* goals. There is however, a small persistent group of women who do not initiate breastfeeding during the birth hospitalization. This population is often the target of efforts to reduce racial/ethnic disparities in breastfeeding. Hospital maternity care practices codified in the *Ten Steps to Successful Breastfeeding* have been shown to improve breastfeeding initiation and reduce non-initiation when fully implemented. Data on the independent associations of specific Steps and breastfeeding initiation have been equivocal. Utilizing NYS-linked data from the Maternity Practices in Infant Nutrition and Care (mPINC) and the Pregnancy Risk Assessment Monitoring System (PRAMS), the association between individual maternity care practices/Steps and breastfeeding non-initiation was evaluated. The study sample included mothers who participated in PRAMS and gave birth to a healthy infant in a NYS hospital that participated in mPINC in 2007. Weighted multiple logistic regression analysis was conducted. The study sample represented 116,198 new mothers, 15.9 percent of whom did not initiate breastfeeding. Mothers who gave birth in a maternity care hospital that reported not fully implementing *Step 7* ‘practice rooming-in’ had twice the odds (AOR=2.14 (95% CI:1.19,3.88) of not
initiating breastfeeding, after adjustment for maternal demographic and hospital characteristics. No other maternity care practices/Steps were significantly associated with non-initiation. Full implementation of ‘rooming-in’ in hospitals serving populations at higher risk for non-initiation may contribute to improved prevalence of breastfeeding initiation.

**Background**

Human milk is the gold standard for infant feeding. Breastfeeding has well-documented health benefits for infants, including fewer episodes of acute respiratory illnesses, otitis media, and gastroenteritis, reduced incidence of sudden infant death syndrome, and reduced risk of asthma, obesity, and chronic disease in childhood and beyond.\(^1\) Breastfeeding benefits mothers by reducing postpartum bleeding and anemia and by lowering the risk for breast and ovarian cancers, and osteoporosis.\(^1\)

Most mothers decide during pregnancy, how they will feed their infant.\(^2,3\) Prenatally, factors such as maternal socio-demographics and interactions with the healthcare system influence mothers’ infant-feeding intentions.\(^2,4-6\) Intention to breastfeed is strongly associated with initiation of breastfeeding after birth.\(^4,7\) The majority of American women (79.2%)\(^8\) attempt to breastfeed during the birth hospitalization. For breastfeeding initiation, *Healthy People 2010* and 2020 goals were set to 75% and 81.9 %,\(^9,10\) respectively. In New York State (NYS), breastfeeding initiation for the 2011 birth cohort is close to meeting the *Healthy People 2020* goal of 81.9%.\(^8\) For NYS birth cohorts 2007, 2008, 2009, 2010, 2011 the prevalence was, 81.4, 78.2, 80.8, 82.6, and 80.5 percent respectively.\(^8\)
In 1991, The Baby-Friendly Hospital Initiative (BFHI) was established by the World Health Organization and the United Nations Children’s Fund. The program “is a global effort for improving the role of maternity services to enable mothers to breastfeed babies for the best start in life.” By 2015 nine of the 125 NYS hospitals currently providing maternity care services, were accredited by Baby Friendly, USA, as Baby-Friendly (https://www.babyfriendlyusa.org/find-facilities/designated-facilities--by-state).

The Ten Steps to Successful Breastfeeding and the International Code of Marketing of Breast-Milk Substitutes are the tenets of the BFHI. Internationally, there is evidence supporting the efficacy of each of the Ten Steps for the enhancement of breastfeeding. Hospital implementation of the Ten Steps (or practices), and acquiring the Baby-Friendly accreditation by a US hospital have been shown to significantly increase and sustain hospital breastfeeding initiation rates over time. Hospital maternity care practices consistent with the Ten Steps have been reported in other published US studies to improve breastfeeding initiation.

Baby-Friendly accreditation itself may not be necessary if the Ten Steps are fully implemented and breastfeeding rates are high. However, unless a hospital is certified, it is difficult to validate full implementation of the Ten Steps. In addition, some hospitals may need the structure of the accreditation process to achieve implementation of the Ten Steps. It has also been reported that full implementation of these Steps in hospitals does not significantly increase birthing costs. Despite this, in 2011, based on the Maternity Practices in Infant Nutrition and Care (mPINC) national survey of hospitals, Centers for Disease Control and Prevention (CDC) reported that most US hospitals have practices inconsistent with the Ten Steps.
The mPINC survey is the first nationwide survey to assess maternity care practices reported by hospitals. For NYS, response rates for this survey have been high (75% or greater). This survey provides a unique opportunity to evaluate NYS hospital maternity practices and breastfeeding outcomes in women who gave birth at those hospitals. Previously, hospital maternity care practices have been evaluated through mothers’ reported experience of those practices while in the hospital. This study utilizes the hospital reported practices from the mPINC survey for NYS, and breastfeeding data from the Pregnancy Risk Assessment Monitoring System (PRAMS) from mothers in NYS (excluding NYC) and NYC, to identify which maternity care practices/Steps are most important for reducing non-initiation of breastfeeding.

Methods

Data Sources:

The mPINC was first conducted in 2007 by CDC to evaluate maternity care and infant feeding practices in hospitals and birth centers in the US. “The survey contains 52 questions regarding the birth facility’s maternity practices, training, personnel, policy, and facility characteristics.” Detailed information on the survey methodology is available (http://www.cdc.gov/breastfeeding/data/mpinc/scoring.htm). The NYS 2007 mPINC dataset included surveys from 110 hospitals (75 % response rate).

PRAMS is a population-based survey of new mothers designed to measure maternal experiences and behaviors before, during, and after pregnancy. PRAMS participants are randomly selected from state birth certificate files. NYS and NYC PRAMS datasets were weighted based on sample design, sampling probability, non-response and non-coverage to be representative of all women giving birth in NYS.
(excluding NYC) and NYC, respectively. In 2007, 1,123 and 1,492 women participated in the NYS (excluding NYC) and NYC PRAMS surveys, respectively. Detailed information on PRAMS methodology can be found elsewhere (www.cdc.gov.prams/methodology.htm). The mPINC and PRAMS data sets were linked by hospital however no individual hospital results were analyzed or presented due to confidentiality and small sample sizes. The final dataset excluded any infants who were transferred to a neonatal intensive care unit (NICU) or was reported as deceased.

Definition of variables

**Dependent/Outcome variable**

The outcome for this study is non-initiation of breastfeeding. The PRAMS survey question asked “Did you ever breastfeed or pump breast milk to feed your new baby after delivery?” All participants with a “no” response to this question were categorized as non-initiating.

**Independent/Exposure variables**

The mPINC survey included a series of questions evaluating hospital practices. Questions measuring the implementation of the *Ten Steps to Successful Breastfeeding* and the practice of providing discharge formula gift packs were selected. Response variables for these questions and the corresponding scores were used to measure if the *Steps* were fully implemented. Response options for most of the items were categorical in nature as follows: Few (0%–9%), Some (10%–49%), Many (50%–89%), Most (90%+), Not sure.\(^2\) Thus responses measured the proportion of mothers/infants that experienced the *Step*. These responses were converted to a score. The scoring algorithm\(^2\) utilized for mPINC, resulted in numerical categories, within the range of 0-100. For the current
study, these scores were dichotomized so full implementation of the Step was a score 90 or higher while incomplete implementation of the Step was a score below 90. Additionally, the variable for provision of discharge formula gift packs (yes/no) was included since it represents the marketing of breast milk substitutes which is a component of the BFHI in conjunction with the Ten Steps.

**Potential confounders**

Variables for hospital characteristics for 2007 were publically available and linked to each hospital. Variables included total annual hospital births, delivery mode (% Cesarean section), insurance coverage of deliveries (% Medicaid), deliveries attended by midwife (%), hospital perinatal level ([link](http://www.health.ny.gov/community/pregnancy/health_care/perinatal/regionalization_d escrip.htm)), and urban/suburban/rural designation (based on the Rural Urban Commuting Area (RUCA) code for the hospital zip code). This dataset was merged with the PRAMS and mPINC datasets and as stated above, hospital identifiers were removed to maintain anonymity.

The 2007 NYS and NYC PRAMS public use datasets contained variables for the 88 survey questions plus core birth certificate variables and operational variables. Both the NYS and NYC PRAMS surveys have the same core questions. Variables used for analysis included demographic information from the birth certificate as well as survey questions. Questions on the PRAMS survey cover factors previously reported in the literature to be associated with breastfeeding behavior. These included maternal age, educational attainment, race, ethnicity, weight status and marital status. Also utilized
were variables for type of delivery (vaginal or Cesarean section), WIC participation, health insurance coverage, intimate partner violence and smoking behavior.

**Data Analysis:**

The final study sample included the 2007 PRAMS records for mothers who gave birth in NYS hospitals with 2007 mPINC survey data. Weighted analyses of the linked data were conducted. Univariate analysis was completed to assess breastfeeding non-initiation in the study sample and the distribution of independent variable sub-groups.

Bivariate analyses generated unadjusted odds ratios (OR) with 95% confidence intervals (CI) for the association between non-initiation and hospital maternity care practices/Steps. Variables that have been indicated in the literature and/or in bivariate analyses to be associated with non-initiation were included in the weighted multiple logistic models. Prior to modeling, Pearson correlation coefficients (r) were generated for independent variables proposed for the full model to assess for multicollinearity. If any variables were highly correlated, (r=0.60 or higher), one variable of the correlated pair was removed. Variables retained were those judged to be more important of the pair for the outcome, non-initiation of breastfeeding, based on published literature. Interactions between Steps, and race/ethnicity have been reported by others and was assessed.

Weighted multiple logistic regression analysis to determine the association between hospital maternity care practices/Steps and breastfeeding non-initiation was conducted. A full model included all identified variables from bivariate analyses. Variables that were found to be significant (p≤0.05) were retained in the model and stepwise elimination of independent variables from the least significant/highest p-value
was conducted to arrive at a final model. The final logistic regression model was assessed for goodness-of-fit. All data were analyzed using SAS (version 9.2 or 9.4, SAS Institute, Inc., Cary, NC). PROC SURVEY was used for the analysis of all weighted data. This research was approved by the Institutional Review Board of the NYS Department of Health.

**Results**

The merged data from the PRAMS and the mPINC datasets included PRAMS participants who gave birth at those hospitals with completed 2007 mPINC survey (n=95, 86% of hospitals in the mPINC dataset). After excluding mothers, whose infant was admitted to the NICU or deceased or mothers who delivered in hospitals that did not participate in the 2007 mPINC survey, 1,294 completed PRAMS surveys were used for analyses. The weighted sample represented 116,198 new mothers in NYS.

In this study sample, 15.9% of mothers did not initiate breastfeeding. A description of the study population, by maternal characteristics, is presented in Table 1. Approximately half of mothers were white and aged 21-30 years. The majority were married and had an educational attainment beyond high school. Based on self-reported pre-pregnancy weight and height, 54% had a calculated BMI to be in the normal weight status category and less than 5% percent reported smoking. Fifty percent were primiparas.

Table 2 displays hospital characteristics that are potentially associated with maternity care practices/Steps. The majority of hospitals, had greater than 1,000 deliveries annually and were located in urban areas. More than a third of their maternity
patients had Medicaid insurance. Seventy-one of the hospitals had Cesarean section rates greater than 25%.

The mPINC hospital survey measured the degree of adherence to each of the Ten Steps with a score between 0-100. A final total score for overall maternity care for each hospital was included in the mPINC dataset. The NYS mean score for 2007 mPINC was 67. For hospitals analyzed for this study the mean score was 66. The range of total mPINC scores for these hospitals was 35 through 88. Failure to achieve complete implementation of an individual Step was defined as a score of <90 for this study, which is consistent with the methodology used by the CDC.24 The percent of hospitals that did not achieve each of the Ten Steps (i.e., score <90) or the provision of discharge formula gift packs are provided in Figure 1. Incomplete implementation was observed in over 50% of the hospitals for seven of the ten Steps, and the majority of hospitals also provided formula gift packs at discharge. Distribution of mothers by Steps, as well as the unadjusted ORs for the association between each Step and non-initiation of breastfeeding is shown in Table 3. Only Step 9, ‘give no pacifier’ was significantly associated with non-initiation of breastfeeding (UOR=0.57; 95%CI: 0.33, 0.96).

A full multivariate logistic regression model that included all the Steps and both hospital, and maternal characteristics identified as potential confounders was developed. When all Steps were included in the model, none of the Steps were significantly associated with non-initiation (data not shown). Each practice/Step was then individually modeled with potential confounding variables. Interactions for Steps and race/ethnicity were assessed but none were statistically significant (p<0.05). After individual modeling, Step 7 ‘Practice rooming in’ was the only Step/practice significantly associated with non-

69
initiation. In the full model (Model 1), giving birth in hospitals that reported not fully implementing ‘rooming-in,’ resulted in an AOR=2.48 (95% CI: 1.40, 4.40) for non-initiation of breastfeeding (Table 4). Provision of discharge formula gift packs was also positively associated with non-initiation (AOR=1.74; 95% CI: 1.15, 2.64). Other variables significantly positively associated with non-initiation of breastfeeding include maternal smoking, which was strongly associated with non-initiation (AOR=27.60 (95% CI: 7.2, 105.80). Non-Hispanic ethnicity and not being married were significantly positively associated also (AOR=3.06; 95% CI: 1.51, 6.19) and (AOR=5.28; 95% CI: 2.70, 10.34), respectively.

Stepwise elimination of non-significant variables resulted in the reduced logistic regression model (Model 2) in Table 4. The positive association between failure to fully implement Step 7 ‘practice rooming in,’ and non-initiation of breastfeeding persisted with an AOR=2.14 (95% CI: 1.19, 3.88). Additionally, several maternal characteristics associated with non-initiation of breastfeeding persisted, including smoking AOR=5.96 (95% CI: 2.08, 17.01), non-Hispanic ethnicity AOR=2.78 (95% CI: 1.65, 4.67), and being unmarried AOR=2.66 (95% CI: 1.72, 4.11).

Regarding hospital characteristics, perinatal level designation was significantly positively associated with non-initiation. In the reduced model (Model 2) hospitals designated Level 1 (basic care) had an AOR=2.73 (95% CI: 1.09, 6.84), Level 2 (specialty care) an AOR=3.86 (95% CI: 1.74, 8.56), and Level 3 (sub-specialty care), an AOR=2.09 (95% CI: 1.04, 4.18), compared to the Regional Perinatal Centers (RPCs) that provide the highest level of care.
Discussion

The current study provides evidence of the importance of at least one aspect of hospital maternity care practices for non-initiation of breastfeeding. In this study sample, women who gave birth at hospitals that reported incomplete implementation of Step 7 ‘practice rooming-in’ were more than twice as likely to not initiate breastfeeding when compared to women giving birth at a hospital that reported complete implementation of ‘rooming-in.’ This finding is in contrast to a study in Oregon hospitals that reported\textsuperscript{16} that rooming-in was not significantly associated with breastfeeding initiation. However, in a small study from Puerto Rico ‘rooming-in’ was shown to increase the odds of breastfeeding initiation by a factor of five (OR=5.0 (95\% CI: 1.5, 16.9)).\textsuperscript{25} It is likely that separation of mother and infant during the birth hospitalization reduces the opportunity for successful breastfeeding initiation. It is important to note that implementation of Step 7, ‘practice rooming-in’ is also significantly positively associated with breastfeeding duration\textsuperscript{26,27}

There is substantial evidence that maternal factors influence breastfeeding non-initiation. Of the maternal socio-demographic factors evaluated in this study, smoking was the strongest predictor of non-initiation. The odds, of not initiating breastfeeding, was over five times greater in women who reported smoking compared to non-smokers. The published literature on this topic is unequivocal; smoking is significantly associated with not initiating breastfeeding. Our findings are consistent with an early review\textsuperscript{28} as well as more recent studies\textsuperscript{29} including one utilizing PRAMS data from Missouri.\textsuperscript{30}

Being unmarried was also associated with increased likelihood of not initiating breastfeeding in the full and reduced models. This result is consistent with many other
studies. Non-Hispanic ethnicity, was also found to be inversely and significantly, associated with initiation of breastfeeding. A large population of Hispanics of Puerto Rican and Dominican origin are concentrated in the Northeast, especially in NYC. National data supports that Hispanics have the highest level of breastfeeding initiation. In a recent study using PRAMS data, non-initiation of breastfeeding was highest in non-Hispanics.

One hospital characteristic, perinatal level, was also associated with non-initiation. Women giving birth at hospitals designated Level 1 (basic care), Level 2 (specialty care) and Level 3 (sub-specialty care) were two to three times as likely to not initiate breastfeeding when compared to women giving birth at facilities designated RPCs. These results are consistent with findings from a study of New Jersey maternity care hospitals. It may be that the RPCs, which have the largest number of annual deliveries, have greater resources such as staffing and training opportunities that better support initiation of breastfeeding.

This study has numerous strengths. First, the large number of hospitals that provide maternity care in NYS and that completed the mPINC survey allowed inclusion of 95 hospitals, more than any other study evaluating maternity care practices on state specific breastfeeding rates. Secondly, utilizing NYS and NYC PRAMS data, which are weighted to represent the population of women giving birth in NYS, facilitates inference through design and analysis features to limit selection bias. Thirdly, this study included only mothers with infants who did not receive NICU care, thus eliminating variations in breastfeeding non-initiation due to infant prematurity and/or morbidity.
This study has several limitations. The data are self-reported. In the case of PRAMS, the data are self-reported by the mother. Three indicators collected by PRAMS, including breastfeeding initiation, have been found to be valid and reliable. Other research has found that maternal recall of breastfeeding is valid and reliable when interviews are completed within three years of breastfeeding cessation. The PRAMS survey is mailed 2-4 months after delivery, so it is unlikely that this time frame would result in recall bias. Additionally, reporting error is not likely to differ by outcome (non-initiation) because respondents were asked a large number of questions regarding prenatal and postnatal experiences other than breastfeeding so they would be unlikely to identify breastfeeding initiation as a specific outcome.

The mPINC data were also self-reported. The survey “was to be completed by a key informant on behalf of his or her institution in their capacity as the person most knowledgeable about the relevant practices (http://www.cdc.gov/breastfeeding/data/mpinc/survey.htm).” It is possible that not all responses accurately reflect true hospital practices. Lastly, a large number, but not all, NYS hospitals providing maternity care in 2007 completed the mPINC survey. It is possible that those that did not complete the survey differ from those that did, in an undetermined way.

The 2007 mPINC survey was the first year in a biennial series of the survey. Since 2007, many interventions and policy changes for the promotion of breastfeeding in NYS have occurred. This study provides baseline data for longitudinal study of the impact of hospital practices, characteristics and maternal socio-demographics on non-initiation of breastfeeding in NYS. Future research should include further evaluation of
the strongest predictors of breastfeeding non-initiation in NYS. However, the practice/Step identified in this study to be significantly associated with breastfeeding non-initiation was rooming-in. Of the hospitals included in this study sample, only 20% reported complete implementation for that Step. For hospitals with sub-optimal initiation rates, implementing this Step could result in important improvement in breastfeeding initiation, and in turn, improved health of mothers and their infants. This may be most crucial for facilities providing care to underserved populations, providing an opportunity to decrease racial/ethnic disparities in breastfeeding initiation and health outcomes.

Importantly, only 15% of women giving birth in NYS did not initiate breastfeeding. The behavioral factor most strongly associated with non-initiation in this study was maternal smoking. Developing and tailoring interventions to target women who smoke may be a more efficient use of clinical and public health resources than targeting the entire populations. Reductions in smoking during pregnancy might lead to increased breastfeeding initiation, but also improve birth outcomes by reducing growth retardation, reducing health risks in infancy including SIDS, and lead to improved maternal health.

References


Figure 1: Percent of hospitals with mPINC Scores for Incomplete Implementation (score <90) of the Ten Steps and Formula gift.
Table 1: Maternal characteristics for study population (weighted n = 116,164)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Weighted n</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breastfeeding initiation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>18,482</td>
<td>15.90</td>
</tr>
<tr>
<td>Yes</td>
<td>97,682</td>
<td>84.10</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 20</td>
<td>8,478</td>
<td>11.12</td>
</tr>
<tr>
<td>21-30</td>
<td>37,881</td>
<td>49.7</td>
</tr>
<tr>
<td>31-40</td>
<td>28,222</td>
<td>37.02</td>
</tr>
<tr>
<td>40 or above</td>
<td>1,645</td>
<td>2.16</td>
</tr>
<tr>
<td><strong>Race/ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>57,627</td>
<td>48.33</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>20,976</td>
<td>17.59</td>
</tr>
<tr>
<td>Hispanic</td>
<td>26,681</td>
<td>22.38</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>13,412</td>
<td>11.25</td>
</tr>
<tr>
<td>Native American</td>
<td>327</td>
<td>0.27</td>
</tr>
<tr>
<td>Other</td>
<td>217</td>
<td>0.18</td>
</tr>
<tr>
<td><strong>Educational attainment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greater than High School</td>
<td>66,074</td>
<td>55.33</td>
</tr>
<tr>
<td>High school or less</td>
<td>53,342</td>
<td>44.67</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>74,978</td>
<td>62.39</td>
</tr>
<tr>
<td>Not married</td>
<td>45,198</td>
<td>37.61</td>
</tr>
<tr>
<td><strong>Pre-pregnancy weight status (BMI kg/m²)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight (&lt;18.5)</td>
<td>16,547</td>
<td>14.81</td>
</tr>
<tr>
<td>Normal (18.5-&lt;25)</td>
<td>60,570</td>
<td>54.22</td>
</tr>
<tr>
<td>Overweight (25-&lt;30)</td>
<td>13,019</td>
<td>11.65</td>
</tr>
<tr>
<td>Obese (&gt;30)</td>
<td>21,570</td>
<td>19.31</td>
</tr>
<tr>
<td><strong>Smoking</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>115,052</td>
<td>95.74</td>
</tr>
<tr>
<td>Yes</td>
<td>5,123</td>
<td>4.26</td>
</tr>
<tr>
<td><strong>History of physical abuse</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>116,484</td>
<td>97.99</td>
</tr>
<tr>
<td>Yes</td>
<td>2,388</td>
<td>2.01</td>
</tr>
<tr>
<td><strong>WIC while pregnant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>62,284</td>
<td>52.79</td>
</tr>
<tr>
<td>Yes</td>
<td>55,703</td>
<td>47.21</td>
</tr>
<tr>
<td><strong>Medicaid before pregnancy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>94,620</td>
<td>79.09</td>
</tr>
<tr>
<td>Yes</td>
<td>25,016</td>
<td>20.91</td>
</tr>
<tr>
<td><strong>Delivery type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaginal</td>
<td>82,557</td>
<td>68.89</td>
</tr>
<tr>
<td>C-section</td>
<td>37,276</td>
<td>31.11</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Number (n)</td>
<td>Percent</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Annual deliveries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;500</td>
<td>22</td>
<td>23.40</td>
</tr>
<tr>
<td>500-999</td>
<td>11</td>
<td>11.70</td>
</tr>
<tr>
<td>1000-1999</td>
<td>23</td>
<td>24.47</td>
</tr>
<tr>
<td>2000-5000+</td>
<td>38</td>
<td>40.43</td>
</tr>
<tr>
<td><strong>C-section deliveries (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25%</td>
<td>23</td>
<td>24.47</td>
</tr>
<tr>
<td>&gt;=25%</td>
<td>71</td>
<td>75.53</td>
</tr>
<tr>
<td><strong>Medicaid insured deliveries (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;=33%</td>
<td>39</td>
<td>41.49</td>
</tr>
<tr>
<td>34-66%</td>
<td>35</td>
<td>37.23</td>
</tr>
<tr>
<td>67-100%</td>
<td>20</td>
<td>21.28</td>
</tr>
<tr>
<td><strong>Deliveries attended by midwife</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>29</td>
<td>30.85</td>
</tr>
<tr>
<td>Yes</td>
<td>65</td>
<td>69.15</td>
</tr>
<tr>
<td><strong>Rural/Urban</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>71</td>
<td>75.53</td>
</tr>
<tr>
<td>Town/Large rural</td>
<td>15</td>
<td>15.96</td>
</tr>
<tr>
<td>Small/Isolated rural</td>
<td>8</td>
<td>8.51</td>
</tr>
<tr>
<td><strong>Perinatal Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1 (Basic Care)</td>
<td>37</td>
<td>39.36</td>
</tr>
<tr>
<td>Level 2 (Specialty Care)</td>
<td>18</td>
<td>19.15</td>
</tr>
<tr>
<td>Level 3 (Sub-specialty Care)</td>
<td>29</td>
<td>30.85</td>
</tr>
<tr>
<td>Level 4 Regional Perinatal Center (RPC)</td>
<td>10</td>
<td>10.64</td>
</tr>
<tr>
<td>Hospital practice</td>
<td>mPINC score</td>
<td>Weighted n</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>1. Have a written breastfeeding policy</td>
<td>&lt;90 90-100</td>
<td>51,016 65,148</td>
</tr>
<tr>
<td>2. Train all health care staff</td>
<td>&lt;90 90-100</td>
<td>107,687 8,477</td>
</tr>
<tr>
<td>3. Inform all pregnant women about the benefits and management of breastfeeding</td>
<td>&lt;90 90-100</td>
<td>15,045 99,350</td>
</tr>
<tr>
<td>4. Help mothers initiate early breastfeeding after birth</td>
<td>&lt;90 90-100</td>
<td>59,373 85,755</td>
</tr>
<tr>
<td>5. Show mothers how to breastfeed</td>
<td>&lt;90 90-100</td>
<td>82,569 28,672</td>
</tr>
<tr>
<td>6. Give breastfeeding newborn infants no food or drink other than breast milk</td>
<td>&lt;90 90-100</td>
<td>69,437 39,375</td>
</tr>
<tr>
<td>7. Practice rooming in</td>
<td>&lt;90 90-100</td>
<td>71,777 39,375</td>
</tr>
<tr>
<td>8. Encourage breastfeeding on demand</td>
<td>&lt;90 90-100</td>
<td>69,437 39,375</td>
</tr>
<tr>
<td>9. Give no artificial teats or pacifiers</td>
<td>&lt;90 90-100</td>
<td>31,118 39,375</td>
</tr>
</tbody>
</table>
Table 4: Adjusted association for rooming-in (Step 7 of *Ten Steps*) and characteristics of hospital and mother for non-initiation of breastfeeding

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level</th>
<th>Model 1^a</th>
<th>95% CI</th>
<th>Model 2^b</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice rooming in (Step 7)</td>
<td>&lt;90 90-100</td>
<td>2.48</td>
<td>1.40</td>
<td>2.14</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.00</td>
<td>4.40</td>
<td>1.00</td>
<td>3.88</td>
</tr>
<tr>
<td>Discharge formula gift provided</td>
<td>Yes</td>
<td>1.74</td>
<td>1.15</td>
<td>2.64</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal age (years)</td>
<td>&lt;20</td>
<td>1.91</td>
<td>0.80</td>
<td>4.51</td>
<td></td>
</tr>
<tr>
<td></td>
<td>21-50 years</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal Hispanic Ethnicity</td>
<td>No</td>
<td>3.06</td>
<td>1.51</td>
<td>2.78</td>
<td>1.65</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>1.00</td>
<td>6.19</td>
<td>1.00</td>
<td>4.67</td>
</tr>
<tr>
<td>Maternal race</td>
<td>White</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Black</td>
<td>0.58</td>
<td>0.27</td>
<td>1.24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>1.32</td>
<td>0.57</td>
<td>3.05</td>
<td></td>
</tr>
<tr>
<td>Maternal educational attainment</td>
<td>Greater than</td>
<td>0.95</td>
<td>0.47</td>
<td>1.89</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High School</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>High school or less</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td>Not Married</td>
<td>5.28</td>
<td>2.70</td>
<td>10.34</td>
<td>2.66</td>
</tr>
<tr>
<td></td>
<td>Married</td>
<td>1.00</td>
<td>10.80</td>
<td>1.00</td>
<td>4.11</td>
</tr>
<tr>
<td>Maternal pre-pregnancy BMI (Kg/M²)</td>
<td>Underweight (&lt;18.5) and</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal Weight (18.5&lt;25)</td>
<td>1.36</td>
<td>0.71</td>
<td>2.58</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overweight (25&lt;-30) and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Obese (&gt;30)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal smoking</td>
<td>Yes</td>
<td>27.60</td>
<td>7.20</td>
<td>105.80</td>
<td>5.96</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td>2.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.0</td>
<td></td>
</tr>
<tr>
<td>Hospital annual deliveries</td>
<td>&lt;500</td>
<td>7.62</td>
<td>2.76</td>
<td>21.06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>500-999</td>
<td>1.75</td>
<td>0.93</td>
<td>3.29</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1000-1999</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2000-5000+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perinatal level</td>
<td>Regional Perinatal Center (RPC)</td>
<td>1.00</td>
<td></td>
<td>2.73</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>Level 1 (Basic Care)</td>
<td></td>
<td></td>
<td>6.84</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Level 2 (Specialty Care)</td>
<td>2.19</td>
<td>0.76</td>
<td>6.27</td>
<td>3.86</td>
</tr>
<tr>
<td></td>
<td>Level 3 (Sub-specialty Care)</td>
<td>1.96</td>
<td>0.67</td>
<td>5.69</td>
<td>2.09</td>
</tr>
</tbody>
</table>

^a Model 1 includes all variables identified as significant in bivariate analysis. (p<0.001)

^b Model 2 was generated from a stepwise elimination of non-significant variable from model 1. (p<0.001)
Summary of General Methodologic and Policy Issues

The study of breastfeeding is associated with specific challenges. These include methodological issues. Measurement and reporting of breastfeeding, especially exclusive breastfeeding is complicated by potential inconsistency in definitions and time frames. This can occur across surveys and/or researchers. For measurement of exclusive breastfeeding, the WHO recommended method of collection of data is via 24-hour recall. Misclassification occurs since mothers may be providing food or beverages other than breast milk but not on a regular basis, which may be missed with a 24-hour recall. Supplementation with alternative food/beverages is not uncommon and should be captured. For this study, PRAMS survey question asks at what age (in weeks) the child was provided food or drink other than breastmilk. This may depend on maternal recall since PRAMS surveys may be received by mothers four months postpartum or later. Maternal recall at least for breastfeeding has been shown to be valid up to three years.

Additionally, utilizing the appropriate preposition is crucial to correctly measuring the time frame of breastfeeding. Issues with measuring exclusive breastfeeding ‘at’ hospital discharge, through birth certificate questions, was raised by Chapman et al. The wording ‘at’ discharge did not capture feeding during the entire birth hospitalization. Subsequently, in 2010 the National Center for Health Statistics (NCHS) revised the birth certificate breastfeeding question to reflect breastfeeding inclusive of the entire time ‘between’ delivery and discharge. Using a measure such as exclusive breastfeeding ‘at’ 3 months or ‘at’ 6 months provides information that again, may misclassify infants due to irregular or inconsistent use of
supplemental food or drink. Hector recommends only using exclusive breastfeeding ‘to’ 3 months or to 6 months to clearly identify the longitudinal nature of the indicator. The current practice in the US for reporting exclusive breastfeeding is to use ‘at’ 3 or 6 months.

There are also specific analytical challenges while working with breastfeeding data. Breastfeeding behavior is self-selected. Selection into breastfeeding or bottle feeding is strongly influenced by race and socioeconomic status (SES). “A mother’s decision to breastfeed her child as well as how long she is able to do so is based on a complex web of personal, familial and social factors.” The socio-ecological model of breastfeeding (figure 1) illustrates the extent of these relationships. Identification of variables that function as true confounders or as causal intermediates can be difficult. This has become apparent recently with a small but consistent number of studies reporting that for certain outcomes such as obesity, published findings may exaggerate the benefits of breastfeeding. It is yet to be determined whether changes in breastfeeding prevalence can reduce racial and SES disparities in child and maternal health or whether disparities in breastfeeding are driven by race and SES.

Although recent publications have questioned some of the previously reported benefits of breastfeeding, potential new associations between breastfeeding and child health have been suggested. There are also areas that have yet to be explored. The importance of the human microbiome to medicine and health has been highlighted. There are established differences in bacterial profiles of microbiomes between breast and bottle fed infants. Breast milk provides probiotics (beneficial live bacteria). Prebiotics are non-digestible food ingredients that beneficially affect
the host by selectively stimulating the growth and/or activity of one or a limited number
of bacteria in the colon. Breast milk also contains prebiotics in the form of
oligosaccharides. There may also be other bioactive compounds in breast milk that
have health impacts. It has been hypothesized that the benefits of breastfeeding may be
partially explained by epigenetic processes yet the specific mechanisms have yet to be
clarified.

Humans have evolved consuming breast milk. Formula feeding culture is
relatively recent and developed parallel to the medicalization of birth and infant feeding.
“Medicalization [of childbirth] is a process that took place during much of the late
nineteenth and early twentieth centuries and it continues today. Characterized by
physician-lead highly interventionist model of care….” Formula feeding originally
began as a lifesaving medical intervention. The rise of formula feeding has been
attributed to the following factors: changes in public health and infection control, the
development of the profession of pediatrics, commercial formula interests and advances
in nutrition. Formula marketing through hospitals is evidence of the extent to which
formula is ingrained in the provision of birthing care.

The medicalized system of child birth developed from a real need to reduce
maternal and infant morbidity and mortality; however in developed countries where
presently the majority of births are healthy and uncomplicated, systems in place impede
woman-centered care. One aspect of this that impacts breastfeeding is the processing
of newborns. This entails APGAR assessment, eye prophylaxis, vitamin K injection,
newborn metabolic screening, hearing test, hepatitis B vaccine
Interruptions of the mother-infant dyad are frequent in hospitals and although well intentioned and in some aspects health promoting, may interfere with establishment of breastfeeding. Immediate and continuous skin to skin contact enhances breastfeeding, and is recommended for at least an hour after birth. In healthy newborns, hospital procedures listed above can be completed while the infant is skin to skin or delayed until after the establishment of breastfeeding.

The de-medicalization of childbirth and the birth hospitalization has been affected by the Baby Friendly Hospital Initiative (BFHI). The major tenets of the BFHI are the Ten Steps to Successful Breastfeeding. Many of the Steps specifically contribute to de-medicalization by empowering women with knowledge (Step 3) and skills (Step 5) as well as promoting mother infant bonding/togetherness (Steps 4, 7, 8). When implemented correctly and completely the Steps result in mother’s report of an improved experience and also improved breastfeeding prevalence. Breastfeeding initiation, duration and exclusivity appear to be differentially impacted by Steps. Also, the true positive effects of the Ten Steps may only be realized in the presence of certain individual and or socio-demographic characteristics. Future analyses will investigate interactions between the Steps and these variables. Meanwhile continued support for implementation of the Ten Steps in hospitals is warranted.

Efforts to increase the number of US hospitals designated Baby Friendly has been encouraged and supported by numerous US government programs including CDC’s ‘Best Fed Beginnings.’ Significant improvement in hospital maternity care quality measures has been demonstrated through data collected biennially with the Maternity Care
Practices in Infant Nutrition and Care (mPINC) survey. It has also been suggested that poor performance on mPINC hospital scores be utilized as a catalyst for improvement.

_Step 10 of the Ten Steps_ is hospital provision of post discharge support. This has been shown to be important and not easily accomplished. Hospitals and hospital maternity care practices are important for improving breastfeeding prevalence however, hospitals are just one component of the socio-ecological model of breastfeeding (figure 1). Significant barriers to successful breastfeeding exist for women in the early post-partum period and beyond. The length of maternity leave from employment is associated with establishment of breastfeeding with those with the shortest leave least likely to breastfeed or breastfeed exclusively. Fifty-seven percent of US women with children under one year of age participate in the workforce (http://www.bls.gov/news.release/famee.nr0.htm). Mandatory paid maternity leave in California was shown to increase exclusive breastfeeding by 3-5%. Without changes in maternity leave it is likely that breastfeeding prevalence, especially exclusive breastfeeding prevalence will plateau short of public health goals.

According to Fein et al., the most effective way to successfully combine breastfeeding and work is to be able to feed the infant from the breast during the workday, which is not typical of most workplaces. Most women returning to work while breastfeeding, utilize breast pumps. Breast pumps are available to WIC participants and are funded through medical insurance as part of the 2012 Affordable Care Act. Providing pumped breast milk from a bottle has been the recommendation for working women. However there are a number of studies that have raised concerns with bottle
feeding. Bottle feeding practices such as encouraging bottle emptying, considered over-
feeding, may be associated with excessive infant weight gain regardless of the type of milk (breast or formula) the bottle contains. Bottle emptying behavior has also been shown to be significantly associated with “…the likelihood of mothers pressuring their 6-year-old child to eat and children's low satiety responsiveness.” Breastfeeding from the breast appears to enhance the infant’s ability to respond to satiety cues that persist into childhood. This should be further evaluated in order to quantify the risk of provision of breast milk from a bottle.

Finally, the role of government in protecting public health was eloquently outlined by Thomas Frieden. The Government’s role in breastfeeding within the socio-ecological framework is illustrated in Figure 1. State laws that protect and support breastfeeding have been reported to increase breastfeeding prevalence in those states, with the greatest increase in breastfeeding observed in underserved populations. The northeastern US has the highest proportion of states with laws protecting and supporting breastfeeding. NYS not only has legislation to improve and support breastfeeding but has developed a statewide system to promote and monitor progress towards public health goals for breastfeeding. Epidemiological findings will continue to inform interventions for policy, system and environmental change, to improve breastfeeding in NYS.


Table 1:

**Ten Steps to Successful Breastfeeding**

Every facility providing maternity services and care for newborn infants should:

1. Have a written breastfeeding policy that is routinely communicated to all health care staff.
2. Train all health care staff in skills necessary to implement this policy.
3. Inform all pregnant women about the benefits and management of breastfeeding.
4. Help mothers initiate breastfeeding within half an hour of birth.
5. Show mothers how to breastfeed, and how to maintain lactation even if they should be separated from their infants.
6. Give newborn infants no food or drink other than breast milk, unless medically indicated.
7. Practice rooming-in - that is, allow mothers and infants to remain together - 24 hours a day.
8. Encourage breastfeeding on demand.
9. Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants.
10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic.

**Source:** *Protecting, Promoting and Supporting Breastfeeding: The Special Role of Maternity Services*, a joint WHO/UNICEF statement published by the [World Health Organization](https://www.who.int).
Table 2: CDC 2007 National Survey of Maternity Practices in Infant Nutrition and Care (mPINC) questions corresponding to the Ten Steps to Successful Breastfeeding.

<table>
<thead>
<tr>
<th>Step</th>
<th>mPINC survey question number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have a written breastfeeding policy that is routinely communicated to all health care staff.</td>
<td>B11, B12</td>
</tr>
<tr>
<td>2. Train all health care staff in skills necessary to implement this policy.</td>
<td>B3, B4</td>
</tr>
<tr>
<td>3. Inform all pregnant women about the benefits and management of breastfeeding.</td>
<td>none</td>
</tr>
<tr>
<td>4. Help mothers initiate breastfeeding within half an hour of birth.</td>
<td>A6, A10</td>
</tr>
<tr>
<td>5. Show mothers how to breastfeed, and how to maintain lactation even if they should be separated from their infants.</td>
<td>A12</td>
</tr>
<tr>
<td>6. Give newborn infants no food or drink other than breast milk, unless medically indicated.</td>
<td>A17</td>
</tr>
<tr>
<td>7. Practice rooming-in - that is, allow mothers and infants to remain together - 24 hours a day.</td>
<td>A28</td>
</tr>
<tr>
<td>8. Encourage breastfeeding on demand.</td>
<td>A13, A14</td>
</tr>
<tr>
<td>9. Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants.</td>
<td>A20</td>
</tr>
<tr>
<td>10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic.</td>
<td>A30</td>
</tr>
</tbody>
</table>
Figure 1: Socio-ecological model of breastfeeding

Source: http://www.louisianabreastfeedingcoalition.org/community/