A COHORT STUDY OF EXCLUSIVE BREASTFEEDING FROM BIRTH TO HOSPITAL DISCHARGE AND ASSOCIATED RISK FACTORS AMONG INFANTS BORN IN HOSPITAL IN THREE COMMUNITIES IN NEWFOUNDLAND AND LABRADOR

By

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ABSTRACT

Objective: To identify maternal (e.g. age, education level, partnership status), infant (e.g. gestational age, Apgar scores, ventilation), and hospital-level characteristics (e.g. type of delivery, facility, pain management) associated with exclusive breastfeeding in hospital in three communities in Newfoundland and Labrador.

Methods: A retrospective cohort study of 1,556 infants born in Clarenville, Corner Brook, and Gander from 2015 to 2016. The primary outcome variable was exclusive breastfeeding from birth to hospital discharge, defined as the infant ingesting only mother's own milk during hospital stay. For descriptive statistics, mean/standard deviation and frequency/proportion were provided for continuous and categorical variables, respectively. Logistic regression was used to identify significant risk factors associated with exclusive breastfeeding in hospital in the univariate and multivariate analysis.

Results: 50.3% of the study population exclusively breastfed from birth to hospital discharge. There were significant differences ($p < 0.05$) in exclusive breastfeeding between hospital sites, with Gander having the highest rate at 59.5%, followed by Clarenville (49.7%), and Corner Brook (48.0%). There were differences across hospital sites in maternal education levels, gestational age, cesarian section rates, epidural use, episiotomies, induction rates, length of stay, forceps, and vacuum use ($p < 0.05$). Intervention rates were greatest in Clarenville, with a higher proportion of individuals

undergoing induction, epidural, cesarian section, and operative vaginal delivery ($p < 0.05$). In the multivariate model, compared to Gander, infants from Clarenville (OR = 0.61, 95% CI: 0.41 – 0.92) and Corner Brook (OR = 0.55, 95% CI: 0.39 – 0.78) had significantly lower exclusive breastfeeding rates in hospital. Other significant factors associated with increased likelihood of exclusive breastfeeding from birth to discharge from hospital included no pre-existing diabetes (OR = 4.262, 95% CI: 1.201 – 15.118), not smoking (OR = 2.473, 95% CI: 1.814 – 3.371), post-secondary education (OR = 2.178, 95% CI: 1.624 – 2.922), infants not requiring bag-mask ventilation (OR = 1.928, 95% CI: 1.163 – 3.194), non-cesarian delivery (OR = 1.660, 95% CI: 1.297 – 2.126), and no narcotics and epidural during labour (OR = 1.475, 95% CI: 1.022 – 2.129). Vacuum use during delivery was associated with decreased likelihood of exclusive breastfeeding in hospital (OR = 0.472, 95% CI: 0.318 – 0.701).

Conclusions: Hospital site of birth is significantly associated with exclusive breastfeeding from birth to discharge in Newfoundland and Labrador, adding to the literature that maternity practices and health policies contribute to infant feeding in hospital. Several other maternal and infant characteristics and interventions also contribute to exclusive breastfeeding from birth to discharge.

Keywords: Exclusive breastfeeding, formula feeding, infant feeding, obstetrics, hospital, lactation consultant, Baby-Friendly Hospital Initiative, labour and delivery

GENERAL ABSTRACT

Exclusive breastfeeding, or nothing other than breastmilk, is recommended for all newborns in the first months of life because of the health benefits for mom and baby. However, breastfeeding rates in Newfoundland and Labrador (NL) are low compared to other Canadian provinces. This research study aimed to understand what factors influenced exclusive breastfeeding in hospital in three communities in different regional health authorities in NL. After studying over 1,500 births in Clarenville, Corner Brook, and Gander from 2015 to 2016, we found that about half of mothers exclusively breastfed their babies at hospital discharge. People were more likely to exclusively breastfeed if they delivered in Gander, were not smoking, achieved higher levels of education, and if they didn't have certain procedures or treatments (e.g. cesarian section, epidural, and vacuum). We also studied differences in health outcomes and intervention rates between hospitals. The hospitals we studied had different rates of cesarian section, epidural use, episiotomies, induction, forceps, and vacuum use, and length of stay in hospital. Our research confirms the hospital where babies are born, and the practices and policies within the hospital, affect exclusive breastfeeding from birth to discharge.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
AOR	Adjusted Odds Ratio
ARM	Artificial Rupture of Membranes
BCC	Breastfeeding Committee for Canada
BF	Breastfeeding
BFHI	Baby-Friendly Hospital Initiative
BFI	Baby-Friendly Initiative
BFRWG	Breastfeeding Research and Working Group
BMI	Body Mass Index
CFPC	College of Family Physicians of Canada
CI	Confidence Interval
CPS	Canadian Paediatric Society
CS	Cesarian Section
EBF	Exclusive Breastfeeding
EMR	Electronic Medical Record
GA	Gestational Age
GDM	Gestational Diabetes Mellitus
GLM	Generalized Linear Model
GWG	Gestational Weight Gain
HCP	Healthcare Provider

IUGR	Intrauterine Growth Restriction
LMIC	Low- and Middle-Income Countries
NICU	Neonatal Intensive Care Unit
NL	Newfoundland and Labrador
OR	Odds Ratio
PEEP	Positive-End Expiratory Pressure
PHAC	Public Health Agency of Canada
PPNL	Perinatal Program of Newfoundland and Labrador
PROBIT	Promotion of Breastfeeding Intervention Trial
RHA	Regional Health Authority
ROM	Rupture of Membranes
SD	Standard Deviation
SSC	Skin-to-Skin Contact
T2DM	Type Two Diabetes Mellitus
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization

Chapter 1: Introduction

Global health organizations such as the World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF) recommend exclusive breastfeeding for the first six months of infant life due to its positive impact on infant and maternal health. Despite these recommendations, in many Canadian provinces including Newfoundland and Labrador (NL), infant feeding statistics show that many families are not meeting these recommendations. In recent years, breastfeeding has been highlighted as a priority by the Government of NL, as outlined in The Way Forward strategic planning document, and through a commitment to acquiring the designation for its' hospitals as Baby-Friendly, as documented in the Health Accord NL.[1,2] Research has identified several maternal, infant, and hospital-level factors that influence infant feeding practices. Understanding these factors in the local context may help to support and inform the development of evidence-based policies and programs for policymakers, clinicians, healthcare workers, and families to support their infant feeding journeys.

1.1: Health Benefits of Breastfeeding

The health benefits of breastfeeding have been well established. In early 2016, the Lancet launched a series of two papers about breastfeeding.[3,4] In the first of the series, titled "Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect," the authors conducted a meta-analysis of breastfeeding-related literature and identified

several maternal and child health benefits, both in the immediate postpartum period and beyond.[3]

1.1.1: Breastfeeding and the Newborn

The literature endorses profound health benefits for children globally. Breastfeeding protects against several high-morbidity childhood illnesses of an infectious or chronic nature including asthma, childhood leukemia, otitis media, diarrhea, and respiratory infection.[3] In low- and middle-income countries (LMICs) particularly, breastfeeding may prevent over 70% of hospital admissions for diarrhea.[3] Moreover, breastfeeding at any point in time is associated with a significant decrease in sudden infant death and high-mortality disease such as necrotising enterocolitis.[3]

When exploring health benefits of breastfeeding into adolescence and adulthood, longer periods of breastfeeding are associated with a lower likelihood of overweight or obesity. After adjusting for socioeconomic status and other important confounding factors, the prevalence of overweight or obesity in breastfed groups is about 13% lower than in non-breastfed groups (95% CI: 6 – 19%).[3]

The Promotion of Breastfeeding Intervention Trial (PROBIT) was the first randomized trial of the Baby-Friendly Hospital Initiative (BFHI).[5] Results of the original study showed that individuals in health facilities implementing an intervention based on the BFHI steps were more likely to have longer breastfeeding duration, lower risk of

gastrointestinal infections, and atopic eczema.[5] In later years, follow-up interviews were conducted and intelligence of participants at age six was assessed.[6] Their findings suggested that prolonged and exclusive breastfeeding supports cognitive development.[6] Compared to the control group, the experimental group had a 36.9% higher exclusive breastfeeding rate at three months and scored higher on all aspects of the Wechsler Abbreviated Scales of Intelligence.[6] In addition to the numerous benefits to the child, breastfeeding also promotes maternal health.

1.1.2: Breastfeeding and Maternal Health

Research has identified a protective effect of breastfeeding on maternal health outcomes. First, research agrees that breastfeeding offers significant protection from type two diabetes. When comparing longer breastfeeding duration to shorter duration, a meta-analysis of six studies estimated a pooled risk reduction of 0.68 (95% CI: 0.57 – 0.82) in the development of type two diabetes.[7]

Breastfeeding offers various other immediate and prolonged maternal health benefits including protection from postpartum hemorrhage, facilitation of postpartum weight loss, and possibly osteoporosis.[8] There appears to be unclear evidence on the relationship between breastfeeding and osteoporosis, with systematic reviews reporting a non-significant relationship between lactation and bone mineral density.[3,9] Breastfeeding is also protective from postpartum depression, which is likely explained by hormonal

regulation of the hypothalamic-pituitary-adrenal axis, improved self-efficacy, and mother-child bonding.[10]

Breastfeeding is also associated with maternal protection from malignancy. Longer duration of total breastfeeding, including duration of breastfeeding for each child, is associated with lower risk of breast cancer.[11] Similarly, breastfeeding is protective from ovarian cancer. Longer periods of breastfeeding are associated with almost one third of the risk for ovarian cancer than shorter periods of breastfeeding (95% CI: 25 – 36%).[9] In addition to offering protection from significant morbidity, breastfeeding offers a survival benefit globally.

1.1.3: Breastfeeding and Mortality

At a global level, breastfeeding is protective against maternal and childhood mortality. In 2003, the Lancet released a series focusing on Child Survival.[12] The Lives Saved Tool, a modelling software, was created to estimate the projected impact of community-based interventions on child mortality.[13] In recent years, this tool has evolved, and has been used to estimate the number of deaths that are preventable by breastfeeding. In 2016, the Lancet estimated that with a significant increase in breastfeeding in LMICs, over 800,000 deaths would be averted in the year prior.[3] Furthermore, compared to no breastfeeding, current breastfeeding rates avert almost 20,000 deaths annually.[3]

1.2: Infant Feeding Recommendations

Based on the decades of research demonstrating significant maternal and infant health benefits in the immediate postpartum and beyond, breastfeeding is established as the gold standard nutrition for infants in the first months of life. The WHO recommends exclusive breastfeeding, or nothing other than the mother's own milk directly from the breast, for the first six months of life.[14] It is recommended to continue breastfeeding until two years of age and beyond while new foods are added to the infant's diet.[14] In Canada, breastfeeding is supported by both the Canadian Paediatric Society (CPS), the College of Family Physicians of Canada (CFPC), Health Canada, and the Public Health Agency of Canada (PHAC).[15–17] Despite known benefits and recommendations, exclusive breastfeeding rates to six months are low across Canada, with some provinces reporting much lower rates than others.

1.3: Infant Feeding in Newfoundland and Labrador

In 2022, the PHAC released a Canadian Breastfeeding Progress Report.[18] At a National level, 91% of Canadian parents initiated breastfeeding at birth.[18] However, they found that there was a sharp decline in exclusive breastfeeding rate, with 72.8% of individuals exclusively breastfeeding at one month postpartum.[18] They found several explanations for variations in breastfeeding rates including level of education, marital status, age, and province.[18]

NL has historically had some of the lowest provincial breastfeeding rates in the country. In 2022, compared to the Canadian National average of breastfeeding initiation of 91%, breastfeeding initiation rates in NL were almost 20% lower.[18] Within NL, there are also differences in breastfeeding rates based on Regional Health Authority. From 2006 to 2013, Eastern Health had a higher rate of breastfeeding at first neonatal screen, followed by Labrador-Grenfell Health, Western Health, and Central Health.[19]

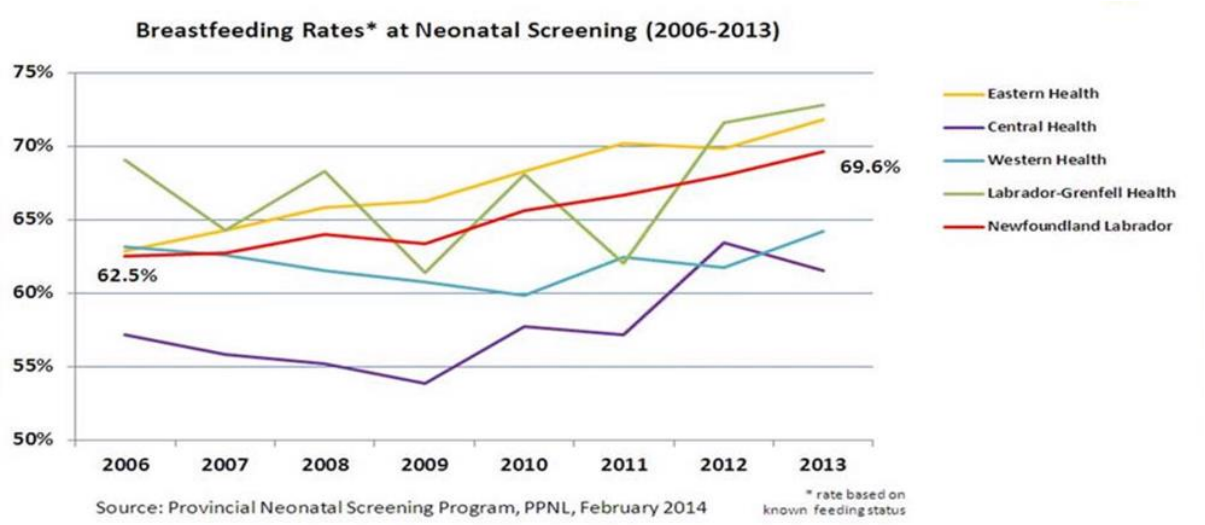

Figure 1: Breastfeeding Rates by Regional Health Authority, used with permission[19]

In response to low breastfeeding rates in NL, for over a decade, the Breastfeeding Research Working Group (BFRWG), under the umbrella of the Baby-Friendly Council of NL, have explored factors unique to NL concerning infant feeding. Their findings have shown that socioeconomic status,[20] embarrassment with breastfeeding in public,[21] and convenience[21] are all factors that influence Newfoundlanders and Labradorians when

making infant feeding choices. Through interviews and focus groups with maternal grandmothers, researchers also identified that grandmothers' past experience, most often with not breastfeeding, influences their daughter's feeding choices away from breastfeeding.[22]

The NL Provincial Government has also identified breastfeeding as a health priority. In its Strategic Planning Document, the Way Forward, the Provincial Government has set goals to promote breastfeeding-friendly practices in the communities of NL, and declared a specific objective to increase the breastfeeding initiation rate in NL by seven percent by 2025.[2] Achieving Baby-Friendly Designation was also recommended by Health Accord NL for health facilities in the province.[1] The evidence shows that the health facility environment has an important impact on early infant feeding outcomes.

1.4: The Baby-Friendly Hospital Initiative

In 1991, the WHO and UNICEF launched the BFHI to protect and promote breastfeeding.[23,24] "Ten Steps to Successful Breastfeeding" were created to indicate the minimum standard of care that health facilities can implement to support breastfeeding.[23,24] In Canada, the Breastfeeding Committee for Canada (BCC) is the National authority for the Baby-Friendly Initiative (BFI).[25] The BCC adapted the Ten Steps to consider the Canadian context and are presented in Figure 2.[23]

The Ten Steps to Successful Breastfeeding in Canada

Critical Management Procedures
1.a. Comply with the International Code of Marketing of Breast-milk Substitutes and relevant World Health Assembly Resolutions.
1.b. Have a written Infant Feeding Policy that is routinely communicated to all staff, pregnant women/persons and parents.
1.c. Establish ongoing BFI monitoring and data-management systems.
2. Ensure that staff have the competencies (knowledge, attitudes and skills) necessary to support mothers/birthing parents to meet their infant feeding goals.
Key Clinical Practices
3. Discuss the importance and process of breastfeeding with pregnant women/persons and their families.
4. Facilitate immediate and uninterrupted skin-to-skin contact at birth. Support mothers/birthing parents to respond to the infant's cues to initiate breastfeeding as soon as possible after birth.
5. Support mothers/parents to initiate and maintain breastfeeding and manage common difficulties.
6. Support mothers/parents to exclusively breastfeed for the first six months, unless supplements are medically indicated.
7. Promote and support mother-infant togetherness.
8. Encourage responsive, cue-based feeding for infants. Encourage sustained breastfeeding beyond six months with appropriate introduction of complementary foods.
9. Discuss the use and effects of feeding bottles, artificial nipples and pacifiers with parents.
10. Provide a seamless transition between the services provided by the hospital, community health services and peer-support programs.

Figure 2: The Ten Steps to Successful Breastfeeding in Canada, used with permission[23]

As of March 31, 2023, there are over 40 health facilities in Canada with BFI designation.[26] This number is projected to increase as the BCC works with Canadian hospitals through a quality improvement initiative designed to grow the number of

designated facilities in the country.[27] The increasing uptake of the BFI in Canada is a direct reflection of the vast maternal and newborn health benefits it promotes.

In 2001, the Promotion of Breastfeeding Intervention Trial (PROBIT) released the findings of their randomized trial of the BFHI.[5] Their methodology involved the implementation of an experimental intervention that was modeled on the BFHI steps, which required over one year of training for hospital staff.[5] They succeeded in enrolling over 17,000 mother-infant dyads and had a one-year follow-up rate of over 90%. Their results showed that the BFHI is significant in improving breastfeeding outcomes. At ages three, six, nine, and 12 months postpartum, infants in the intervention group were approximately 50% less likely to be weaned from breastfeeding.[5] Furthermore, at all time points, breastfeeding rates were approximately 10% higher in the intervention group compared to the control group.[5]

Since 2001, researchers have continued to study the effects of the BFHI. In 2008, researchers availed of the Infant Feeding Practices Study II (IFPS II) to assess the role of Baby-Friendly Hospital practices on breastfeeding duration.[28] The IFPS II was a longitudinal study conducted from 2005 to 2007 by the US Food and Drug Administration (FDA) in collaboration with the Centers for Disease Control and Prevention (CDC).[29] They recruited approximately 4,900 individuals from late pregnancy throughout the infant's first year of life to collect information regarding feeding patterns.[29] Their analysis showed that receiving only breastmilk in hospital was significantly protective of breastfeeding beyond six weeks.[28] More specifically, compared

to infants whose diet was supplemented with formula, infants receiving only breastmilk were less likely (OR=0.35; 95% CI: 0.27 – 0.47) to be breastfed for less than six weeks.[28] In recent years, other researchers have found a dose-response relationship between BFHI steps and exclusive breastfeeding, meaning that the more steps hospitals adhere to, the greater the exclusive breastfeeding rates.[30,31]

As of April 2023, the Labrador West Health Centre is the only BFI designated hospital in NL.[26] However, there are efforts to increase the number of designated facilities, with two additional hospitals in NL participating in the BCC quality improvement initiative to achieve designation: one in Grand-Falls Windsor, and one in St. John's.[27] In addition to the health facility environment, there are other factors that contribute to mode of infant feeding choice.

1.5: Barriers to Breastfeeding

The second article of the 2016 Lancet breastfeeding series, "Why invest, and what it will take to improve breastfeeding practices?" explores determinants of breastfeeding.[4] Through a conceptual model, they explore three categories of determinants of breastfeeding: individual, setting, and structural.[4]

At the individual level, maternal factors such as breastfeeding intention, culture, self-efficacy, smoking, obesity, and depression, are all examples of breastfeeding determinants.[4] Breastfeeding can also be challenging and may lead to a myriad of

complications such as sore nipples, nipple abrasion, cracked nipples, sebaceous cysts, Candida infection, mastitis, breast abscess, and mental and emotional demands.[32] Infant-level factors such as fussiness, preterm delivery, mother-infant separation, and in-hospital supplementation can lead to shorter breastfeeding duration.[4] Furthermore, exclusive breastfeeding may not be an option for individuals availing of fertility services, families expanded through adoption, parents returning to work, infants with separated parents, and more. There are also a variety of circumstances where patients may be counselled on medical conditions that may require supplementation of the newborn diet with formula.

1.6: Medical Indications for Formula Supplementation of a Breastfed Newborn

The CPS, WHO, and UNICEF agree on several contraindications to exclusive breastfeeding that require medically indicated formula supplementation in hospital. Maternal indications for supplementation can include HIV-positive status, current radiation therapy, delayed lactation leading to inadequate infant intake, glandular insufficiency, breast pathology, and use of contraindicated medications such as cytotoxic chemotherapies.[15,33–35] Infant indications for supplementation may include gestational age less than 32 weeks, very low birth weight, classic galactosemia, maple syrup urine disease, asymptomatic hypoglycemia that does not resolve with breastfeeding, and signs of inadequate intake (e.g. lethargy, excessive weight loss, delayed meconium, and persistent jaundice). [15,33–35]

However, the literature suggests that healthy breastfed newborns often receive non-medically indicated formula supplementation in hospital. In 2012, the Canadian Hospitals Maternity Policies and Practices Survey estimated that across 209 Canadian hospitals, 34% of breastfed newborns were given fluids other than breastmilk during their hospital stay.[36] In 2022, a systematic review and meta-analysis highlighted the introduction of formula in the newborn period as a significant risk factor for shorter breastfeeding duration.[37] Researchers have found that formula supplementation of healthy breastfed newborns often occurs based on maternal preference or request, perceived low milk supply, concern about infant hunger, latching issues, fussiness, BMI, maternal exhaustion, cesarian section, grandparent request, cultural beliefs, and more.[38–40] Understanding the factors that contribute to exclusive breastfeeding in hospital is important as the early postpartum period is relevant in establishing breastfeeding duration.

1.7: Infant Feeding Practices in Hospital Predict Breastfeeding Duration

There is an abundance of evidence demonstrating the relationship between infant feeding practices in hospital with feeding habits in the first year of life. In Canadian populations, researchers have identified non-exclusive breastfeeding in hospitals as an independent predictor of exclusive breastfeeding duration.[41] Formula supplementation in hospital is a barrier to breastfeeding duration at two, four, and six months postpartum.[42–45] More specifically, compared to those who exclusively breastfed in hospital, individuals supplementing with formula were over four times more likely (AOR=4.4; 95% CI: 2.2 –

8.7) to cease breastfeeding by two months postpartum, even after excluding individuals intending to do so.[43] Physiologic explanations for these findings exist. Recognizing the supply and demand nature of breastfeeding, some posit that supplementation with formula interferes with the establishment of breastfeeding by interfering with this equilibrium.[43] Others recognize that the mechanics of feeding from a breast or bottle are dissimilar and can lead to an infant's preference to bottle-feed.[46,47] Based on this evidence, infant feeding practices in hospital are important indicators for future feeding habits.

1.8: Research Question

The aim of this thesis is to understand current breastfeeding practices of our population and identify contributing factors.

The primary research question of this thesis is:

1. Which maternal (e.g. age, education level, partnership status), infant (e.g. gestational age, Apgar scores, ventilation), and hospital-level factors (e.g. type of delivery, facility, pain management) are associated with exclusive breastfeeding at discharge for all singleton, full-term births (37 to 42 weeks gestation) in adults (aged 18 years or older) in three communities in NL: Clarenville, Corner Brook, and Gander from 2015-2016?

Secondary research questions are:

1. What are the characteristics of birthing parents (e.g. age) and newborns (e.g. gestational age) in three communities in NL? How do they differ?
2. What are the rates of common interventions (e.g. cesarian section) and health outcomes (e.g. Apgar scores) during labour and delivery in three communities in NL? How do they differ?
3. What is the relationship between individual maternal (e.g. education level), infant (e.g. ventilation), and hospital-level factors (e.g. epidural) and exclusive breastfeeding at hospital discharge in three communities in NL?
4. Controlling for other variables, is health facility a predictor of exclusive breastfeeding at hospital discharge in NL?

1.9: Patient-Oriented Research

This research was conducted using a patient-oriented approach. In 2014, the Canadian Institutes of Health Research (CIHR) developed a framework for patient-oriented research.[48] A key principle of patient-oriented research is to engage patients in the research process by increasing their contribution from research participant, to collaborator and decision-maker.[49] There are a multitude of ways that patients, caregivers, and families can be involved in the research process: setting research objectives, developing research questions, study design, evaluating results, knowledge translation, and more.[48] A valuable principle of patient-oriented research is to have meaningful patient participation, with their contributions being given significant consideration. Evidence shows that this framework increases the quality of care as research findings are

translated to practice.[48] Involving individuals with lived experience in research helps ensure that it is relevant to the population that it studies and ultimately leads to better health outcomes.[49]

Chapter 2: Literature Review

Global health organizations such as the WHO and UNICEF recommend exclusive breastfeeding for the first six months of infant life.[14,50] However, many populations globally are not meeting these recommendations.[51] Some research suggests that maternal and obstetric attributes are associated with breastfeeding.[52] Understanding which factors are related to breastfeeding can help inform healthcare practices, programs and policy decisions. In this chapter, I present a literature review that aims to explore our current understanding of elements that influence infant feeding choices in hospital.

2.1: Search Strategy

The purpose of this literature review was to understand and evaluate the existing body of knowledge of factors associated with exclusive breastfeeding in hospital. The main question for the literature review was: what are known predictors or barriers for exclusive breastfeeding in hospital in singleton, full-term births (37 to 42 weeks gestation) in adults (aged 18 years or older)?

We developed a search strategy in consultation with a librarian at the Memorial University of Newfoundland Health Sciences Library. In PubMed, we searched the term "exclusive breastfeeding" on April 10, 2023, and limited findings to English-language peer-reviewed studies. No other filters were applied.

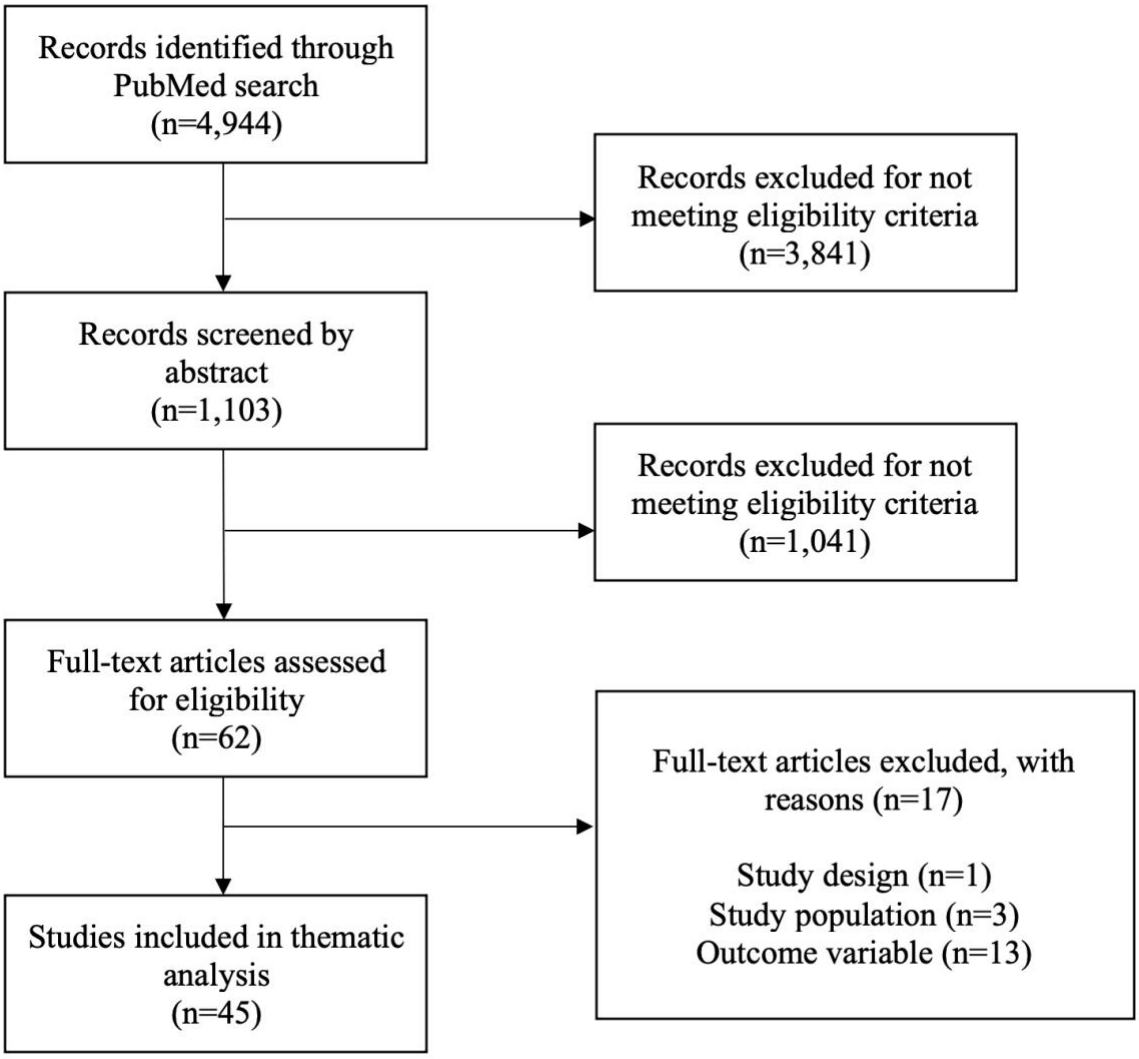

Figure 3: Selecting articles for literature review

The initial search resulted in 4,944 articles. To limit the scope of the review, we excluded experimental studies, such as randomized controlled trials, as there are a significant number of different interventions to increase breastfeeding rates. Commentaries and opinion pieces were excluded. We also limited the review to quantitative articles that have a primary or secondary outcome of breastfeeding in hospital. Finally, we excluded research that focused on a specific sub-population such as

preterm or neonatal intensive care unit (NICU)-admitted newborns to increase the generalizability of the findings. After a title screen and removal of duplicates, 1,103 articles remained. Abstract screening resulted in 62 remaining studies. After full-length review, 17 articles were excluded. The final number of articles considered in this review was 45. The findings from these publications were grouped according to common themes and are presented below accordingly. To start, several articles identified maternal weight and metabolic disease as factors impacting breastfeeding in hospital.

2.2: Body Mass Index and Diabetes

In recent years, researchers have explored the role of body mass index (BMI) and its comorbidities on maternal and infant health outcomes, such as breastfeeding. In North America, the prevalence of obesity has been increasing. NL has a high proportion of individuals living with obesity.[53] Authors have found that food insecurity and increasingly sedentary lifestyles are only some of the factors that have contributed to this trend.[54,55] Obesity is known to be comorbid with other disease states such as type 2 diabetes, hypertension, and more.[56]

This literature review identified several articles studying the relationship between BMI, diabetes, and exclusive breastfeeding in hospital, as presented in Table 1. In general, the research agrees that obesity is a barrier to breastfeeding. It is estimated that there is about a 10% difference in exclusive breastfeeding in hospital in those with a normal weight (BMI 18.5 – 24.9), and those with obesity (BMI > 30).[57] When stratifying

individuals by obesity classes, researchers in the USA found that those with class two obesity (BMI 35.0 – 39.9) are nearly three times more likely to not achieve exclusive breastfeeding in hospital compared to those considered to be overweight (BMI 25.0 – 29.9) (AOR 2.87; 95% CI: 1.10 – 7.39).[58] Others agreed that that lower weight gain during pregnancy was associated with higher breastfeeding rates.[59] Researchers have suggested physiologic and psychosocial explanations for these findings.

Table 1: BMI, Diabetes, and Breastfeeding

Study	Objective	Sample Size	Data Source	Study Design	Results	Limitations
Ballesta-Castillejos et al., 2020 (Spain)[60]	Describe the relationship between maternal BMI and breastfeeding rates	5,871	Online questionnaire	Cross-sectional observational study	Compared to those with normal weight, AOR = 0.79; 95% CI: 0.64 – 0.97 for obesity type I and AOR = 0.57; 95% CI: 0.35 – 0.94 for obesity type III of EBF at discharge	Self-reported data
Haile et al., 2016 (USA)[61]	Examine association between history of GDM and EBF at hospital discharge	2,038	Derived from the Infant Feeding Practices Survey II	Cross-sectional secondary data analysis	GDM AOR = 0.59; 95% CI: 0.39 – 0.92 of EBF at discharge compared to not having GDM. Other factors associated with EBF at discharge included Caucasian race, higher education, higher income, non-obese pre-pregnancy BMI, below gestational weight gain guideline, not having NICU admission	Cross-sectional, no causality. Volunteer bias, selection bias, recall bias
Longmore et al., 2020 (Australia)[62]	Evaluate the associations of pre-existing T2DM in pregnancy and GDM with EBF at discharge	1,050	Pregnancy and Neonatal Diabetes Outcomes in Remote Australia (PANDORA) Study	Cohort study	Factors associated with EBF at discharge: Indigenous, greater gestational age. Non-EBF: T2DM, c-section, neonatal nursery admission. T2DM vs no hyperglycemia AOR = 0.4; 95% CI: 0.2 – 0.8	Loss to follow-up, no sample size calculation, reporting bias
Martinez et al., 2016 (USA)	Examine whether EBF status at hospital discharge among overweight and obese Latinas was associated with pre-pregnancy weight, GWG, and other factors	480	Electronic medical record	Electronic medical records review	AOR = 2.87; 95% CI: 1.10 – 7.39 of failing to exclusively breastfeed at hospital discharge for pre-pregnancy class II obesity compared to overweight. In adjusted analysis other obesity classes were not significantly associated with outcome.	Self-reported height and weight, level of acculturation not assessed
Visram et al., 2013 (Canada)[57]	Characterize breastfeeding intention and immediate post-partum breastfeeding practices in overweight and obese populations	22,131	Better Outcomes Registry & Network birth records database	Population-based cohort study	EBF in hospital differed from normal BMI to overweight to obese: 71.84%, 68.62%, and 62%. AOR of BF in hospital compared to normal BMI was 0.67; 95% CI: 0.60 – 0.75 for both overweight and obese.	Urban population limits generalizability

First, physiological explanations are based on the relationship between BMI and lactogenesis. To elaborate, one mechanism that may contribute is the storage of progesterone in adipose tissue. In individuals with excess adipose, there may be an attenuation in the systemic drop in progesterone levels normally found during preparation of the mammary gland.[60] Second, in some study populations, obesity was associated with greater rates of planned cesarian deliveries, a procedure which in itself is associated with reduced breastfeeding rates.[58] Other researchers suggest a more psychosocial explanation that individuals with obesity are less likely to intend to breastfeed than others.[57] Finally, obesity is often comorbid with pregnancy complications such as prematurity, hypertension, and gestational diabetes.[60]

The literature identified that individuals with gestational diabetes are less likely to exclusively breastfeed at discharge from hospital, even when controlling for pre-pregnancy BMI and gestational weight gain (AOR 0.59; 95% CI 0.39 – 0.92).[61,62] Therefore, while individuals may be comorbid with both obesity and gestational diabetes, there may be mechanisms specific to diabetes that present a barrier to breastfeeding. The mechanism of this relationship is not well understood, but some research suggests that maternal insulin and metabolism is associated with the timing of lactogenesis.[63,64]

Overall, this literature review identified obesity and gestational diabetes as two related barriers to exclusive breastfeeding in hospital.

2.3: Maternity and Hospital Policies

In recent decades, there has been an increasing awareness of the role of hospital- and policy-level factors on maternal and infant health. This has led to several initiatives to promote improved maternal and infant health outcomes, including the BFHI. The BFHI steps include ensuring that staff have the knowledge to support breastfeeding, the importance of breastfeeding is discussed with pregnant people, and new mothers are supported to initiate breastfeeding and manage its challenges, and more.[24]

Table 2 highlights articles focusing on maternity and hospital policies in the context of infant feeding. A systematic-review found that there was a dose-dependent relationship between the number of BFHI steps a facility achieves and their breastfeeding outcomes.[30] One step of the BFHI is related to ensuring compliance with the International Code of Marketing of Breast-Milk Substitutes.[24] In 1981, the International Code of Marketing of Breast-milk Substitutes was created with the goal to provide safe nutrition for newborns.[65] This document was created in response to increasing morbidity and mortality related to the consumption and unethical marketing of infant formula. This literature review found that limiting in-hospital supplementation is essential for breastfeeding success.[30,66] In Vietnam, individuals who received free samples of infant formula were significantly less likely to exclusively breastfeed for the first three days postpartum.[66]

Table 2: Exploring the Role of Maternity and Hospital Policies on Breastfeeding

Study	Objective	Sample Size	Data Source	Study Design	Results	Limitations
Barrera et al., 2019 (USA)[67]	Assess whether maternity care practices were associated with in-hospital exclusive breastfeeding rates	1,305 hospitals	CDC Maternity Practices in infant nutrition and care (mPINC), the Joint Commission, National Immunization Survey	Secondary data analysis, correlation	r=0.45, p<0.0001 positive linear correlation between mPINC score and EBF at discharge. EBF rate was 51.2%.	Self-reported data (recall bias, reporting error), larger hospitals more represented (1,754 birth per year)
Chertok et al., 2022[68]	Examine exclusive breastfeeding rates at discharge over the pandemic with changing guidelines	26,709 mothers	IMAgiNE EURO survey study	Secondary data analysis	Factors associated with EBF: maternal age 25-30, multiparity, graduate education, birth in specific countries. Barriers were age, health insurance status, support, cesarian section, partial or no rooming-in, specific countries, provider professionalism, attention when needed, timing of birth, countries.	Self-reporting, reporting bias, not able to choose variables e.g. gestational age, BFI
Griffin et al., 2022 (USA)[69]	Determine if a postpartum lactation consultant consultation during delivery hospitalization improves EBF rates at hospital discharge in individuals with GDM	517	Self-reported survey	Retrospective, two-group comparison, secondary analysis	EBF at discharge with consult 43.1%, without consult 25.3%. OR = 2.79; 95% CI: 1.75 – 4.43, AOR = 1.52; 95% CI: 0.89 – 2.59 no longer significant after adjusting for BMI, language, GA, Apgar, NICU admission, hypoglycemia	Retrospective as part of secondary analysis – lack data about important variables e.g. prenatal education
Li et al., 2021 (China)[70]	Assess BF supportive services in BFHs during childbirth hospitalization and association between them and EBF at discharge	707	Questionnaire, hospital records	Retrospective cohort study	Mothers who received better BF supportive services (e.g. SSC, encourage BF on demand, information from HCPs, rooming-in) during hospitalization were more likely to EBF at time of discharge, AOR = 3.00; 95% CI: 2.08 – 4.35	75% follow-up rate (selection bias due to loss of follow-up), some variables not included
Merten et al., 2004 (Switzerland)[71]	Identify risk factors for formula supplementation in BFHI institutions	4,351	Questionnaire	Retrospective cohort study	Multiparity (OR 0.58; 95% CI 0.48 – 0.69), cesarian delivery (OR 1.74; 95% CI 1.38 – 2.18) and health facility factors such as number of deliveries, NICU, rooming-in) significantly predicted risk of formula supplementation.	Missing data, reporting errors
Newton et al., 2008 (USA)[72]	Determine how demographic	325	Hospital-based	Retrospective chart review	Factors positively associated with EBF in	High amount of missing data for

Study	Objective	Sample Size	Data Source	Study Design	Results	Limitations
	factors and hospital practices affected EBF in hospital among Latinas at Baby-Friendly Hospital		Perinatal database and electronic medical record		hospital were maternal age < 25 years, being US-born, having a Birth Sister (doula) involved	certain variables such as maternal education, potential charting errors
Nguyen et al., 2022 (Vietnam)[66]	Identify maternal and health system factors associated with EBF in first 3 days postpartum	726	Survey, interviews	Population-based, cross-sectional study	EBF for first 3 days after birth was less likely among mothers with: vaginal birth with episiotomy & cesarian section (compared to vaginal birth), bringing or purchasing formula at health facility, low level of education achieved, receiving free commercial formula sample during hospital stay. SSC not significant in adjusted multivariate analysis.	Sampling bias, recall bias
Patterson et al., 2018 (USA)[73]	Examine relationships between different variables, BFHI designation, and EBF outcomes in hospital	1,729	Joint Commission, U.S. Census Bureau, Baby-Friendly USA	Retrospective cohort	There were significant differences in EBF in BFHI designated facilities (62%) and non-designated facilities (48%). Education, income, and ethnicity were significantly associated with EBF.	Data used was for the community surrounding hospitals and therefore a proxy for hospital demographics. Hospitals at different stages of obtaining designation and not dichotomous.
Patterson et al., 2019 (USA)[74]	Evaluate maternity care practices that support EBF using standardized in-hospital definition of EBF	723 hospitals	CDC Maternity Practices in infant nutrition and care (mPINC), the Joint Commission, Baby Friendly USA, US Census Bureau	Retrospective cohort	Maternity practices such as supplementation with formula, facility receiving formula samples, maternal-infant separation, SSC, prenatal courses, staff competency, and more are significant in predicting EBF in hospital	Limitations of mPINC survey, data used was for the community surrounding hospitals and therefore a proxy for hospital demographics.
Pechlivani et al., 2005 (Greece)[75]	Assess EBF during hospital stay and factors associated with initiation of EBF	1,603	Questionnaire	Cross sectional study	Hospital practices (such as rooming-in), type of delivery and information received about breastfeeding were more important determinants of EBF than socio-demographic.	Self-reported data
Pérez-Escamilla et al., 2016[30]	Examine the impact of BFHI on	58 articles	N/A	Systematic review	Positive association between BFHI and BF outcomes. Dose-	Unable to compare impact of partial vs full

Study	Objective	Sample Size	Data Source	Study Design	Results	Limitations
	breastfeeding and child health outcomes				dependent relationship between number of BFHI steps women are exposed to. Quasi-experimental and pre-post BFHI implementation studies both show that BFHI implementation is more positively associated with EBF at discharge compared to no BFHI implementation.	implementation of the steps. Examined primiparous and multiparous individuals together.
Tully et al., 2022 (USA)[76]	Explore postnatal unit experiences and how they correlate with early infant feeding outcomes	2,401	Online survey	Cross-sectional survey	Postnatal unit experiences were associated with EBF in hospital. More likely to EBF when rooming-in, accessing support from clinical staff, understandable explanations from nurses, doctors, midwives	Limited generalizability, lack of diversity
Ragusa et al., 2021 (Italy)[77]	Verify whether external factors could protect against risk of abandoning EBF	3,368	Questionnaire	Retrospective observational study	Univariate analysis shows that factors associated with risk of cessation of EBF are cesarean section and hospital type (community, teaching, maternity, or emergency). Associated with EBF is higher level of education, and the practice of rooming-in.	Previously administered questionnaire (limited to their variables), socioeconomic info such as employment and support not available

Another aspect of the BFHI initiative recognizes the role that maternity care practices have on infant feeding outcomes in hospital. The IMAgINE EURO Study Survey, which surveyed 26,709 mothers across 17 European Countries, found that certain maternity practices are barriers to exclusive breastfeeding at discharge.[68] To elaborate, the practice of rooming-in, provider professionalism, and provider attention to patients, are all examples of hospital-level factors that impact breastfeeding.[68,70,76] For example, individuals who roomed-in with their infants were over three times more likely to exclusively breastfeed in hospital (AOR 3.72; 95% CI 2.31 – 5.97).[75] Authors in Australia

also identified rooming-in as a determinant of exclusive breastfeeding at hospital discharge.[78] Several studies identified in the literature support these statements, with authors in Greece finding that hospital practices were more predictive of infant feeding practices compared to sociodemographic factors.[75]

Researchers in Italy have also found that the focus or type of hospital, such as teaching, community, maternity, or emergency, is related to infant feeding outcomes.[77] This re-enforces the concept that there are system-level factors that affect maternal and infant health indicators. Access to allied health professionals such as midwives, lactation consultants, and doulas, are also variable and related to infant feeding.[69,72] For example, there was over a 15% difference in exclusive breastfeeding rates at hospital discharge (43.1% to 25.3%) between those who had access to a lactation consultant and those who did not.[69] Individuals under the care of a midwife were more likely to exclusively breastfeed at discharge compared with those under the care of an obstetrician (AOR 4.49; 95% CI 4.16 – 4.85).[75]

The findings of this literature review underscore the role of hospital practices on infant feeding outcomes. Several hospital practices are recommended in the Baby-Friendly Hospital Initiative, and it appears that facilities with BFHI designation have higher rates of exclusive breastfeeding in hospital.

2.4: Skin-to-Skin Contact and Delaying the Newborn Bath

Increasing evidence is finding that skin-to-skin contact (SSC) in the first few hours of life supports the adaptation of the newborn to the extra-uterine environment.[79] SSC is a practice where a newborn is dried and placed on their mother's chest after the delivery for a period of time.[79] SSC supports successful transition as the infant takes their first breaths, makes changes to their cardiovascular system, and thermoregulates.[80]

Several studies in this literature review explore the role of SSC on infant feeding outcomes in the early postpartum period and are presented in Table 3. Most agree that any duration of SSC is associated with higher rates of exclusive breastfeeding in hospital compared to no SSC.[81–84] Moreover, researchers have found a dose-dependent relationship between SSC and exclusive breastfeeding in hospital.[81,82] Others agreed that individuals practicing longer duration of SSC, such as one to three hours postpartum, are more than three times as likely to exclusively breastfeed in hospital (OR 3.145; 95% CI 3.905, 3.405).[82] After adjusting for maternal characteristics such as education level, type of delivery, and smoking, this positive relationship was only slightly attenuated.[82]

Table 3: Relationships Between Skin-to-Skin Contact, Delaying the Newborn Bath, and Breastfeeding

Study	Objective	Sample Size	Data Source	Study Design	Results	Limitations
Bramson et al., 2009 (USA)[82]	Determine the effect of early SSC and other variables on exclusive breastfeeding in hospital	21,842 mother-infant dyads	Perinatal Services Network	Secondary analysis of data from a prospective cohort quality assurance intervention	Likelihood of breastfeeding increases as period of early SCC increases $p<0.001$. AOR = 2.155 for SCC of 1-3h	Secondary analysis of data
Cinquetti et al., 2019 (Italy)[83]	Evaluate how type of delivery, SSC and nationality affect EBF at discharge	6,017	Pediatric Unit Register of Neonatal feeding which takes data from medical records	Retrospective cohort study	SCC (carried out less often in newborns delivered by cesarian section) was associated with a higher EBF rate in vaginal and operative delivery than not SSC.	Only 3 variables available for study, no inferential analysis
Costa et al., 2022 (Italy)[85]	Evaluate rate of EBF at discharge among mothers with COVID-19 who had a rooming-in versus separation regimen	155 dyads	Data collected by caregivers on maternity ward	Retrospective two-group comparative study	EBF rate of rooming in (34.4%) were significantly greater than those who were separated (3.2%) $p<0.0001$. Dyads with a separation period, had higher rates of exclusive formula feeding (91.9%) compared to those rooming-in (9.7%), $p<0.0001$.	No inferential analysis, smaller sample size
DiCioccio et al., 2019 (USA)[86]	Examine association between delaying newborn bath and in-hospital exclusive breastfeeding	996	Nursery intake and output flow sheet, EMR	Retrospective, two-group, pre- and post-intervention design	EBF rate in hospital increased from 59.8% to 68.2% $p<0.001$ after delaying the first bath at least 12 hours. Odds of in-hospital EBF increased OR = 1.60; 95% CI: 1.14 – 2.25	Two time periods, threat to validity, perhaps inconsistent documentation
Giang et al., 2022 (Vietnam)[81]	Investigate the effect of SSC on EBF during hospital stay	1812	Questionnaire	Cross-sectional study	Compared to infants without SSC, SSC for 15-90 min AOR = 2.62; 95% CI: 1.61 – 4.27 and for more than 90 min AOR = 5.98 95% CI: 3.48 – 10.28. Found a dose-response relationship.	Restricted to mothers who brought child for routine immunization, recall bias, self-reported data
Juan et al., 2022 (China)[84]	Explore association between SSC after CS and breastfeeding outcomes	679	Data collected by trained staff during elective CS	Prospective cohort study	EBF at discharge was highest with SSC beyond 90 minutes (69%), followed by SSC < 30 minutes (62%), and no SSC (52%). Not statistically significant after adjusting for multiple testing. Multivariate model shows SSC >30 minutes significantly associated with EBF at discharge	Smaller sample, not able to control for all confounders
Long et al., 2020 (USA)	Evaluate the impact of delaying the first newborn bath until at least 12 hours after	1,463	Electronic medical record, survey	Pre- and post-practice change comparative cohort design	Pre-implementation EBF rate was 74.1%, post-implementation rates were 70.7% and 79.4%. No significant difference using ANOVA. Perhaps due to higher EBF rate at baseline.	No randomization.

Study	Objective	Sample Size	Data Source	Study Design	Results	Limitations
	birth on EBF at discharge					
Preer et al., 2013 (USA)[88]	Examine the impact of delaying the infant's first bath on in-hospital breastfeeding rates	714	Chart review	Retrospective chart view (pre- and post-implementation)	Delaying the first newborn bath beyond 12h is associated with a higher likelihood of exclusive breastfeeding in hospital compared to no delay in newborn bath. AOR = 1.39; 95% CI: 1.02 – 1.91. Increase from 32.7% EBF rate to 40.2% post-implementation	Possible proxy for SSC, maybe attributing change to a single intervention
Turney et al., 2019 (USA)[89]	Understand if delaying the first bath affects breastfeeding rates	1,959	Computer-generated reports from electronic health record	Pre- and post-implementation evaluation	No significant differences in EBF at discharge for newborns bathed at more than 9h postpartum and those bathed sooner	Not randomized, department encouraged supplementation of healthy newborns when concerned about dehydration
Warren et al., 2020 (Canada)[90]	Determine whether delaying the newborn bath by 24h increases exclusive breastfeeding at discharge	1,225	Electronic medical records	Pre- and post-implementation cohort study	Rate of EBF at discharge increased from 53.6% to 59.4% post-implementation. AOR = 1.334; 95% CI: 1.049 – 1.689	Retrospective, can't attribute change to only delaying the bath, not exclusive from SSC

As previously discussed, the early newborn period is a critical time for adjustment to the new environment, and this process is supported by SSC. However, the practice of newborn bathing in the first few hours of life also presents an interruption to this adjustment period. There is also evidence that substances that remain on the infant's skin after delivery, such as amniotic fluid and vernix cavernosa, are important to this process.[91,92] Subsequently, initiatives to delay the newborn bath to beyond the first few hours of life have been undertaken.

In the USA, delaying the newborn bath from two hours postpartum to 12 to 24 hours was associated with about a 10% increase in exclusive breastfeeding in hospital.[86] Similarly, Canadian authors identified an increase in exclusive breastfeeding rates at

discharge from 53.6% to 59.4% after the implementation of a hospital-level policy to delay the newborn bath.[90] However, in another study population with a high exclusive breastfeeding rate at baseline (greater than 70%), there was no significant improvement after delaying the newborn bath.[87] Therefore, in populations with lower exclusive breastfeeding rates, policies that support delayed newborn baths could improve breastfeeding rates. There is also evidence to suggest the duration of delaying the newborn bath should be considered. For example, researchers found that delaying the newborn bath beyond 12 hours is associated with a higher likelihood of exclusive breastfeeding in hospital (AOR 1.39; 95% CI 1.02 – 1.91).[88] However, others have not found significant differences in delaying the newborn bath beyond nine hours.[89]

Overall, SSC and delaying the newborn bath were identified as protective factors for exclusive breastfeeding in hospital. Authors have recognized that these are highly related factors, with some even questioning whether delaying the newborn bath is essentially a proxy for SSC.[88] Regardless, evidence shows that SSC and delaying the newborn bath are practices that support the newborn transition to the extra-uterine environment, and are associated with higher rates of exclusive breastfeeding in hospital.

2.5: Parental and Family Characteristics

This literature review identified several systemic and policy-related factors that influence infant feeding in hospital. However, several parental and family characteristics were also found to be influential, as listed in Table 4.

Table 4: The Role of Parental and Familial Characteristics in Infant Feeding Choices

Study	Objective	Sample Size	Data Source	Study Design	Results	Limitations
Cox et al., 2014 (Australia)[78]	Identify factors associated with EBF at discharge	427	Questionnaire	Prospective cohort study	Determinants of EBF at discharge were not being admitted to NICU, grandmother who breastfed, perception of partner's feeding preference, not receiving conflicting advice in hospital, demand feeding, rooming in	Response bias (52% contacted responded)
Cummins et al., 2021[59]	Examine literature to find factors that positively influence in-hospital EBF practice among women with GDM	26 studies	Medline, Scopus, Pubmed, CINAHL, Cochrane	Integrated review	Factors associated with EBF in-hospital: personal (age over 30, higher education, primiparous, race and ethnicity), lifestyle/physiologic (normal BMI, low weight gain during pregnancy), psychophysiological (normal lactogenesis II, breastfeeding knowledge, confidence, intention, support networks), antenatal education, antenatal support from caregivers, vaginal birth, full-term, SSC, rooming-in, post-natal support/BFHI.	Exclusion of non-english
Gomez et al., 2022 (USA)[93]	Evaluate relationship between maternal covid-19 infection and odds of in-hospital EBF	6,151	Data extraction from electronic health record	Retrospective descriptive quantitative	Covid-19 infection, glucose gel given, medicaid, African American, length of stay were all barriers to EBF in hospital	Retrospective, non-randomised, observational, unknown confounders (maternal age, mode of delivery)
Gray et al., 2021 (USA)[94]	Determine how suspected known factors influencing breastfeeding success influence in-hospital feeding	7,370	Electronic health record	Retrospective longitudinal single group observational study	Factors associated with increased EBF rates were race (white), ethnicity (not Hispanic), insurance method (private), GA (over 38 wks)	Limited variables (e.g. not able to assess breastfeeding education or past experience), chart review, hospital serves individuals with more cormorbidities
Lande et al., 2020 (Georgia)[95]	Identify factors associated with exclusive breastfeeding of term newborns at hospital discharge	7,134	National Birth Registry Data	Retrospective cohort study	EBF at discharge: higher education AOR 0.75 (0.59, 0.97), cesarean delivery 0.47 (0.37,0.60), birthweight <2500g 0.51 (0.27, 0.97), NICU admission 0.02 (0.02, 0.03)	Did not consider gestational age, small sample of newborns not exclusively breastfed (n=551) compared to those who were (n=6,583)
Le et al., 2018 (Vietnam)[96]	Assess prevalence of EBF	6,706	Face-to-face interview using standardized	Prospective cohort study	In urban population, factors associated with non-EBF were higher SES, married, complication during pregnancy,	Population with high burden of infectious

Study	Objective	Sample Size	Data Source	Study Design	Results	Limitations
	during hospital stay		electronic questionnaire		HIV/Hep B, premature birth, c-section, neonatal complication at birth, race. Low birth weight, older maternal age associated with EBF in urban population. In rural population, factors associated with non-EBF were c-section and neonatal complication at birth.	diseases, recall bias, self-reported data
McDonald et al., 2012 (Canada)[97]	Estimate population-based rates of EBF at discharge and understand factors associated with exclusive breastfeeding	92,364	Better Outcomes Registry & Network database	Retrospective population-based cohort study	Higher likelihood of EBF at discharge was related to older age, non-smokers, non-drug-users, no assisted reproductive technology, living in areas with higher family incomes. Lower likelihood was associated with previous term, no prenatal education classes preterm birth. Antenatal care from a midwife was associated with EBF AOR = 4.49; 95% CI: 4.16 – 4.85 compared to those receiving care from obstetricians.	Missing some variables such as family support
O'Callahan et al., 2020 (USA)[98]	Evaluate whether newborn circumcision influences rate of EBF before hospital discharge	1,109	Electronic hospital record	Retrospective cohort study	Circumcision not related. Epidural and c-section associated with lower likelihood of EBF.	Missing data, retrospective, only explored certain confounding factors.
Ragusa et al., 2020 (Italy)[99]	Observe prevalence of BF in hospital and the influence of factors that affect the success of breastfeeding	3,813	Questionnaire	Observational study	EBF rate among individuals with CS was 35% compared to 51% with vaginal delivery $p<0.001$. Higher level of education achieved was associated with more EBF in hospital. Education level influenced prenatal education attendance, and the difference in EBF in those who attended vs not was 11% (53% to 42%). Significantly different rates of EBF in hospital with a range from 12% to 75% between health facilities.	No inferential statistics, descriptive only

First, maternal characteristics were found to have implications for infant feeding. Older age was associated with a higher likelihood of exclusive breastfeeding at discharge.[97] In particular, age over 30 is associated with exclusive breastfeeding in-hospital.[59] Other research identified higher education levels as protective of in-hospital

exclusive breastfeeding.[59,95,99] This could perhaps be related to individuals with higher levels of education being more likely to attend prenatal classes.[99] Race and ethnicity were also identified as being related to infant feeding in hospital.[59,93,94]

Second, new parents are often surrounded by family and friends at the time of delivery and in the early postpartum period. This support system, or lack thereof, also has important implications for infant feeding in hospital. For example, individuals whose mother breastfed were more likely to do so exclusively at discharge.[78] Perception of their partner's feeding preference was also a determinant of exclusive breastfeeding at discharge.[78]

Finally, one study found individuals in urban areas, compared to their rural counterparts, have a greater number of factors that impact exclusive breastfeeding in hospital. For example, maternal age, socioeconomic status, bodyweight, and partnership status were all determinants of breastfeeding in urban populations, but not in rural.[96]

2.6: Labour and Delivery

In recent decades, there has been a rising amount of discussion about the increasing rate of interventions during labour and delivery.[100,101] While such interventions are essential, and life-saving medical procedures, some researchers wonder how they affect later maternal and infant health outcomes, such as breastfeeding.

Table 5 outlines articles exploring interventions during labour and delivery in the context of infant feeding in hospital. Researchers in the USA have found that individuals undergoing cesarian section are about half as likely to exclusively breastfeed at discharge compared to those delivering vaginally (AOR 0.41; 95% CI 0.24 – 0.71).[102] Other authors have recognized that it is important to stratify individuals by whether they had a planned elective or an emergency cesarian section, as indications and characteristics of those populations may differ. In this review, the literature agrees that individuals undergoing planned elective cesarian section are less likely to exclusively breastfeed.[103,104] Moreover, a systematic-review and meta-analysis estimated a pooled odds ratio of 0.83 (95% CI: 0.80 – 0.86) of early breastfeeding (initiation or in hospital) in those experiencing elective cesarian section.[104] However, there is varying evidence regarding the relationship between emergency cesarian section and exclusive breastfeeding, and it is not a clear barrier.[103,104]

Table 5: How Does Labour and Delivery Affect Infant Feeding?

Study	Objective	Sample Size	Data Source	Study Design	Results	Limitations
Kling et al., 2016 (USA)[102]	Examine the association between method of delivery and EBF at hospital discharge	1,494	Derived from the Infant Feeding Practices Survey II	Cross-sectional secondary data analysis	EBF at discharge significantly different $p<0.001$ between vaginal (79.9%) and cesarean (70.6%). AOR = 0.41; 95% CI: 0.24 – 0.71 for EBF at discharge with cesarean compared to vaginal. Other relevant factors included race or ethnicity, education, GWG (below recommended), GA 35-38 weeks	Volunteer, selection, recall bias. Loss of 41% of sample due to incomplete information.
Liu et al., 2012 (China)[103]	Investigate association between mode of delivery and method of newborn	431,704	Perinatal Health Care Surveillance System	Secondary data analysis	Compared to spontaneous vaginal delivery, the likelihood of EBF for unlaboured cesarian section by maternal request (CDMR), laboured	Retrospective. Planned vs actual route of delivery potential for misclassification.

Study	Objective	Sample Size	Data Source	Study Design	Results	Limitations
	feeding (comparing planned cesarean section on maternal request and planned vaginal delivery)				CDMR, laboured CS, assisted vaginal delivery were AOR = 0.81; 95% CI: 0.77 – 0.86, 0.92; 95% CI: 0.79 – 1.07, 0.90; 95% CI: 0.86 – 0.94, and 0.85; 95% CI: 0.82 – 0.89, respectively. Planned CMDR was associated with lower BF rate.	
Oommen et al., 2021 (Norway)[105]	Compare EBF at discharge by fentanyl exposure (IV, epidural, or none)	1,101	Questionnaire	Prospective observational study	Intrapartum opioid exposure negatively associated with EBF at discharge with ORs of 1.80; 95% CI: 1.09 – 2.97 for IV fentanyl, 2.45; 95% CI: 1.34 – 4.48 for epidural fentanyl, 4.20; 95% CI: 2.49 – 7.09 for IV+epidural fentanyl. IV fentanyl up to 200mcg was associated with lower prevalence of BF problems than epidural fentanyl	Small sample sizes of certain groups, not an RCT, confounders not accounted for in analysis
Prior et al., 2012[104]	Determine the association between mode of delivery and early breastfeeding	53 articles in qualitative synthesis, 48 in meta-analysis	N/A	Systematic-review and meta-analysis	Random-effects analysis of 42 studies (556,363 subjects) showed early breastfeeding was lower after CS than vaginal delivery: pooled OR 0.57; 95% CI: 0.50 – 0.64. Breastfeeding rates were lower after elective CS: pooled OR 0.83; 95% CI: 0.80 – 0.86, whereas emergency CS did not have any effect.	Relation between breastfeeding and mode of delivery was not a primary outcome in 74% of studies, recall bias, non-standardizations of breastfeeding outcomes
Wetzl et al., 2019 (Italy)[106]	Investigate whether receiving neuroaxial labour analgesia (either a priori or as last result) is associated with breastfeeding initiation success at BFH	3,628	Computerised medical charts	Single-centre community-based cohort study	EBF rates in hospital were lower for individuals receiving neuraxial analgesia both a priori and as a last resort compared to those not having it (also true in actual vaginal delivery group which excluded cesarean sections)	BFH, limited generalizability due to single-centre study, did not differentiate between spinal or epidural
Zanardo et al., 2010 (Italy)[107]	Compare breastfeeding practices in a cohort of	163	Perinatal database	Retrospective cohort study	EBF rates in individuals requiring laryngeal mask airways, compared to	Small sample size. LMA n=50, ETT n=13, controls n=100

Study	Objective	Sample Size	Data Source	Study Design	Results	Limitations
	term infants who require positive-pressure ventilation resuscitation, using either laryngeal mask airway or endotracheal tube				endotracheal tube, to controls was 66%, 69.2%, 91%, respectively $p<0.01$	

Explanations for differences in infant feeding practice based on planned elective or emergency cesarian section exist. Some suggest that individuals who request a cesarian section are similar to those who do not intent to breastfeed.[104] Other theories believe that there are essential physiologic processes for lactation that occur during labour.[108] Therefore, individuals who undergo emergent cesarian section after a trial of labour have been exposed to physiologic changes that individuals planning elective cesarian section have not.[108] However, the multitude of reasons why a person may require elective or unplanned cesarian section, such as fetal compromise or placental anomalies, should also be considered.

Pain management is also a frequent intervention used by many labouring individuals. One study in this literature review explored the role of dosing and route of opioids during labour and delivery on infant feeding outcomes. The authors found that intrapartum opioid exposure through both intravenous and epidural routes are associated with lower rates of exclusive breastfeeding at discharge.[105] A possible explanation for this finding is that infants receive some doses of the analgesia through the placenta leading to

decreased alertness at delivery.[105] This leads to a potential interruption in the newborn adjustment and breastfeeding success.

Overall, this literature review showed that individuals who undergo delivery by cesarian section, particularly if the cesarian section is planned, and receive opioid analgesics, are at risk for decreased exclusive breastfeeding in hospital. Equitable health care includes access to life-saving surgical procedures and adequate pain management during labour and delivery. Following labour and delivery, healthcare providers could identify patients with exclusive breastfeeding goals who are at risk for breastfeeding cessation or lack of initiation and increase awareness and support them.

2.7: Limitations

While the aforementioned articles represented a significant geographical range, Canadian studies were limited. When applying many of these findings to the local context in NL, we cannot account for population-level differences such as access to care, healthcare models, culture, language, and societal norms. Further studies that explore factors associated with breastfeeding in NL and Canada are needed.

Methodology should also be considered when interpreting the findings of this literature review. First, the focus of this review was to explore and identify maternal and infant characteristics associated with actual infant feeding behaviour in hospital. Therefore, this literature review excluded experimental studies, as they were not relevant

for answering the research question. Second, many studies relied on survey or questionnaire data to draw findings. While surveys are inexpensive strategies to reach a larger sample size, there are still concerns with self-report bias, whereby participants may not report the truth to provide a socially desirable answer.[109] Moreover, cross-sectional surveys provide weak evidence for determining if associations or relationships exist between exposure and outcomes due to the reliance on prevalence data.[110] A selection of articles relied on small sample sizes and lacked inferential statistics such as univariate or multivariate analysis.[83,85,99] In addition, several studies used a retrospective approach in their methods. It is generally agreed that prospective studies provide more robust evidence as they ensure that the exposure precedes the outcome. However, due to the nature of the research topic, some chronology is understood. For example, intrapartum pain management precedes exclusive breastfeeding at discharge.

This literature review also highlighted the importance of clear breastfeeding definitions. Most studies consistently applied the WHO definition of exclusive breastfeeding, described as no other food or drink other than breastmilk.[111] However, the time period of question was inconsistent within the literature. Most authors described exclusive breastfeeding in hospital as only breastmilk from birth to discharge.[57,58,60,72,75,76,78,82,86–88,90,93,94,99,106,112] However, some authors only considered exclusive breastfeeding on the day of discharge or did not clearly state the time period.[61,62,66,68,69,83,85,95,97,102–105] While these definitions may appear to be subtly different, the evidence suggests that considering infant feeding habits during the entirety of the hospitalization has significant implications for infant feeding in the first year of life.[41–45]

Another implication of only considering infant feeding on the day of discharge is overestimation of EBF rates in hospital.

2.8: Conclusion

The literature evaluated in this review identified various elements related to infant feeding practices in hospital. Barriers to exclusive breastfeeding in hospital included maternal obesity, gestational diabetes, older age, cesarian delivery, opioid and analgesia. Protective factors for exclusive breastfeeding in hospital included skin-to-skin contact, delayed newborn bath, family history of breastfeeding, maternal education, Baby-Friendly Hospital designation, and access to allied health providers. Some of these elements may be non-modifiable, such as lifesaving cesarian delivery, however, several modifiable factors exist. Increased skin-to-skin contact, delayed newborn bathing, Baby-Friendly Hospital designation and adherence, and increased support for parents in hospital are all achievable strategies that appear to be associated with improved exclusive breastfeeding in hospital. When interpreting the findings of this literature review, some methodological concerns should be considered.

Exploring risk factors for breastfeeding using hospital-level data instead of self-reported surveys may provide higher quality evidence. Conducting research in NL would add to the body of literature generalizable to high-income countries. Furthermore, exploring factors associated with breastfeeding in hospital could help inform future decision-makers and researchers as obstetric services are being modified in NL, as

outlined in the Health Accord.[1] To address the contextual and methodological gaps in the literature, the current retrospective cohort study will examine the relationship between maternal, infant and hospital characteristics with exclusive breastfeeding from birth to hospital discharge in three communities in NL.

Chapter 3: Methods

The following chapter outlines the contributions of patient engagement, followed by the study's design, data analysis, and ethical considerations for research.

3.1: Patient Engagement

As previously discussed, this research was completed using a patient-oriented approach. Through patient engagement sessions and collaboration with a patient partner, we aimed to involve key knowledge users in various aspects of the research project including data collection, data analysis, and knowledge translation.

A patient partner involved with the BFRWG was invited to collaborate on this research project at its inception. Through communication in-person and via email, her expertise as a patient informed selecting variables for study, reviewing poster presentations, and reviewing the patient engagement session plans.

For the patient engagement sessions, key knowledge users were contacted through a post on the Birth Justice NL Community Facebook Page in June 2020. The post consisted of a short paragraph and a poster presenting basic information on the patient engagement sessions. Emails with the same information were sent to several community organizations, including Daybreak Centre, La Leche League Canada, First Light, and the Association for New Canadians. Parents, health providers, or other interested parties were

invited to the sessions. Ten interested individuals reached out via Facebook messenger and email to the study team.

The engagement sessions considered the following perspectives in the engagement sessions: mother (6), prospective mother (1), expectant mother (2), community member (2), nurse (3), doula (1), and midwifery student (1). Most patient partners were born between 1990 to 1999 (55.6%), followed by 1980 to 1989 (44.6%)—all individuals identified as female, and one person as Indigenous. Participants were highly educated, with all having started or completed post-secondary education. Three-quarters of the participants were employed.

The patient engagement sessions were conducted one-on-one using a virtual platform chosen by the individual, such as Zoom, Facebook messenger, and telephone. All sessions took place in June 2020 and lasted about one hour. To begin the session, we presented a brief PowerPoint explaining the purpose of the session, knowledge translation, the research project, and the goals for the meeting. There was then a short discussion based on ten pre-written discussion-generating questions (Appendix A). Discussions helped to understand and incorporate: perspectives on which independent variables were most relevant, and to identify the most effective ways to disseminate findings to the patient population and healthcare providers.

From a patient perspective, individuals overwhelmingly agreed the foremost variables to include in the study were related to interventions, including cesarian section,

epidural, episiotomy, induction, and forceps and vacuum use. As these interventions are relevant to breastfeeding both clinically and in the literature, the findings of the engagement sessions did not change the variable list for our study. However, these discussions helped us select which variables were most relevant for the patient population when reporting our findings and disseminating to the public. For example, intervention rates in this study, differences between hospital sites, and their implications on breastfeeding rates are important findings for patients.

Patient partners also emphasized that all health providers involved in maternity care, from the prenatal to the postpartum period, should be informed of the findings of this study. Finally, they imparted that the best ways to disseminate these findings to the patient population would be through infographics on social media and posted in areas where these individuals access health services such as clinics, hospitals, and public health offices. These discussions directly informed our knowledge translation strategy.

To conclude the session, individuals were thanked for their time and contributions and asked to complete a short feedback survey. CIHR recognizes that evaluating patient engagement in research is valuable to determine if a meaningful engagement was achieved.[48] To evaluate the engagement sessions, we used a formative assessment method. We adapted the Public and Patient Engagement Evaluation Tool, developed by patients and researchers at McMaster University and designed for one-time engagement activities.[113] Participants were asked to rate their agreement with ten statements from strongly disagree to strongly agree (Appendix B). Nine of the ten individuals completed

the survey. Overall, the participants received the engagement sessions well, with full results in Figure 4.

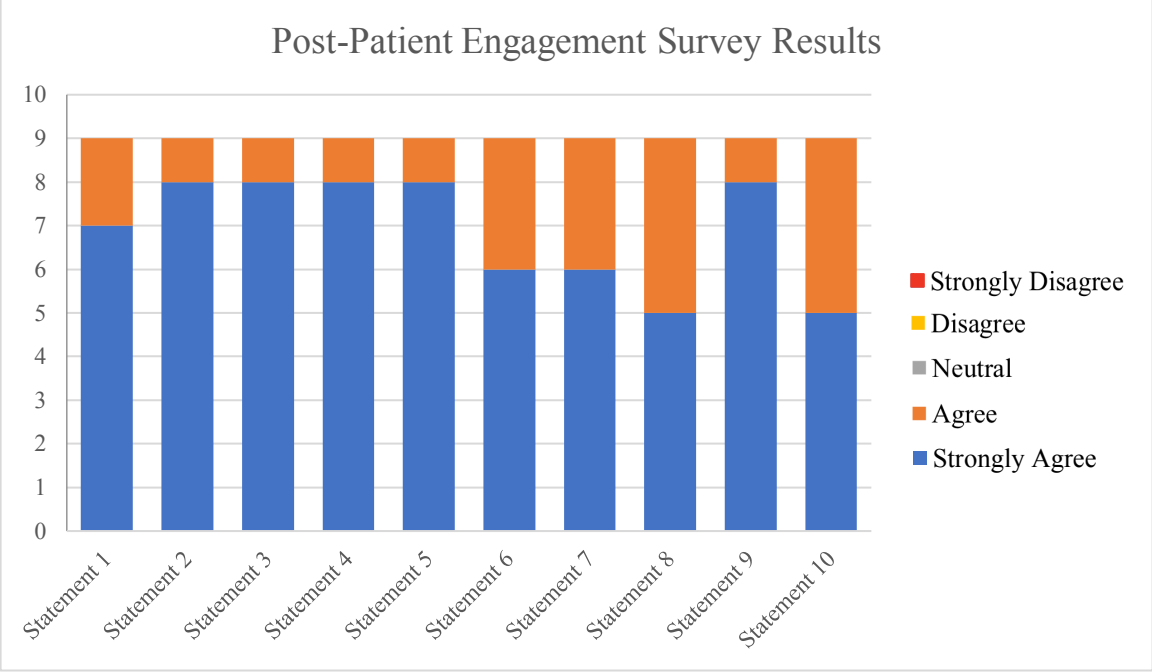

Figure 4: Post-Patient Engagement Survey Results

Overwhelmingly, individuals strongly agreed that they had a clear understanding of the purpose of the session, had enough information to contribute, were able to express their views, felt we heard their ideas, the session achieved its objectives, and were satisfied with the experience. Participants also strongly agreed that their input would be utilized to make a difference, although one-third only agreed. Individuals strongly agreed (55.6%) and agreed (44.6%) that they were better informed about the discussed topics due to their participation in the engagement session and that it was a good use of their time.

The discussions with our patient partners and the collaboration during patient engagement sessions were used to inform study design, data interpretation, and knowledge translation plans.

3.2: Research Study Design

This was a retrospective cohort study of births in Clarenville, Corner Brook, and Gander from January 1st, 2015, to December 31st, 2016. The purpose of this study was to first examine the differences in exclusive breastfeeding from birth to hospital discharge across three communities in NL, and second, to identify risk factors associated with exclusive breastfeeding in hospital in the entire study population. De-identified secondary data was sourced through the NL Perinatal Program (PPNL). PPNL is operated by Eastern Health and collects health information for births in the entire province.[114] This database collects over 200 variables, including demographics, procedures, interventions and more, collected throughout the mother and baby's hospital stay.[115]

3.3: Study Population

At the time of the current study, NL's provincial population was serviced by a health system made up of four Regional Health Authorities (RHAs): Eastern, Central, Western, and Labrador-Grenfell Health. The current study considered three of four RHAs.

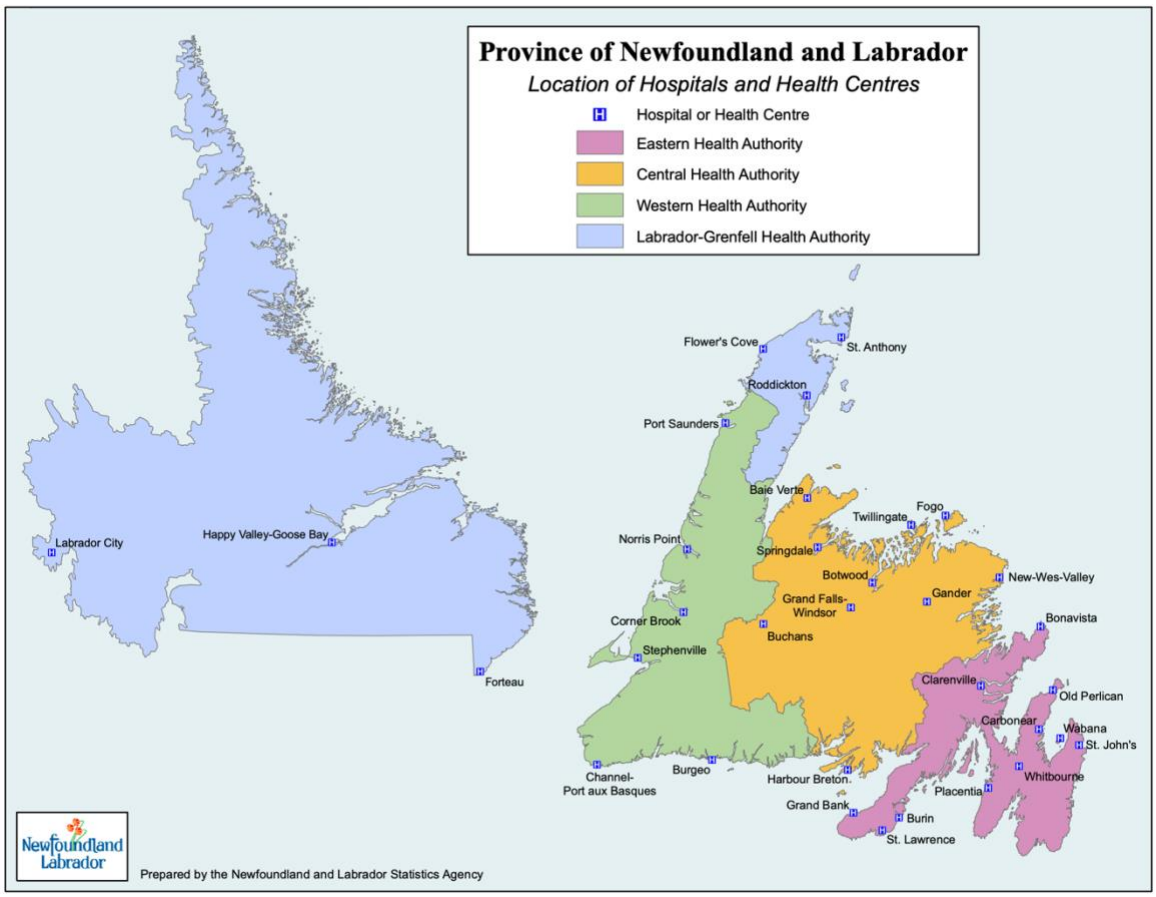

Figure 5: Location of Hospitals and Health Centres in NL, used with permission[116]

The Dr. G. B. Cross Memorial Hospital of the Eastern Health Region, located in the town of Clarenville, is a 41 inpatient bed health facility.[117] In 2016, Clarenville had a population of 6,291.[118] The James Paton Memorial Hospital of the Central Health Region, located in the town of Gander, has 85 acute care beds. In the study timeframe, Gander had a population of 10,220.[119,120] Finally, the Western Memorial Regional Hospital of Western Health, is located in the City of Corner Brook. While Corner Brook has a population of about 30,969, this 217-bed facility serves over 75,000 people.[121,122] Individuals at all facilities had access to a variety of health services including pediatrics,

obstetrics, and gynecology. Through communication with the Provincial Breastfeeding Consultant and Regional Lactation Consultants, we established that access to lactation consultants varied by region during the study timeframe. Lactation consultants were accessible in hospital in Gander but were likely not in Corner Brook until 2016. Lactation consultants were likely not accessible at Dr. G. B. Cross Memorial Hospital at the time of this study.

The James Paton Memorial Hospital in Gander was selected in order to gain a better understanding of the hospital practices and the maternal and infant health outcomes related to infant feeding pre-midwifery implementation scheduled for 2019. As comparators, the Dr. G. B. Cross Memorial Hospital in Clarenville was selected from the Eastern Health RHA due to its' similarity in size and available hospital services. The Western Memorial Regional Hospital was chosen from the Western Health RHA as it is the main provider of obstetric services in the Western Health Region.

The CPS recognizes that adolescent parents have unique health needs including higher rates of psychosocial concerns, higher prevalence of mental health disorders, different socioeconomic circumstances, and varying social supports.[123] The literature also shows that adolescents have increased risks of cesarian section, assisted vaginal delivery, and formula supplementation while in hospital.[124] Our study aimed to identify factors associated with exclusive breastfeeding in hospital in the adult population (18 years of age or older), and thus excluded younger parents from our study.

In order to detect differences in exclusive breastfeeding rates across the three hospitals, a sample size calculation resulted in a required sample size of 831 (277 per group). Sample size calculation used 80% power and an alpha of $p = 0.05$ (two-tailed). This was based on an estimated difference between 11–16.5% in exclusive breastfeeding rates from Butler et al. (2015).[125]

Data for 1,818 births from 2015 to 2016 in the listed locations were received from PPNL. The sample included all patients aged 18 or older with a singleton, full-term (37 to 42 weeks' gestation) live birth in Gander, Corner Brook, and Clarenville. After applying the inclusion criteria, 1,727 remained. Participants were excluded if the value for the outcome variable, exclusive breastfeeding from birth to hospital discharge, was missing. After excluding 171 individuals with unknown infant feeding status in hospital, the final sample yielded 1,556 individuals (Figure 6).

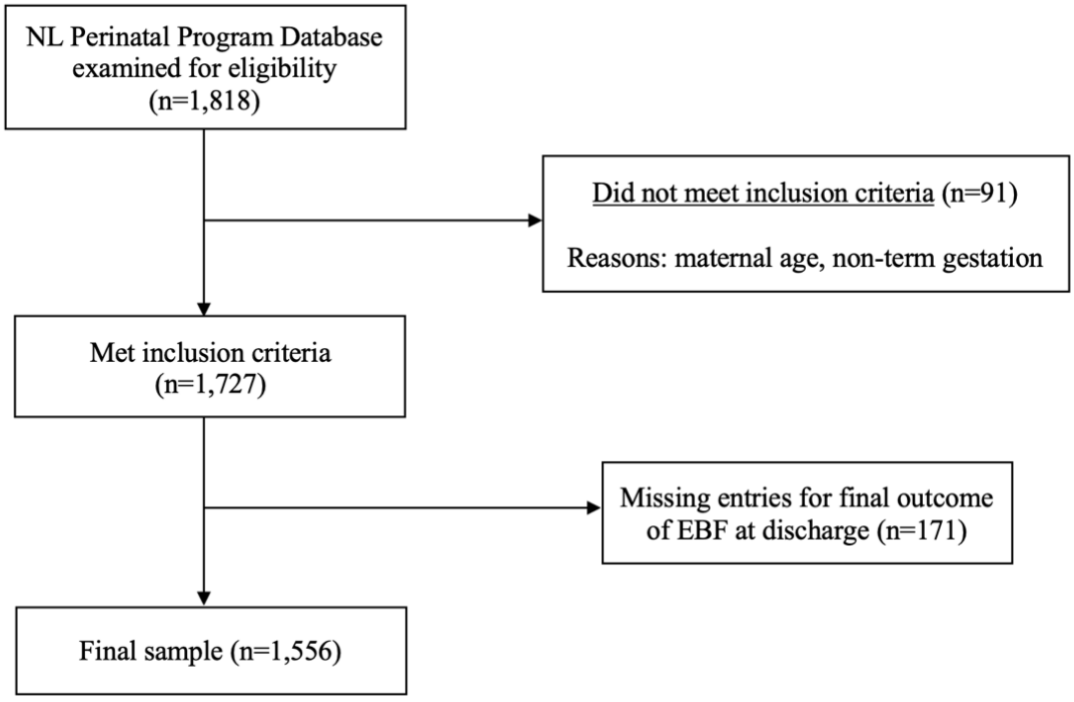

Figure 6: Creating the final sample for analysis

3.4: Time Period

Towards the end of 2016, obstetrical services were temporarily diverted from Gander to Grand Falls-Windsor due to physician shortages.[126] In the years following, obstetric services were again intermittently diverted away from Gander. Then, in 2019, the Government of Newfoundland and Labrador initiated a pilot project of midwifery in Gander.[127] We selected the time frame of this study, 2015 to 2016, to capture infant feeding outcomes leading up to the diversion of obstetric services and pre-midwifery implementation.

3.5: Outcome Variable

In this study, our outcome variable was exclusive breastfeeding from birth to discharge from hospital. Infants who were fed with no fluids or solids other than breastmilk were categorized as exclusively breastfed, as described by the WHO.[111] Infants who received formula, water, or any substance other than breast milk were categorized as non-exclusively breastfed. This data was extracted by the PPNL directly from each hospital's medical records.

3.6: Data Analysis

Data from the PPNL was analyzed remotely during the Covid-19 Pandemic using SAS 9.4 Windows Version 6.2.9000. Over 70 independent variables were selected for analysis based on the literature, clinical practice, and perspectives from patient partner and patient engagement sessions (Appendix C). All variables with more than 15% of missing data were excluded from the analysis.

For the descriptive analysis, mean/standard deviation and frequency/proportion were provided for continuous variables and categorical variables, respectively. Characteristic factors were compared between three sites (Gander, Corner Brook, and Clarenville) by ANOVA and Chi-square for continuous and categorical variables, respectively. Fisher's exact test was used for categorical variables where the expected counts were less than 5. Logistic regression was used to detect significant risk factors of exclusive breastfeeding from birth to discharge in univariate and multivariate models. The

three facilities were combined for univariate and multivariate analysis. These tests of statistical significance used $p = 0.05$ as statistically significant.

Purposeful selection method was used to build our final model (Appendix D). Risk factors significant at $p = 0.20$ from the univariate logistic regression were included in an initial multivariate model. However, only significant risk factors (at $p = 0.05$ level), and clinically important risk factors (for example identified in the literature), were included in the final multivariate model. Maternal age was found to be a clinically important risk factor for exclusive breastfeeding in hospital in the literature.[59,96,97] Following great consideration, our research team decided to include maternal age in the multivariate model based on its clinical rather than statistical importance. This strategy allowed us to control for age as we considered the relationship between other independent variables and breastfeeding in hospital.

3.7: Ethical Considerations

Ethical approval for this research was obtained in 2019 from the NL Health Research Ethics Board (HREB #2019.119) and Eastern Health's Research Proposal Approvals Committee (RPAC) and is found in Appendix E. As per patient-oriented research guidelines, ethics approval for public engagement sessions was not required. All discussions and correspondences were kept anonymous.

Chapter 4: Results

The following chapter includes the results of the data analysis, starting with a description of the study cohort, followed by univariate and multivariate analysis findings.

4.1: Descriptive Statistics

Table 6 presents the descriptive statistics of the total sample and of the three facilities included in the study. Half of the study population exclusively breastfed from birth to discharge from hospital (50%). There was a significant difference ($p < 0.05$) across hospital sites, with the highest rates in Gander (60%), followed by Clarenville (50%), and Corner Brook (48%). The study population's average age at delivery was 28.10 years (SD = 5.20, $p = 0.9921$). The largest age group was 25 to 29 years (34%), followed by 18 to 24 and 30 to 34 years (both 27%), and over 35 years (12%). There were no significant differences in the distribution of age groups across hospital site of birth ($p > 0.05$). Most participants were partnered at the time of delivery (83%), but there were differences in the population ($p < 0.05$), with birthing parents in Corner Brook having the highest proportion of unpartnered status (21%). Participants generally had high levels of education. The majority completed post-secondary (60%), followed by high school (25%). Compared to the other hospital sites, Gander had the lowest proportion of participants achieving post-secondary levels of education (46%, $p = 0.0001$).

The pre-pregnancy smoking rate ranged from 32% (Corner Brook) to 28% (Gander). However, the differences across the three sites were not significant ($p > 0.05$). Smoking rates during pregnancy overall were 19%; 15% in Gander, 17% in Clarenville, and 21% in Corner Brook. However, the differences were not statistically significant ($p > 0.05$). Smoking rates decreased by about 10% from pre-pregnancy to during pregnancy. Pre-pregnancy diabetes rates ranged from 1.7% (Corner Brook) to 0.65% (Clarenville). The differences across the three sites were not statistically significant ($p > 0.05$).

Table 6: Descriptive Statistics of the Sample

	Clarenville n=310	Corner Brook n=982	Gander n=264	Total n=1,556	p-value
Breastfeeding at Discharge, n (%)					
Exclusive Breastfeeding	154 (49.68)	471 (47.96)	157 (59.47)	782 (50.26)	0.0039
Non-exclusive breastfeeding	156 (50.32)	511 (52.04)	107 (40.53)	774 (49.74)	
Any Breastfeeding in Hospital, n (%)					
No	119 (38.39)	322 (32.79)	69 (26.14)	510 (32.78)	0.0078
Yes	191 (61.61)	660 (67.21)	195 (73.86)	1046 (67.22)	
Age groups, n (%)					
<25 years	76 (24.52)	272 (27.70)	75 (28.41)	423 (27.19)	0.8067
25-29 years	114 (36.77)	332 (33.81)	82 (31.06)	528 (33.93)	
30-34 years	86 (27.74)	262 (26.68)	73 (27.65)	421 (27.06)	
35+ years	34 (10.97)	116 (11.81)	34 (12.88)	184 (11.83)	
Partnered Status, n (%)					
Unpartnered	31 (10.13)	204 (21.27)	29 (11.24)	264 (17.33)	<0.0001
Partnered	275 (89.87)	755 (78.73)	229 (88.76)	1259 (82.67)	
Education, n (%)					
Not Graduated High School	19 (6.23)	68 (6.96)	29 (11.33)	116 (7.54)	0.0001
High School	73 (23.93)	221 (22.62)	84 (32.81)	378 (24.58)	
Beyond High School	19 (6.23)	73 (7.47)	25 (9.77)	117 (7.61)	
College/University/Trade	194 (63.61)	615 (62.95)	118 (46.09)	927 (60.27)	
Pre-Pregnancy Smoking, n (%)					
No	184 (71.04)	648 (68.21)	159 (71.62)	991 (69.25)	0.4821

	Clarenville n=310	Corner Brook n=982	Gander n=264	Total n=1,556	p-value
Yes	75 (28.96)	302 (31.79)	63 (28.38)	440 (30.75)	
Smoking During Pregnancy, n (%)					
No	250 (82.78)	767 (79.32)	183 (84.72)	1200 (80.81)	0.1178
Yes	52 (17.22)	200 (20.68)	33 (15.28)	285 (19.19)	
Pre-existing Diabetes, n (%)	2 (0.65)	17 (1.73)	2 (0.76)	21 (1.35)	0.3000[a]
Gravida, n (%)					
1	108 (34.95)	326 (33.37)	88 (34.78)	522 (33.92)	0.9246
2	109 (35.28)	338 (34.60)	94 (37.15)	541 (35.15)	
3	53 (17.15)	185 (18.94)	43 (17.00)	281 (18.26)	
>3	39 (12.62)	128 (13.10)	28 (11.07)	195 (12.67)	
Parity, n (%)					
0	137 (44.34)	413 (42.06)	118 (46.64)	668 (43.26)	0.8550
1	118 (38.19)	396 (40.33)	94 (37.15)	608 (39.38)	
2	39 (12.62)	124 (12.63)	32 (12.65)	195 (12.63)	
>2	15 (4.85)	49 (4.99)	9 (3.56)	73 (4.73)	
Previous Cesarean Section Count, n (%)					
0	260 (84.14)	838 (85.69)	189 (81.12)	1287 (84.67)	0.0826
1	47 (15.21)	118 (12.07)	40 (17.17)	205 (13.49)	
>1	2 (0.65)	22 (2.25)	4 (1.72)	28 (1.84)	
Birth Weight (grams), mean (SD)	3495.17 (464.15)	3565.75 (468.96)	3608.61 (476.29)	3558.96 (470.30)	0.0119

	Clarenville n=310	Corner Brook n=982	Gander n=264	Total n=1,556	p-value
Birth Weight Groups, n (%)					
<2500g	4 (1.29)	18 (1.83)	4 (1.52)	26 (1.67)	0.4609
2500-3999g	261 (84.19)	838 (85.34)	215 (81.44)	1314 (84.45)	
4000g	45 (14.52)	126 (12.83)	45 (17.05)	216 (13.88)	
Gestational Age Groups (weeks), n (%)					
37	29 (9.35)	84 (8.55)	10 (3.79)	123 (7.90)	<0.0001
38	69 (22.26)	254 (25.87)	29 (10.98)	352 (22.62)	
39	107 (34.52)	336 (34.22)	56 (21.21)	499 (32.07)	
40	79 (25.48)	246 (25.05)	117 (44.32)	442 (28.41)	
41	26 (8.39)	62 (6.21)	52 (19.70)	140 (9.00)	

[a] Fisher's exact test p-value

Examination of obstetric history showed that over two-fifths of the study population were nulliparous on admission to hospital (43%), with no significant differences across hospital sites ($p > 0.05$). The highest proportion of participants were gravida two (37%), followed by gravida one (34%), gravida three (18%), and gravida four or more (13%). There were no statistically significant differences in the distributions of previous cesarian section counts across the three sites; 85% had never had one, 14% had one, and 2% had more than one ($p > 0.05$).

As shown in Table 7, very few (2%) participants in this study experienced labour lasting over 24 hours. Results were significantly different across hospital sites, with a higher proportion of patients in Gander having long labour (6%) compared to 1% in Corner Brook and 2% in Clarenville ($p < 0.05$). The average length of stay in hospital for births was 2.72 days, and was statistically significant across the three sites ($p < 0.05$) with the most prolonged duration in Gander (3.78 days), followed by Corner Brook (2.55 days) and Clarenville (2.32 days).

Polyhydramnios was only reported in Corner Brook (1%). Rates of adverse events, such as pre-eclampsia and postpartum hemorrhage, were both low (1% and 5%, respectively) and not significantly different across hospital birth sites ($p > 0.05$). In the study population, health providers monitored fetal heart rate most frequently electronically (77%), followed by intermittent auscultation (16%). Modes of monitoring were significantly different across hospital sites ($p < 0.05$), with Clarenville and Gander mainly using electronic methods (98%), compared to Corner Brook, where intermittent

auscultation was used about one-quarter of the time (25%). The rupture of membranes was spontaneous in 43% of births, with the highest rate in Gander (62%), followed by Clarenville (47%) and Corner Brook (39%). Membranes were ruptured artificially in 45% of births, with a significant difference across sites ($p < 0.05$).

Table 7: Labour and Delivery Interventions and Outcomes

	Clarenville n=310	Corner Brook n=982	Gander n=264	Total n=1,556	p-value
Long Labour (> 24hours), n (%)	6 (1.94)	13 (1.32)	17 (6.44)	36 (2.31)	<0.0001
Length of Stay (days), mean (SD)	2.32 (1.00)	2.55 (1.34)	3.78 (1.49)	2.72 (1.40)	<0.0001
Polyhydramnios, n (%)	0 (0.00)	14 (1.43)	0 (0.00)	14 (0.90)	0.0115[a]
Pre-Eclampsia, n (%)	7 (2.26)	9 (0.92)	2 (0.76)	18 (1.16)	0.1508[a]
Post-partum haemorrhage, n (%)	13 (4.19)	53 (5.40)	5 (1.89)	71 (4.56)	0.0502
Fetal Heart Monitor, n (%)					
Electronic	304 (98.38)	625 (64.90)	254 (97.69)	1183 (77.22)	<0.0001
Intermittent Auscultation	0 (0.00)	240 (24.92)	0 (0.00)	240 (15.67)	
None	2 (0.65)	16 (1.66)	6 (2.31)	24 (1.57)	
Both Electronic and Intermittent Auscultation	3 (0.97)	82 (8.52)	0 (0.00)	85 (5.55)	
Induction, n (%)	129 (41.61)	284 (28.92)	98 (37.12)	511 (32.84)	<0.0001
Indication for Induction, n (%)					
Post Due Date	49 (38.28)	73 (28.08)	52 (78.79)	174 (38.33)	<0.0001
Hypertension	11 (8.59)	23 (8.85)	0 (0.00)	34 (7.49)	
Spontaneous ROM	35 (27.34)	32 (12.31)	2 (3.03)	69 (15.20)	
Other[b]	33 (25.78)	132 (50.77)	12 (18.18)	177 (38.99)	
Spontaneous ROM, n (%)	113 (46.50)	378 (38.85)	106 (62.35)	597 (43.07)	<0.0001
Questionable ROM, n (%)	0 (0.00)	12 (1.23)	3 (1.76)	15 (1.08)	0.1043[a]
Artificial ROM to Rupture Membranes, n (%)	127 (52.26)	437 (44.91)	57 (33.53)	621 (44.81)	0.0008

	Clarenville n=310	Corner Brook n=982	Gander n=264	Total n=1,556	p-value
Forceps and Vacuum, n (%)					
Neither	245 (79.03)	879 (89.51)	227 (85.98)	1351 (86.83)	<0.0001
Forceps	10 (3.23)	16 (1.63)	25 (9.47)	51 (3.28)	
Vacuum	47 (15.16)	80 (8.15)	11 (4.17)	138 (8.87)	
Both	8 (2.58)	7 (0.71)	1 (0.38)	16 (1.03)	
Episiotomy, n (%)	58 (18.71)	102 (10.39)	27 (10.23)	187 (12.02)	0.0003
Cesarian Section, n (%)	123 (39.68)	293 (29.84)	82 (31.06)	498 (32.01)	0.0050
Primary Indication for Cesarian Section, n (%)					
Failure to Progress	36 (29.27)	73 (25.17)	25 (31.25)	134 (27.18)	0.3642
Previous C-Section	50 (40.65)	103 (35.52)	30 (37.50)	183 (37.12)	
Other[c]	37 (30.08)	114 (39.31)	25 (31.25)	176 (35.70)	
Local Anesthetic, n (%)	19 (6.13)	29 (2.95)	0 (0.00)	48 (3.08)	0.0001
Epidural, n (%)	126 (40.65)	275 (28.00)	49 (18.56)	450 (28.92)	<0.0001
Narcotics, n (%)	30 (9.68)	462 (47.05)	47 (17.80)	539 (34.64)	<0.0001
Narcotics and Epidural, n (%)	7 (2.26)	142 (14.46)	9 (3.41)	158 (10.15)	<0.0001
General for Pain, n (%)	16 (5.16)	20 (2.04)	7 (2.65)	43 (2.76)	0.0137
Entonox/Blendox, n (%)	49 (15.81)	357 (36.35)	8 (3.03)	414 (26.61)	<0.0001
No Analgesic, n (%)	31 (10.00)	161 (16.40)	81 (30.68)	253 (17.54)	<0.0001
Apgar Scores, mean (SD)					
1 minute	8.75 (0.67)	8.72 (1.39)	8.49 (1.46)	8.68 (1.30)	0.0247
5 minutes	9.07 (0.34)	9.60 (0.92)	9.67 (0.77)	9.51 (0.84)	<0.0001

	Clarenville n=310	Corner Brook n=982	Gander n=264	Total n=1,556	p-value
Bag Mask Ventilation, n (%)	18 (5.81)	59 (6.01)	10 (3.79)	87 (5.59)	0.3721
Ventilation 30 min, n (%)	1 (0.32)	5 (0.51)	4 (1.52)	10 (0.64)	0.1226[a]
PEEP, n (%)	0 (0.00)	35 (3.57)	1 (0.38)	36 (2.32)	0.0001
Other in Antenatal, n (%)	22 (7.10)	41 (4.18)	4 (1.52)	67 (4.31)	0.0043

[a] Fisher's exact test p-value

[b] Includes: no entry, no indication given, and other.

[c] Includes: IUGR, fetal anomaly, non-reassuring fetal heart rate, failed induction, failed vacuum/forceps, failure to progress, malpresentation, pre-eclampsia, eclampsia, placenta previa, umbilical cord prolapse, placental abruption, and other.

Examination of the cesarian section rate showed that it was significantly different across hospital birth sites ($p < 0.05$). Cesarian section rate was highest in Clarenville (40%), followed by Gander (31%) and Corner Brook (30%), with an overall average of 32%. The induction rate in this population was 33%, with significantly different rates across hospital sites ($p < 0.05$). The rate was highest in Clarenville (42%), followed by Gander (37%) and Corner Brook (29%). The most frequent indication for induction was post-due dates (38%). Most participants (87%) received neither forceps nor vacuum to assist delivery. The episiotomy rate in this study was 12%, highest in Clarenville (19%) compared to Corner Brook and Gander (both 10%), ($p < 0.05$).

Examination of interventions also explored the various pain management techniques. The most frequent method of pain management was narcotics (35%), followed by epidural (29%), nitrous oxide (27%), then local and general (both 3%). There were significant differences in pain management between hospital sites ($p < 0.05$). Epidural rates were greatest in Clarenville (41%), and narcotic rates were highest in Corner Brook (47%). Gander generally had lower pain management intervention rates, with 31% having no analgesic, compared to Clarenville and Corner Brook (10% and 16%, respectively), ($p < 0.05$).

The average infant birth weight was 3558.96 grams. Most infants (85%) weighed between 2500 to 3999g, with no differences across sites ($p > 0.05$). The average gestational age was 39 weeks. Further examination showed that most infants were born at 39 weeks (32%), followed by 40 weeks (28%), 38 weeks (23%), 41 weeks (9%), and 37

weeks (8%). There was a significant difference between hospital site of birth, with infants in Gander being born at a higher gestational age ($p > 0.05$). Apgar scores progressed similarly, although statistically different, across hospital sites ($p < 0.05$). Eighty-seven infants (6%) received bag-mask ventilation at delivery. Ventilation for 30 minutes and positive end-expiratory pressure intervention rates were low.

4.2: Univariate Analysis

Table 8 presents the results of the univariate analysis. The hospital site of birth was significantly associated with the outcome variable ($p = 0.0042$). Compared to Gander, individuals in Clarenville (OR = 0.673; 95% CI 0.483 – 0.937) and Corner Brook (OR = 0.628; 95% CI 0.477 – 0.828) were significantly less likely to have exclusive breastfeed until discharge. Maternal age was significantly associated with exclusive breastfeeding from birth to discharge. Compared to those aged 25 to 29, individuals aged 30-34 were about 1.4 times more likely (95% CI: 1.087 – 1.819) to breastfeed in hospital exclusively. Compared to those with a partner, those without a partner were about one-half as likely to breastfeed in hospital (OR = 0.517; 95% CI: 0.394 – 0.680). Achieved level of education was also associated with the outcome variable, with those completing college or university more than twice as likely as those who completed high school to breastfeed (OR = 2.387, 95% CI: 1.867 – 3.052).

Not smoking pre-pregnancy and during pregnancy was associated with exclusive breastfeeding at discharge. Compared to individuals who smoked during pregnancy, those

who did not smoke were 3.098 times more likely (95% CI: 2.340 – 4.102) to breastfeed exclusively in hospital. Those without pre-existing diabetes were significantly more likely to breastfeed exclusively (OR = 4.368; 95% CI: 1.463 – 13.040). Patients with polyhydramnios were more likely to exclusively breastfeed until discharge (OR = 3.744; 95% CI: 1.040 – 13.471). Neither gravida nor parity was significantly associated with the outcome variable. Previous cesarian section count, labour lasting over 24 hours, length of stay, pre-eclampsia, and postpartum hemorrhage were also not significantly associated with exclusive breastfeeding from birth to hospital discharge.

Table 8: Univariate analysis of factors associated with exclusive breastfeeding from birth to discharge from all sites

Variable	Odds Ratio	95% CI	Type 3 p-value
Hospital Site of Birth			
Gander	1		0.0042
Clarenville	0.673	0.483, 0.937	
Corner Brook	0.628	0.477, 0.828	
Maternal Age			
25-29 yrs	1		0.0004
Under 25 yrs	0.824	0.637, 1.066	
30-34 yrs	1.406	1.087, 1.819	
Over 35 yrs	1.392	0.993, 1.951	
Partnered			
Yes	1		<0.0001
No	0.517	0.394, 0.680	
Education Level			
Graduated High School	1		<0.0001
Not Graduated High School	0.770	0.495, 1.198	
Beyond High School	0.991	0.646, 1.520	
College or University	2.387	1.867, 3.052	
Smoking Pre-Pregnancy			
Yes	1		<0.0001
No	2.459	1.948, 3.103	
Current Smoking			
Yes	1		<0.0001

Variable	Odds Ratio	95% CI	Type 3 p-value
No	3.098	2.340, 4.102	
Pre-Existing Diabetes			
Yes	1		0.0082
No	4.368	1.463, 13.040	
Gravida			
1	1		0.2342
2	0.965	0.758, 1.227	
3	0.894	0.669, 1.195	
>3	0.716	0.514, 0.997	
Parity			
0	1		0.1557
1	0.885	0.711, 1.103	
2	0.774	0.562, 1.066	
>2	0.630	0.386, 1.029	
Number of Previous Cesarian Sections			
0	1		0.1493
1	0.748	0.556, 1.007	
>1	1.103	0.521, 2.337	
Long Labour			
Yes (>24h)	1		0.0903
No (<24h)	1.812	0.911, 3.603	
Length of Stay (days)	1.005	0.936, 1.079	0.8952
Polyhydramnios			
Yes	1		0.0433
No	3.744	1.040, 13.471	
Preeclampsia			
Yes	1		0.6219
No	1.265	0.497, 3.223	
Postpartum Haemorrhage			
Yes	1		0.1691
No	1.402	0.866, 2.270	
Fetal Heart Monitoring			
Intermittent Auscultation	1		0.0662
Electric Monitoring	1.104	0.837, 1.458	
Neither	0.517	0.213, 1.253	
Both	0.689	0.417, 1.139	
Spontaneous ROM			
Yes	1		0.6698
No	0.955	0.772, 1.181	

Variable	Odds Ratio	95% CI	Type 3 p-value
Questionable ROM			
Yes	1		0.0830
No	2.762	0.876, 8.714	
ARM To Rupture Membrane			
Yes			
No	1		0.1067
	0.840	0.680, 1.038	
Induction of Labour			
Yes	1		0.6806
No	1.045	0.846, 1.292	
Forceps and Vacuum			
Neither	1		0.0252
Forceps Only	0.771	0.439, 1.352	
Vacuum Only	0.585	0.408, 0.838	
Both	1.206	0.447, 3.258	
Episiotomy			
Yes	1		0.8785
No	1.024	0.754, 1.390	
Cesarian Section			
Yes	1		0.0043
No	1.365	1.102, 1.691	
Local for Pain			
Yes	1		0.0880
No	0.597	0.330, 1.080	
Epidural for Pain			
Yes	1		0.2563
No	1.135	0.912, 1.414	
Narcotic for Pain			
Yes	1		0.6789
No	1.045	0.848, 1.288	
Narcotic and Epidural for Pain			
Yes	1		0.0380
No	1.422	1.020, 1.983	
General for Pain			
Yes	1		0.0863
No	1.730	0.925, 3.238	
Nitrous Oxide for Pain			
Yes	1		0.7363
No	0.962	0.768, 1.205	
No Analgesic for Pain			
Yes	1		0.0884

Variable	Odds Ratio	95% CI	Type 3 p-value
No	0.796	0.612, 1.035	
Baby Birth Weight Groups			
2500-3999g	1		0.0626
Less than 2500g	0.356	0.149, 0.851	
Greater than 3999g	0.929	0.697, 1.239	
Gestational Age Groups (Weeks)			
40	1		0.0002
37	0.702	0.470, 1.047	
38	0.521	0.392, 0.692	
39	0.770	0.595, 0.996	
41	0.957	0.653, 1.404	
Gestational Age (weeks)	1.216	1.109, 1.333	<0.0001
Apgar Scores			
1 minute	1.098	1.015, 1.188	0.0180
5 minutes	1.166	1.030, 1.321	0.0128
Bag Mask			
Yes	1		0.0007
No	2.222	1.401, 3.524	
Ventilation 30 min			
Yes	1		0.0763
No	4.073	0.862, 19.241	
PEEP			
Yes	1		0.0035
No	3.109	1.452, 6.655	
Other Antenatal Provider			
Yes	1		0.1585
No	1.429	0.870, 2.346	

Two interventions were associated with the outcome variable. Compared to participants with a cesarian section, patients with a non-cesarian delivery were 1.365 times more likely to exclusively breastfeed until discharge (95% CI: 1.102 – 1.691). Individuals having vacuum-assisted delivery were significantly less likely to exclusively breastfeed (OR = 0.585; 95% CI: 0.408 – 0.838). Other interventions, including fetal

heart monitoring, membrane rupture, induction, and episiotomy, were not significantly associated with the outcome variable.

Individuals not receiving narcotics nor epidural analgesia were 1.422 times more likely to exclusively breastfeed until hospital discharge (95% CI: 1.020 – 1.983). Other pain management techniques, including local, general, and nitrous oxide, were not significantly associated with exclusive breastfeeding at discharge.

Infant health outcomes were also significant in predicting exclusive breastfeeding in hospital. Infants weighing less than 2500 grams were significantly less likely to be exclusively breastfed in hospital (OR = 0.356; 95% CI: 0.149 – 0.851), and infants of a higher gestational age were also more likely to be exclusively breastfed (OR = 1.216; 95% CI: 1.109 – 1.333). Compared to those who received bag-mask ventilation, infants who did not receive this intervention were 2.222 times more likely to be exclusively breastfed until discharge (95% CI: 1.401 – 3.524). While ventilation for 30 minutes post-delivery did not have a significant association with the outcome, infants not receiving positive end-expiratory pressure compared to those who did were 3.109 times more likely to be exclusively breastfed (95% CI: 1.452 – 6.655).

4.3: Multivariate Analysis

Results of the multivariate analysis are presented in Table 9. Hospital site of birth was a predictor of exclusive breastfeeding from birth to discharge even after adjusting for

maternal age, education level, current smoking, pre-existing diabetes, forceps and vacuum use, narcotic and epidural use, cesarian section, gestational age, and bag-mask ventilation (p = 0.0035). Compared to those in Gander, individuals in Clarenville (OR = 0.616, 95% CI: 0.414 – 0.916, p = 0.0168) and Corner Brook (OR = 0.551, 95% CI: 0.389 – 0.780, p = 0.0008) were 40% and 45% less likely to breastfeed exclusively, respectively. Compared to those aged 25 to 29, individuals aged 18 to 24 years and over 30 years were significantly more likely to breastfeed in hospital exclusively. Compared to those with a high school diploma, participants with a college or university-level education were over two times more likely to exclusively breastfeed (OR = 2.178; 95% CI: 1.624 – 2.922).

Table 9: Multivariate analysis of factors associated with exclusive breastfeeding from birth to discharge from all sites

Variable	Adjusted Odds Ratio	95% CI	p-value*	Type 3 p-value**
Hospital Site of Birth				
Gander	1			0.0035
Clarenville	0.616	0.414, 0.916	0.0168	
Corner Brook	0.551	0.389, 0.780	0.0008	
Maternal Age				
25-29 yrs	1			0.4872
Under 25 yrs	1.138	0.843, 1.536	0.3995	
30-34 yrs	1.135	0.857, 1.505	0.3765	
Over 35 yrs	1.327	0.909, 1.938	0.1421	
Education Level				
Graduated High School	1			<0.0001
Not Graduated High School	0.979	0.603, 1.590	0.9324	
Beyond High School	0.956	0.596, 1.534	0.8530	
College or University	2.178	1.624, 2.922	<0.0001	
Current Smoking				
Yes	1			<0.0001
No	2.473	1.814, 3.371	<0.0001	
Pre-Existing Diabetes				
Yes	1			0.0248

Variable	Adjusted Odds Ratio	95% CI	p-value*	Type 3 p-value**
No	4.262	1.201, 15.118	0.0248	
Forceps and Vacuum				0.0007
Neither	1			
Forceps Only	0.522	0.271, 1.007	0.0523	
Vacuum Only	0.472	0.318, 0.701	0.0002	
Both	1.133	0.393, 3.269	0.8167	
Narcotic and Epidural				0.0381
Yes	1			
No	1.475	1.022, 2.129	0.0381	
Cesarian Section				<0.0001
Yes	1			
No	1.660	1.297, 2.126	<0.0001	
Gestational Age	1.202	1.081, 1.335	0.0007	0.0007
Bag Mask				0.0109
Yes	1			
No	1.928	1.163, 3.194	0.0109	

Abbreviations: CI= Confidence Interval
* Analysis of Maximum Likelihood Estimates: p-values for each category of variable
** Type 3 Analysis of Effects: p-value for entire variable

Patients with a non-cesarian delivery were 66% more likely to exclusively breastfeed from birth to discharge compared to those with a cesarian delivery (OR = 1.660; 95% CI: 1.297 – 2.126). Compared to individuals who are current smokers, those who did not smoke were almost 2.5 times more likely (95% CI: 1.814 – 3.371) to breastfeed in hospital exclusively. Patients without pre-existing diabetes were over four times more likely (95% CI: 1.201 – 15.118) to breastfeed than those with diabetes. Having vacuum-assisted delivery was a barrier to exclusive breastfeeding in hospital (OR = 4.72; 95% CI 0.318 – 0.701). Patients not having narcotic and epidural were 48% more likely to breastfeed than their counterparts (OR = 1.475; 95% CI: 1.022 – 2.129). Infants

not requiring bag-mask ventilation were almost two times more likely (OR = 1.928; 95% CI: 1.163 – 3.194) to receive exclusive breastfeeding compared to infants who needed it.

Chapter 5: Discussion

This chapter explores the results of this study and considers it within the context of our research questions and existing literature.

5.1: Characteristics of the Study Population

Secondary research objectives of this project included describing characteristics and health outcomes of individuals birthing in the three communities of this study, and examining differences based on hospital site. Individuals in this study were similar in terms of age, smoking status, and obstetric history. However, there were significant differences across hospital sites, with participants in Corner Brook having a lower proportion of partnered parents and individuals in Gander achieving lower levels of education. Individuals in Gander also tended to have a longer length of stay in hospital, and delivered infants of a higher gestational age.

We found significant differences in the rates of interventions across hospital sites. Differences were found in rates of forceps and vacuum use, inductions, episiotomies, epidural usage, cesarian section, and more. Compared to other sites, Clarenville had notably higher rates of interventions, including induction, vacuum, episiotomies, epidural, and cesarian section, and fewer patients having no analgesic and spontaneous rupture of their membranes. Patients in Gander more frequently had no analgesia and fewer interventions.

Possible explanations for these variations include practitioner preferences, hospital environment and individual patient factors not accounted for in the analysis. Some authors posit that the obstetrician's approach to childbirth contributes to the normalization of interventions.[128] Others suggest the lack of systemic monitoring and evaluation programs creates an environment supporting variation in practice.[129]

5.2: Maternal Factors Contributing to Infant Feeding in Hospital

This study identified several maternal characteristics that are significant in predicting exclusive breastfeeding in hospital: education level, smoking status, and diabetes. In the following subsections, we explore these findings in relation to the literature.

5.2.1: Maternal Age

The literature review demonstrated that maternal age is predictive of infant feeding practices in hospital. One Canadian study estimated a 26% increase in odds of exclusive breastfeeding for every 10-year increment (OR 1.26, 95% CI 1.23 – 1.30 for 10-year increments).[97] Other research agrees that older maternal age is associated with higher exclusive breastfeeding rates in hospital.[59,96] In our univariate analysis, maternal age was not associated with the primary outcome of exclusive breastfeeding from birth to discharge. In our multivariate model, maternal age was not significantly associated with breastfeeding exclusively in hospital.

5.2.2: Maternal Education Level

This research suggests that a high maternal education level is associated with exclusive breastfeeding in hospital. Univariate and multivariate analyses show that college or university graduates, compared to high school graduates, are more than twice as likely to exclusively breastfeed (OR = 2.387; 95% CI 1.867 – 3.052, AOR = 2.178; 95% CI: 1.624 – 2.922). Compared to the literature, it appears that education has a more profound effect on EBF in our population.[59,68,95,102] For example, the IMAgiNE EURO Survey Study data calculated that high school graduates were only about 25% less likely to exclusively breastfeed compared to university graduates (OR = 0.75, 95% CI: 0.69 – 0.81).[68]

Possible explanations for the relationship between EBF and education could include the relationship between education and employment. For example, authors have found that higher educated individuals may have flexibility in their work environment, thus supporting them in reaching their breastfeeding goals.[52] It is not entirely clear based on this project why our population's EBF rates were more affected by education status. Although research agrees that higher levels of education are associated with EBF, in our study, Gander had the highest EBF rate but had the lowest proportion of individuals achieving post-secondary education, about 17% lower than the other health facilities. According to our analysis, characteristics of birthing individuals and their infants in Gander were not remarkably different than the other study sites, except that a higher

proportion of their infants were born at 40 weeks (44%), had a longer length of stay, and lower analgesia rates. However, length of stay was not significantly associated with the outcome in univariate and multivariate analysis, and gestational age, smoking status, and pain management were accounted for in our multivariate model. Other contributing factors could include hospital policies such as SSC or access to lactation consultants that was not specifically accounted for in our analysis.

5.2.3: Smoking Status

The descriptive analysis shows that the pre-pregnancy smoking rates in this study population were high (31%). During pregnancy, the smoking rate decreased by about 12% to a new rate of 19%. To contrast, in 2015, 13% of Canadian individuals over the age of 14 were current cigarette smokers.[130] Further statistical analysis showed that non-smoking individuals were more likely to breastfeed exclusively than smoking individuals.

An increasing amount of evidence suggests smoking negatively impacts the behavior of breastfeeding. Explanations include the negative physiological impact of smoking on maternal hormones and the contribution of other psychosocial factors, such as age and socioeconomic status.[131,132] Others question the role of breastfeeding intention on its success in the smoking population. A recent prospective cohort study of 401 individuals found that smoking negatively affects breastfeeding in hospital and beyond, despite a strong intention to breastfeed.[132] In those intending to breastfeed, non-smokers were over three times more likely to have any breastfeeding in the first week postpartum

compared to smoking individuals (AOR = 3.61; 95% CI: 1.28 – 10.17).[132] These findings suggest that the role of smoking on breastfeeding is complex and physiologic explanations should also be considered.

A review of the literature has found that smoking has a negative physiological effect on prolactin levels, a hormone that is essential for lactation.[133] They also found that smoking is related to hypo- and hyperthyroidism, both of which can interfere with milk production.[133] In the literature, authors found that individuals who smoked were 2.51 times more likely never to have breastfed (95% CI 2.36 – 2.66).[134] Furthermore, smoking during pregnancy is associated with a higher risk of breastfeeding discontinuation after one month of life (AOR = 3.65; 95% CI: 1.29 – 10.34).[131] Our findings regarding the relationship between smoking and breastfeeding are consistent with other studies, where authors have found that non-smoking individuals have higher breastfeeding rates.[131,134]

In addition to smoking having negative health effects on the smoking individual, the environmental tobacco exposure is associated with a multitude of risks to the newborn including sudden infant death syndrome.[135] While health providers should support smoking cessation for all patients and educate on risks of smoking within the home or around the newborn, the Canadian Pediatric Society does not consider smoking to be a contraindication to breastfeeding, and instead states that it may mitigate some of the harm from smoking.[136]

5.2.4: Diabetes and Obesity

As described in the literature, obesity and diabetes are barriers to exclusive breastfeeding in hospital. Possible explanations include physiological relationships between adiposity and lactogenesis, greater rates of planned cesarian deliveries, comorbidity with pregnancy complications, and insulin levels and breastmilk biosynthesis.[137]

Our analysis suggests that patients without pre-existing diabetes are over four times more likely than those without diabetes to breastfeed at discharge exclusively. However, it is essential to note that the extremely low number of individuals with pre-existing diabetes in our study population impacted the results. Other Canadian authors have found 33% lower odds of breastfeeding in hospital (95% CI: 25% - 40%) for individuals with overweight and obesity, compared to those with a normal BMI.[57] As maternal BMI is not reliably recorded by PPNL, we were unable to include obesity as a variable.

Overall, education, smoking, and diabetes are maternal-level factors predictive of exclusive breastfeeding in hospital in our population. Smoking cessation and continued breastfeeding should be encouraged for smoking individuals. More reliably recorded data could be useful in understanding the role of metabolic disease and BMI in exclusive breastfeeding.

5.3: Infant Factors Contributing to Infant Feeding in Hospital

This study identified several infant characteristics that are significant in predicting exclusive breastfeeding in hospital: gestational age and ventilation. In the following subsections, we explore these findings in relation to the literature.

5.3.1: Gestational Age

Our findings suggest that exclusive breastfeeding in hospital is more likely in newborns of a greater gestational age. Moreover, we found that early-term infants, or gestational age of 37 and 38 weeks, are particularly at risk for non-exclusive breastfeeding in hospital. This finding is consistent with the literature. In 2013, Canadian researchers found that gestational age was predictive of any breastfeeding at hospital discharge, with early-term newborns having lower odds of being breastfed compared to those with a gestational age of 41 (37 weeks: AOR, 0.74; 95% CI, 0.67-0.82).[138] Possible explanations for this finding are that early-term newborns may have subtle immature oral-motor development leading to mechanical breastfeeding difficulty, or an increased risk of hypoglycemia potentially leading to a medically-indicated need for formula supplementation.[138]

5.3.2: Assisted Ventilation of the Infant at Birth

Our research suggests that infants who do not require bag-mask ventilation, compared to those who do, are significantly more likely be exclusively breastfed. The literature agrees with this finding and describes that infants receiving bag-mask

ventilation and resuscitation are less likely to initiate breastfeeding in the first hour of life.[139,140] However, bag-mask ventilation does not appear to affect breastfeeding duration beyond hospital discharge.[139] Other research has examined the relationship between infant feeding practices and more invasive ventilation methods, such as laryngeal mask airway (LMA) and endotracheal tube (ETT). Infants requiring either LMA or ETT had significantly lower exclusive breastfeeding rates at discharge compared to other infants.[107] Further research could explore this relationship, but possible explanations could be due to the temporary mechanical and physiological disruption of the lactation process during ventilation, and it may be a marker for infant with medical issues, which could also interfere with breastfeeding.

5.4: Hospital-Level Factors Contributing to Infant Feeding in Hospital

Our research identified several hospital-level factors, including policies, interventions, and accessible health services, as predictors of exclusive breastfeeding from birth to discharge. The following subsections contextualize these findings within the literature.

5.4.1: Health Facility as a Predictor of Exclusive Breastfeeding in Hospital

The hospital site of birth was significantly associated with the outcome variable. Individuals delivering their infants in Clarenville and Corner Brook were significantly less likely to exclusively breastfeed from birth to hospital discharge than those in Gander. The study sample was relatively similar across hospital site of birth. Some factors that

were different in Gander included infants being born at a higher gestational age, lower rates of analgesia, and about one day longer length of stay in hospital.

As previously described, lactation consultants were known to be available in hospital in Gander, but not at the other sites, for the duration of the study. The literature suggests that lactation consultant support in the prenatal and postnatal period supports breastfeeding. Lactation consultants are specially trained individuals who can support mothers and babies with breastfeeding challenges. In 2005, a RCT of 304 individuals found that those receiving lactation consultant support were significantly more likely than those who did not to have longer breastfeeding duration.[141] More recently, a RCT in Australia estimated that access to a lactation consultant resulted in about a 12% higher EBF rate at one month postpartum.[142] Another contributing factor could include the lower use of analgesia in Gander. There is evidence in the literature suggesting that analgesia during labour and delivery is a barrier to EBF in the early postpartum period due to infant sedation effects through placental transfer.[105,143] It is possible that individuals in Gander benefitted from a combination of having newborns delivered at a higher gestational age with less analgesia and longer hospital stay with access to lactation consultants to establish exclusive breastfeeding.

Despite accounting for several independent variables in the multivariate model, including maternal age, education level, cesarian section, there seem to still be inherent differences related to the hospital site of birth. As demonstrated in the literature, hospital policies have a significant impact on infant feeding practices in hospital. Several aspects

of maternity policies are related to breastfeeding in hospital, including compliance with the International Code of Marketing of Breast-Milk Substitutes, limiting in-hospital supplementation, rooming-in, support level from health providers, type of hospital, SSC, delaying the newborn bath, and access to allied health professionals, such as lactation consultants.[66–69,72,75–77,81–83,90] Moreover, BFI designation, and number of BFI steps a facility achieves positively influences breastfeeding.[5,30]

While several of these aspects were not assessed in our study, we stratified the study population by hospital site of birth, recognizing that with the RHA system in NL, healthcare services and policies are not standardized across the province.[144] In NL, initiatives exist to address this discrepancy. In 2022, the Health Accord for NL released a Report titled "Our province. Our health. Our future. A 10-Year Health Transformation," that includes strategic direction for a Provincial healthcare system.[145] Among their recommendations included a Call To Action to change from four RHAs to one Provincial Health Authority in 2023, recognizing that the geography of NL contributes to variations in health outcomes.[145]

There may also be intrinsic or unknown differences between individuals at each study site that we have not accounted for in our analysis.

5.4.2: Cesarian Section

As previously discussed, the increase in rate of intervention during labour and delivery with procedures such as cesarian section has been met with criticism.[101] Based on data from Statistics Canada, the cesarian section rate increased from about 15 to 18% (14.7 to 17.6 per 100 deliveries) in Canada from 1979 to 1993.[101] From 1979 to 1993, NL's cesarian section rate climbed from about 18 to 21% (18.3 to 21.2 per 100 deliveries).[101] In recent years, the Canadian cesarian section rate has continued to increase, accounting for 27% of deliveries in 2010 and 31% in 2020.[146] NL has typically had cesarian section rates above the National average accounting for 32% of deliveries in 2010 and 31% in 2020.[146]

In our study population, the overall cesarian section rate was about 32%, with Clarenville having a nearly 10% greater cesarian section rate than the other sites at 40%. This research study found that patients without a cesarian section had 66% higher odds of exclusive breastfeeding from birth to discharge than those without cesarian section, which is consistent with the literature. Researchers in the USA have found that individuals undergoing cesarian section are more than half as likely to exclusively breastfeed at discharge compared to those delivering vaginally (AOR = 0.41; 95% CI 0.24 – 0.71).[102] Research has suggested that cesarian sections negatively impact breastfeeding due to challenges with pain, positioning, and maternal and fetal stress.[147,148] However, this relationship could also be affected by skin-to-skin contact, which may be delayed or impaired due to safety concerns following cesarian section. Maternal or infant health status may also necessitate cesarian section, however, the literature suggests that

emergent cesarian section, compared to elective, is not a barrier to exclusive breastfeeding.[103,104]

This study was limited in that we were unable to assess SSC during labour and delivery. Other authors have evaluated SSC post-cesarian section through an experimental approach and have found that SSC mitigates the negative impacts of cesarian section on exclusive breastfeeding.[83,84,149,150] Moreover, early SSC postpartum was estimated to decrease in-hospital supplementation by about 40%.[151]

5.4.3: Vacuum and Forceps Use

Our study also identified a significant relationship between vacuum-assisted delivery and breastfeeding in hospital. Compared to newborns not requiring an operative vaginal delivery, meaning no forceps or vacuum, individuals who required vacuum-assisted delivery were about half as likely to exclusively breastfeed from birth to discharge (AOR=0.472, 95% CI 0.318 – 0.701). In the literature, there is evidence that vacuum-assisted delivery is associated with a higher risk of breastfeeding cessation within seven to ten days postpartum.[152] Possible explanations for this finding are thought to be related to the risk of cephalohematoma with vacuum-assisted delivery. Cephalohematoma increases the risk of hyperbilirubinemia and jaundice, potentially leading to medically-indicated formula supplementation in hospital.[153,154] Forceps-assisted delivery also reduces the risk of exclusive breastfeeding secondary to cephalohematoma and cranial nerve injuries.[153] However, our study did not identify

forceps-assisted delivery as a barrier to breastfeeding, likely due to the size of the study and the small proportion of individuals requiring this intervention (3.3%).

5.4.4: Pain Management

Pain management is also a frequent intervention used by many labouring individuals. One study identified in the literature explored the role of dosing and route of opioids during labour and delivery on infant feeding outcomes. The authors found that intrapartum opioid exposure through both intravenous and epidural routes are associated with lower rates of exclusive breastfeeding at discharge.[105,107] A possible explanation for this finding is that the infant receives some doses of the analgesia through the placenta leading to decreased alertness at delivery.[105] This leads to a potential interruption in the newborn adjustment and breastfeeding success. Our study agreed that pain management techniques, such as concurrent narcotic and epidural use, are barriers to exclusive breastfeeding from birth to hospital discharge. Individuals not receiving narcotics and epidurals were almost 50% more likely to exclusively breastfeed in hospital (AOR = 1.475, 95% CI 1.022, 2.129). Access to adequate pain management is an essential component of comprehensive intrapartum care. Understanding that exposure to narcotic analgesia during labour and delivery may present a barrier to breastfeeding in the early postpartum period is relevant for healthcare providers as they support their patients on their infant feeding journeys.

Overall, our research found that events in hospital during labour and delivery are significant predictors of infant feeding in hospital, such as operative vaginal deliveries, cesarian sections, and health facility. Individuals involved in hospital maternity care should recognize this relationship. Ways to mitigate hospital-level factors that are barriers to exclusive breastfeeding include Baby-Friendly policies and more frequent access to lactation consultants.

5.5: Final Considerations

To summarize, this research identified several maternal, infant, and hospital-level factors that are independent predictors of exclusive breastfeeding from birth to discharge from hospital. While we discussed these predictors separately, other explanations exist to connect these variables. For example, it is possible that individuals requiring operative vaginal and cesarian deliveries required more analgesia than individuals having spontaneous vaginal deliveries. Operative deliveries could also indicate maternal and infant health at the time of the delivery and could be related to the infant bag mask ventilation. We also suspect that access to lactation consultants in Gander contributed to increased rates of exclusive breastfeeding in hospital based on evidence from the literature.

Based on the variables we were able to assess, this research adds to the existing literature on the role of events during labour and delivery on breastfeeding in hospital. Recognizing the relationship between breastfeeding in the early postpartum period and

breastfeeding duration, and understanding predictors of formula supplementation in hospital is important to achieve breastfeeding recommendations set out by the WHO, UNICEF, and supported by the CPS, Health Canada, and PHAC.

Chapter 6: Conclusion

This chapter concludes this thesis by exploring strengths and limitations of the study, implications for the future, planning knowledge translation, and summarizing key findings.

6.1: Strengths and Limitations

There were several strengths of this study. The team acquired the data from the PPNL, a Provincial program that collects information to monitor health outcomes, develop programs, provide education, and facilitate research. This data source allowed us to examine all births at the designated locations during the study period and considered over 70 independent variables in the analysis. This study is the first in NL to explore factors associated with exclusive breastfeeding from birth to hospital discharge. Finally, with relatively broad inclusion criteria, the findings of this study are generalizable to most NL and Canadian communities as well.

Limitations stemmed from the design of this project. While randomized controlled trials provide the highest quality of evidence, an observational cohort study was the most appropriate design as there was no specific intervention or exposure. As a retrospective cohort study of secondary data, we are limited by the variables collected at the time. Consequently, we could not explore variables, such as SSC and timing of newborn bath, that are known to be associated with breastfeeding rates. While the data we sourced was

overall thorough, several important variables such as gestational weight gain had to be excluded due to a high number of missing data. Also, prospective studies generally provide more robust evidence than retrospective studies, as we can ensure the exposure or risk factor precedes the outcome. However, based on the topic's nature, many risk factors, such as smoking status, cesarian section, and education level, all inherently precede discharge from hospital.

6.2: Implications and Future Research

Exclusive breastfeeding is recommended in the first six months of life based on its vast maternal and infant health benefits, as previously stated. The literature shows that early infant feeding behaviours, such as exclusive breastfeeding in hospital, are significantly associated with exclusive breastfeeding in the months postpartum. This research identifies several protective factors and barriers for exclusive breastfeeding in hospital in NL. As a result, these findings can support healthcare providers in identifying individuals at a greater risk for breastfeeding cessation, and support individuals with protective factors to achieve their goals. This research can inform the Government of NL as they aim to achieve the breastfeeding rate increase as described in The Way Forward document, and as other policies are implemented, such as the Baby-Friendly Hospital Initiative. This work lays the foundation for researchers to evaluate new obstetric models of care, such as midwifery, as they are implemented in NL. Furthermore, this research can inform other Canadian researchers in the field of infant feeding as it is one of the few Canadian studies exploring factors associated with breastfeeding in hospital.

Our research also identifies smoking and infant feeding as an area that requires further discussion. As previously stated, the NL birthing population at the time of this study had a significantly higher smoking rate than the Canadian National average. Healthcare providers in the province of NL should continue to counsel our population on smoking cessation pre- and during pregnancy. Furthermore, they should gain competency in practicing the harm-reduction approach supported by the CPS that endorses continued breastfeeding while smoking and limiting environmental childhood exposure to tobacco. Future research with clinically important implications for our population in NL could delve deeper into the relationships between smoking, intention to breastfeed, and exclusive breastfeeding in hospital and beyond.

This study also identified that hospital site of birth is predictive of infant feeding in hospital. Future research should further explore differences in maternity and hospital policies that may be contributing to infant feeding such as support levels of healthcare providers, skin-to-skin contact, and delayed newborn bath. A deeper analysis of medical- and non-medical formula supplementation in hospital would add to the literature and understanding of breastfeeding in hospital. Researchers could also explore how obtaining BFI designation and transition to a Provincial Health Authority impacts exclusive breastfeeding in hospital. Other areas for future research could include exploring barriers and protective factors for breastfeeding duration beyond hospital discharge.

Based on this research, the following is recommended:

1. Improved in-hospital documentation of factors associated with exclusive breastfeeding, including but not limited to: SSC, timing of newborn bath, pre-pregnancy weight, gestational weight gain, and access to lactation consultants.
2. Improved in-hospital documentation of medical and non-medical formula supplementation.
3. Healthcare providers should encourage smoking cessation pre- and during pregnancy. They should also educate patients on best practices to limit tobacco exposure to infants and encourage safe continued breastfeeding if smoking.
4. Healthcare providers should identify individuals at risk for breastfeeding cessation, such as patients having cesarian sections, operative vaginal delivery, epidurals, or infants requiring assisted ventilation, and take action to support them in achieving their infant feeding goals.
5. Improved access to lactation consultants in-hospital and in the community.
6. All hospitals in NL should take action to achieve BFI designation.

6.3: Knowledge Translation

Based on discussions with key knowledge users, a knowledge translation plan was developed. We intend to create an infographic including a brief synopsis of the research project including key outcomes of rates of cesarian sections, epidurals, episiotomies, inductions, forceps, and vacuum, and their relationship with breastfeeding rates. This poster can be distributed through relevant units in hospitals, physician clinics, and social

media. Other suggestions that could be incorporated if able to receive financial support include a short video directed at mothers, public presentations intended for parents and families, presentations with family physicians, or a mobile phone application for parents. I will also explore traditional knowledge translation methods in the academic context, including poster presentations, oral presentations, and publications.

6.4: Conclusion

Breastfeeding is universally recognized as the optimal choice of nutrition for infants exclusively in the first six months of life and complementary in the first two years of life. However, breastfeeding rates remain low across Canada and in NL. This research identified protective factors for exclusive breastfeeding from birth to hospital discharge in a sample of NL, including higher education levels. On the other hand, we identified barriers to breastfeeding, including current smoking, pre-existing diabetes, forceps and vacuum, narcotic and epidural, cesarian section, and bag-mask ventilation. Furthermore, we found that hospital site of birth is a predictor of exclusive breastfeeding in hospital.

Improving modifiable risk factors such as smoking status and glucose management could support improved breastfeeding rates. Awareness that some lifesaving interventions during labour and delivery are barriers to breastfeeding may encourage healthcare providers to better support individuals requiring such interventions to achieve their breastfeeding goals. Mitigation strategies include BFI designation and lactation consultation.

Future research should aim to understand why infant feeding outcomes are variable between hospitals in NL. Researchers could also explore the role of SSC and different models of obstetric care on infant feeding outcomes. Quality improvement projects to accurately capture medical and non-medical formula supplementation would improve our understanding of infant feeding in hospital.

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APPENDICES

APPENDIX A: PATIENT ENGAGEMENT SESSION DISCUSSION QUESTIONS

1. What are your initial thoughts about this research?
2. How do you picture moms, families, and providers hearing about these findings for the first time?
3. Midwifery has played a role historically in Newfoundland and Labrador. What do you think about including this somehow in the KT tool?
4. Midwifery may be a new concept to many moms, families, and healthcare workers. What do you think are the most important parts of their practice to include?
    a. Would you be interested in hearing about midwifery systems such as in the UK, Australia, US, other Canadian provinces?
5. Would you like to hear patient stories about their experiences with midwifery in NL?
6. Our primary outcome of interest in this study is infant feeding outcomes. What infant feeding information should we include when sharing research findings?
    a. Examples to prompt discussion: current rates in Canada compared to NL, recommendations, health benefits, economics, environment

7. We are also including a number of hospital data, such as cesarean sections rates and epidural in our research. Which health outcomes would you be interested in hearing about?
8. Who do you think should be directly informed of the results of the study?
    a. Examples to prompt discussion: nurses, lactation consultants, midwives, pediatricians, OB/GYN's, GPs, mothers, expectant mothers, medical/nursing students, government, health authorities
9. What is the best way to reach you with the findings of the study?
    a. Examples to prompt discussion: journal article, conferences, posters, video, presentations, social media, online groups, mom groups, from health providers
10. Do you have any final thoughts about the project or knowledge translation?

APPENDIX B: POST-PATIENT ENGAGEMENT SURVEY QUESTIONS

Statement 1: I had a clear understanding of the purpose of this engagement session.

Statement 2: I had enough information to contribute to the topic being discussed.

Statement 3: I was able to express my views freely.

Statement 4: I feel that my views were heard.

Statement 5: I think that the engagement session achieved its objectives.

Statement 6: I am confident that the input I provided will be used by the researchers.

Statement 7: I think the input provided through this activity will make a difference to the work of the researchers.

Statement 8: As a result of my participation in this engagement session, I am better informed about public engagement, knowledge translation, and midwifery research in the province.

Statement 9: Overall, I was satisfied with this engagement initiative.

Statement 10: This engagement was a good use of my time.

APPENDIX C: LIST OF STUDY VARIABLES

Age

Alcohol Use Before Pregnancy*

Anemia

Any Breastfeeding in Hospital

Apgar at 1 minute

Apgar at 5 minute

ARM to Induce

ARM to Rupture Membranes

Assisted Reproductive Technology

Augmentation of Labour

Bag Mask Ventilation

Birth Length

Birth Weight

Birth Weight Groups

BMI Groups*

BMI*

Breech Presentation

Caregiver at Delivery Type

Cesarian Section

Current Alcohol Use*

Current Smoking

Depression

Down Syndrome

Drug Use

EBF in Hospital

Education Level

Employment Status*

Endotracheal Tube

Entonox

Epidural

Episiotomy

Family Doctor Antenatal Care

Fetal Heart Monitor

First Antenatal Provider Type

Forceps and Vacuum Use

General Anesthetic

Gestational Age

Gestational Diabetes Requiring Insulin*

Gestational Hypertension

Gravida

GWG

GWG Recommendation Results*

Head Circumference

Hospital Site of Birth

Indication for Induction

Induction of Labour

Initiated Breastfeeding

Intention to Breastfeed

Jaundice

Labour >24h

Length of Stay in Days

Length of Stay in Minutes

Local Anesthetic

Maternal Age Groups

Narcotic and Epidural

Narcotics

Nasal CPAP

No Analgesia

Obstetrician Antenatal Care

Orofacial Clefts

Other Antenatal Care Provider

Other Antenatal Provider Type

Oxytocin

Parity

Partnership Status

PEEP

Place of Birth

Placental Abruption

Polyhydramnios

Postpartum Hemorrhage

Pre-Diabetes Requiring Insulin*

Pre-existing Diabetes

Pre-existing Hypertension

Precipitous Labour

Preconceptual Folic Acid*

Preeclampsia

Prenatal Education*

Previous Cesarian Section

Primary Indication for Cesarian Section

Prostaglandin

Questionable ROM

Second Antenatal Provider Type

Smoking Before Pregnancy

Spontaneous ROM

Third- or Fourth-Degree Tear

Tocolytics

Transfusion

Type of First Feed

Ventilation for 30 minutes

***Note**: * indicates variable excluded due to missing data*

APPENDIX D: MULTIVARIATE ANALYSIS PROCEDURE

Variables from univariate analysis significant at p=0.20:

Maternal Age Group, Partnership Status, Education Level, Previous Cesarian Section Count, Parity, Pre-Pregnancy Smoking, Current Smoking, Postpartum Hemorrhage, Labour >24h, Forceps and Vacuum, Narcotics and Epidural, Local Anesthetic, No Analgesia, General Anesthesia, Questionable ROM, ARM to Rupture Membranes, Cesarian Section, Fetal Heart Monitor, Birth Weight Groups, Gestational Age, Birth Length, Apgar 1 minute, Apgar 5 Minute, Hospital Site of Birth, Bag Mask Ventilation, Ventilation 30 minutes, PEEP, Pre-Existing Diabetes, Polyhydramnios, Other Antenatal Provider

↓

Least significant variable sequentially removed from multivariate model until all independent variables significant at p=0.05. Non-significant variables in the order removed:

Apgar 1 minute, Other Antenatal Provider, Birth Length, General Anesthesia, Apgar 5 minute, Ventilation 30 minute, Postpartum Hemorrhage, Polyhydramnios, Partnership Status, Smoking Before Pregnancy, No Analgesia, Fetal Heart Monitor, PEEP, Questionable ROM, Local Anesthetic, ARM to Rupture Membranes, Birth Weight Groups, Parity, Previous Cesarian Section Count, Labour >24h,

↓

Variables in final multivariate model, all significant at p=0.05:

Maternal Age Groups, Education Level, Current Smoking, Forceps and Vacuum, Narcotic and Epidural, Cesarian Section, Gestational Age, Hospital Site of Birth, Bag Mask Ventilation, Pre-Existing Diabetes

APPENDIX E: ETHICAL APPROVAL

Research Ethics Office
Suite 200, Eastern Trust Building
95 Bonaventure
Avenue St. John's,
NL

A1B 2X5

June 12, 2019

Dear Ms Stanoev:

Researcher Portal File # 20200328
Reference # 2019.119

RE: Impact of Midwifery on Infant Feeding Outcomes in Newfoundland and Labrador

Your application was reviewed by a subcommittee under the direction of the HREB and the following decision was rendered:

X	Approval
	Approval subject to changes
	Rejection

Ethics approval is granted for one year effective June 12, 2019. This ethics approval will be reported to the board at the next scheduled HREB meeting.

This is to confirm that the HREB reviewed and approved or acknowledged the following documents (as indicated):

- Application, approve
- Research proposal, approved

- List of variables, approved
- Data Custodian List signed by NLCHI, acknowledged

Please note the following:

- This ethics approval will lapse on June 12, 2020. It is your responsibility to ensure that the Ethics Renewal form is submitted prior to the renewal date.
- This is your ethics approval only. Organizational approval may also be required. It is your responsibility to seek the necessary organizational approvals.
- Modifications of the study are not permitted without prior approval from the HREB. Request for modification to the study must be outlined on the relevant Event Form available on the Researcher Portal website.
- Though this research has received HREB approval, you are responsible for the ethical conduct of this research.
- If you have any questions please contact info@hrea.ca or 709 777 6974.

The HREB operates according to the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2), ICH Guidance E6: Good Clinical Practice Guidelines (GCP), the Health Research Ethics Authority Act (HREA Act) and applicable laws and regulations. The membership of this Research Ethics Board complies with the membership requirements for Research Ethics Boards defined in Part C Division 5 of the Food and Drug Regulations.

We wish you every success with your study.