**Practice Patterns and Parental Attitudes with respect to Hydration for Infants Admitted with Bronchiolitis**

by

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# ABSTRACT

Objective: To characterize hydration practices for infants with bronchiolitis at the Janeway Children's Hospital and to determine the acceptability of nasogastric (NG) hydration for children admitted with bronchiolitis.

Design: Retrospective chart reviews, parental and health care provider (HCP) surveys, and HCP interviews.

Methods: A sample of 101 eligible infants less than one year old at the time of admission hospitalized with bronchiolitis at the Janeway hospital was obtained. Parents of infants treated with intravenous (IV) hydration were surveyed to determine their acceptance of NG hydration. HCPs were surveyed and interviewed to examine their perspectives on NG hydration.

Results: The proportion of infants treated with NG hydration was 4%. The parental survey response rate was 31.5%. The HCPs survey response rate was 53.3%. Overall, 53% of the parental respondents and 50% of HCP respondents were 'extremely likely' or 'very likely' to be accepting NG hydration in infants with bronchiolitis and difficult IV access. A total of six HCPs were interviewed. The majority of the HCPs considered NG hydration as an appropriate alternative to IV hydration but felt clinical factors should influence the choice.

Conclusion: NG hydration is seldom used but appears to be an acceptable alternative to parents and HCPs for infants with bronchiolitis.

# GENERAL SUMMARY

Bronchiolitis is a common acute viral illness affecting the upper and lower respiratory tracts in young children, usually less than one year of age. It causes symptoms of nasal congestion, cough and wheeze, and sometimes respiratory distress and inability to feed. A number of guidelines on bronchiolitis recommend nasogastric (NG) over intravenous (IV) hydration in hospitalized infants unable to feed normally. To explore the current practices for infants with bronchiolitis hospitalized at the Janeway Children's Hospital, and to determine the acceptability of NG hydration in these cases among parents and health care providers (HCPs), retrospective chart reviews, parental and HCP surveys, and HCP interviews were conducted. A chart review of 101 hospitalized infants treated with non-oral fluids showed that only 4% of them were treated with NG hydration. The response rate for a parental survey of infants treated with IV fluids for bronchiolitis was 31.5%. Overall, 53% of the parental respondents were accepting of NG hydration in infants with bronchiolitis and difficult IV access. Similarly, 50% of the HCP respondents were accepting of this treatment in this situation. NG hydration is seldom used but appears to be an acceptable alternative to parents and HCPs for infants with bronchiolitis, especially when IV access is difficult.

# CO-AUTHORSHIP STATEMENTS

I, Saima Saqib, made a major intellectual and practical contribution to the work reported in each chapter of this thesis. However, I would like to acknowledge the contributions of Dr. Robert Porter, Dr. Gerry Mugford and Dr. Kevin Chan, who provided guidance and feedback. The main idea for the thesis came from Dr. Porter, and I worked collaboratively with him to move from an idea to a workable project. I performed the literature review, abstracted all chart data, contributed to the construction of the survey tool, and performed collation and analysis of the survey data. Dr. Porter conducted the health care provider interviews, and I performed the transcription and analysis of the interviews.

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# List of Abbreviations

| | |
|---|---|
| AAP | American Academy of Pediatrics |
| CI | Confidence Interval |
| CPAP | Continuous positive airway pressure |
| CPS | Canadian Pediatric Society |
| D10NS | 10% dextrose in normal saline |
| D5½NS | 5% dextrose in 0.45% normal saline |
| D5NS | 5% dextrose in normal saline |
| ED | Emergency department |
| HCP | Health care provider |
| HFNC | High flow nasal cannula |
| HMPV | Human metapneumovirus |
| HREB | Health Research Ethics Board |
| ICU | Intensive care unit |
| ID | Identification |
| IV | Intravenous |
| LOS | Length of hospital stay |
| LRT | Lower respiratory tract |
| mmHg | Millimeters of mercury |
| NE | Not evaluated |
| NG | Nasogastric |
| NICE | National Institute for Health and Care Excellence |

| | |
|---|---|
| NICU | Neonatal intensive care unit |
| NL | Newfoundland and Labrador |
| NP | Nasopharyngeal |
| NR | Not recommended |
| NRR | Not routinely recommended |
| NS | Normal saline |
| NSW | New South Wales |
| NZ | New Zealand |
| OG | Orogastric |
| PICU | Pediatric intensive care unit |
| PIV | Parainfluenza virus |
| PREDICT | Pediatric Research in Emergency Departments International Collaborative |
| QI | Quality improvement |
| RCT | Randomized controlled trial |
| RSV | Respiratory syncytial virus |
| SD | Standard deviation |
| SIADH | Syndrome of inappropriate secretion of antidiuretic hormone |
| SIGN | Scottish Intercollegiate Guidelines Network |
| UK | United Kingdom |
| URT | Upper respiratory tract |
| US | United States |

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# Chapter 1 Background and Literature Review

## Chapter 1.1 Introduction

Bronchiolitis is a common acute illness affecting the lower respiratory tract (LRT) in infants and young children less than two years of age (Kou et al., 2018; Panitch, 2003a; Perk and Ozdil, 2018; Ralston et al., 2014; Smith et al., 2017; The Scottish Intercollegiate Guidelines Network (SIGN), 2006). It is most common in infants less than one year of age (American Academy of Pediatrics (AAP), 2006; Friedman et al., 2014; Ralston et al., 2014; Turner et al., 2008), and presents mostly in infants two to six months old (Baraldi et al., 2014; Hodge and Chetcuti, 2000; Verma et al., 2013). Acute bronchiolitis is one of the most prevalent acute illnesses in infants (Meissner, 2016; Valla et al., 2019). Bronchiolitis is a viral illness, and the most prevalent causative viral pathogen is respiratory syncytial virus (RSV), responsible for more than 75% of the cases (Castro-Rodriguez et al., 2015; Florin et al., 2017; Panitch, 2003a; Panitch, 2003b). However, other viral pathogens such as human metapneumovirus (HMPV), human rhinovirus, influenza virus, parainfluenza virus (PIV), adenovirus and certain enteroviruses have also been detected in children hospitalized with a diagnosis of bronchiolitis (Hodge and Chetcuti, 2000; Horst, 1994; Meissner, 2016; Nicolai and Pohl, 1990; Oymar et al., 2014). Bronchiolitis is generally is a self-limiting disease, usually lasting for two to eight days, but in some cases, symptoms may take longer to resolve (National Institute for Health and Care Excellence (NICE), 2015; SIGN, 2006). Hospitalization is usually not required in milder forms of illness; however, in some cases, the patient may require

hospital admission for management of severe respiratory symptoms, ventilatory support or correction of dehydration (AAP, 2006; Caffrey and Clarke, 2016; Friedman et al., 2014; New South Wales Health (NSW), 2018; O'Brien et al., 2019; Ralston et al., 2014). In fact, acute bronchiolitis is one of the major causes of hospital admission during infancy worldwide (Friedman et al., 2014; NICE, 2015; Valla et al., 2019).

## Chapter 1.2 Epidemiology

Bronchiolitis is a seasonal viral illness which peaks mostly in winter months (NSW, 2018) and spans to spring (Kou et al., 2018; Nicolai and Pohl, 1990). The occurrence of bronchiolitis is both sporadic and epidemic with high incidence during early November to mid-April (Florin et al., 2017; Oymar et al., 2014). In India, the incidence of bronchiolitis is highest from September to March (Verma et al., 2013), whereas in Australia, the highest incidence lies between March and July (NSW, 2018). However, in some tropical regions, bronchiolitis is not seasonal (Caballero et al., 2017). Recovery from the first episode of the illness does not confer immunity to RSV for subsequent illness, and reinfection is possible even within same season (Nicolai and Pohl, 1990; SIGN, 2006). Therefore, children may have one or more attacks of acute bronchiolitis within the first two years of life (NSW, 2018; SIGN, 2006), and reinfection with RSV is possible in later years of life (Meissner, 2016). There are certain factors that increase the risk of contracting the virus and subsequent bronchiolitis. These include male gender, person to person contact (direct or indirect contact with secretions, airborne droplets through sneezing or coughing), having siblings, overcrowded households, poor socioeconomic living conditions, day care centre attendance, cigarette smoke exposure, and being born

during the months of peak season (Da Dalt et al., 2013; Florin et al., 2017; Horst, 1994; Howidi et al., 2007; Kou et al., 2018). There are also certain co-existing medical conditions that predispose infants and young children to severe and recurrent episodes of bronchiolitis. These include congenital heart defects, chronic lung disease of prematurity, prematurity of less than 29 weeks gestation, immunodeficiencies, cystic fibrosis, and nerve and muscles system diseases (Da Dalt et al., 2013; Ferlini et al., 2016; Howidi et al., 2007; Meissner, 2016; Oymar et al., 2014; Perk and Ozdil, 2018; Smith et al., 2017; Wang et al., 1995).

**Chapter 1.3 Pathophysiology**

The virus (RSV in most cases) invades the nasal mucosa and ciliary epithelium of the upper respiratory tract (URT), resulting in inflammation and edema of the upper airways (Florin et al., 2017; Oymar et al., 2014). With further viral invasion, there is more edema and sloughing of the URT epithelial cells into the LRT (Oymar et al., 2014; Rodriguez, 1999), causing destruction of cells (necrosis) and collection of cellular debris in the LRT (Friedman et al., 2014; Yildirim et al., 2016). This pathological process also causes impaired ciliary function and decreased clearance of mucus secretions, leading to further collection of inflammatory debris in the LRT with added excessive mucus production by goblet cells. This leads to blockage of bronchioles due to pooling of excessive secretions (Meissner, 2016; Oymar et al., 2014). Furthermore, hyperinflation and atelectasis of bronchioles occur due to sloughed off necrotic cells, reduced epithelial ciliary function and excessive mucus in smaller airways (Horst, 1994; Smith et al., 2017). The exact mechanism of viral invasion is not known but it is reported that the process of

viral invasion is characterized by immunological responses of the body, such as proliferation and infiltration of white blood cells (monocytes and lymphocytes) in the peri-bronchial region causing submucosal and adventitial tissue edema and constriction of muscles of bronchiolar walls (Meissner, 2016; Oymar et al., 2014; Tercier, 1983). This cascade of pathological responses leads to narrowing of bronchioles, partial or total airflow obstruction, and impairment of gas exchange (Florin et al., 2017; Perk and Ozdil, 2018), resulting in hypoxemia and increased work of breathing (Meissner, 2016; Oymar et al., 2014). However, viral invasion is usually limited to the respiratory mucosal cell and does not spread to the other neighboring organs or blood (Perk and Ozdil, 2018).

**Chapter 1.4 Clinical manifestations**

The incubation period of RSV is two to seven days (Perk and Ozdil, 2018; Rodriguez, 1999). Infants usually present with a two to four-day history of prodromal symptoms of URT infection, such as mild cough, rhinorrhea and low-grade fever (Florin et al., 2017; Horst, 1994). When viral invasion progresses to the LRT, these prodromal symptoms are followed by increasing cough and wheezing (Meissner, 2016). There can be clinical signs of increased work of breathing, such as supraclavicular, intercostal or subcostal indrawing, nasal flaring or grunting, depending on the severity of airway obstruction (Meissner, 2016; Worrall, 2008).

On physical examination, the findings include prolonged expiration, inspiratory crackles and expiratory wheeze on chest auscultation (Grover et al., 2011; Perk and Ozdil, 2018). The chest may be hyper resonant on percussion due to hyperinflation of the lungs and air trapping in bronchioles. Infants may also present with lethargy due to poor

feeding or vomiting and tachypnea due to respiratory difficulty (Oymar et al., 2014; Smith et al., 2017; Verma et al., 2013). However, the severity of the clinical presentation may vary (Kou et al., 2018) and infants with pre-existing co-morbidities may present with more severe respiratory symptoms (Oymar et al., 2014; Tercier, 1983; Verma et al., 2013). In preterm infants, apnea may be the only clinical manifestation (Oymar et al., 2014).

Chronological age is considered one of the strongest predictors of hospitalization, with the majority occurring in infants under six months of age (Panitch, 2003b; Perk and Ozdil, 2018; Smith et al., 2017). Some evidence suggests that exclusive breastfeeding is protective against RSV infection, reducing length of hospital stay (LOS) and number of hospitalizations, as well as protecting against the need for supplemental oxygen and the risk of respiratory failure in infants with bronchiolitis. Breast milk has immunomodulators such as gamma interferons, cytokines, and lactoferrin, which affect directly or indirectly an infant's immune system, facilitating the development of immunity against certain childhood infections, such as RSV. Furthermore, these immunomodulators are found to be higher in infants who are being breastfed and are sick with bronchiolitis (Dixon, 2015; Friedman et al., 2014). The mean duration of the bronchiolitis illness is two weeks, but it may be prolonged to three weeks or more in many infants, related to certain risk factors, pre-existing physical illnesses and severity of respiratory symptoms (Florin et al., 2017; Worrall, 2008).

## Chapter 1.5 Clinical Care of Children with Bronchiolitis

### Chapter 1.5.1 Management of Bronchiolitis

Bronchiolitis is diagnosed clinically by history of the symptoms, clinical presentation, and physical examination (AAP, 2006; Friedman et al., 2014; Hodge and Chetcuti, 2000; McNaughten et al., 2017). Hospitalization is not required in milder forms of the illness (Howidi et al., 2007; Parker et al., 2009). Repeated examinations may be required to assess clinical severity over time, because there are variations in clinical findings that evolve rapidly. Worsening of the clinical picture may be attributable to accumulation of mucus secretions and necrotic debris in smaller airways, while coughing may clear these secretions and dramatically improve the picture. In addition to this, blocked nasal passages might be a confounding factor in clinical assessment, or sleep may change to agitation upon waking an infant. For these reasons, repeated assessments are advised to clinicians, especially when deciding whether to admit, and if any diagnostic or medical treatment is required (Baraldi et al., 2014; Florin et al., 2017). Indications for hospital admission include poor feeding (the inability to eat or intolerance of feeds), dehydration or the need for fluid supplementation, clinically significant increased work of breathing, and the inability to maintain adequate oxyhemoglobin saturation (Panitch, 2003a; Panitch, 2003b). Dehydration can result from excessive fluid losses due to elevated temperature (fever), inability to feed, or inability to sustain feeds due to increased work of breathing or tachypnea (Panitch, 2003a; Panitch, 2003b). The use of a clinical severity assessment scale for bronchiolitis (Baraldi et al., 2014; O'Brien et al., 2019; NSW, 2018; Turner et al., 2008), including the modified Respiratory Index Score

(RIS), may assist clinicians in managing infants with bronchiolitis (Chong et al., 2017). However, repeated clinical assessments are important to evaluate the clinical severity and general condition of the patient and cannot be neglected but should rather be prioritized. The modified RIS is described in Table 1-1 (Chong et al., 2017). The use of a severity score along with the general clinical impression can guide clinicians on the management of infants with bronchiolitis, informing decisions regarding the necessity for hospitalization and whether any diagnostic or pharmacological interventions are required. Higher clinical severity scores or the clinical judgement of severe respiratory symptoms, poor feeding and decreased mental status, may assist clinicians in deciding whether additional interventions or hospitalization is needed for the infant (Kou et al., 2018; NSW, 2018).

The evidence shows that non-invasive interventions and supportive therapy, which include minimal handling and close observation, should be the mainstay in the management of bronchiolitis (Da Dalt et al., 2013; Dawson et al., 1993). Etiological testing (viral testing, chest radiography, blood testing) is not recommended, except in cases of severe illness or respiratory distress, signs of secondary bacterial infection or certain co-morbid states such as congenital heart disease, bronchopulmonary dysplasia or cystic fibrosis (Caballero et al., 2017; McNaughten et al., 2017). Also, viral testing may be used for cohorting of admitted patients (Friedman et al., 2014; SIGN, 2006). However diagnostic testing is widely used in different hospital settings in United Kingdom (UK), especially RSV testing (rapid viral antigen testing) via nasopharyngeal aspirate, along with cell culture, immunofluorescence, and enzyme immunoassay (Caballero et al., 2017;

Hodge and Chetcuti, 2000). Supportive treatment revolved mainly around repeated clinical assessments, maintenance of adequate oxygen saturation and fluid replacement (Caballero et al., 2017; Castro-Rodriguez et al., 2015). Continuous pulse oximetry is not reported to be used routinely except in severe illness or certain co-morbid illnesses. Oxygen supplementation via high-flow nasal cannula (HFNC) allows humidified oxygen flow whereas continuous positive air way pressure (CPAP) would reduce airway resistance and improve oxygenation. However, several other techniques of supplementing oxygen are also used, such as nasal cannula, face mask or face tent. The cut-off points for starting oxygen therapy vary and ranged from ≤ 90-92% in room air (Caballero et al., 2017; Castro-Rodriguez et al., 2015).

Howidi et al. examined the association of age on the clinical severity of bronchiolitis with respect to supplemental oxygen requirement and LOS. In their retrospective case review of 89 infants admitted with bronchiolitis, they reported that infants younger than 90 days of age had more requirements for supplemental oxygen as compared to older infants (91 days to 12 months of age) (Howidi et al., 2007). The study concluded that younger age is an important predictor for the clinical severity of bronchiolitis and an important factor for major medical interventions such as supplemental oxygen therapy, intensive care unit (ICU) admission and longer LOS (Howidi et al., 2007). Another prospective cohort study on infants aged 2-23 months, presenting to emergency department (ED) with bronchiolitis, identified certain risk factors of disease clinical severity, including respiratory exhaustion with use of accessary muscles or chest retractions, respiratory rate of 60 breaths per minute or more, oxygen saturation 92% or

less and poor oral intake with signs of dehydration, as the important predictors of major medical interventions (i.e., intravenous (IV) fluids, ventilatory support, ICU admission) and these risk factors were reported to be associated with longer LOS (Parker et al., 2009). Timely administration of noninvasive respiratory support to maintain oxygen saturation, in the form of CPAP or BiPAP (biphasic positive airway pressure) or nasal high flow (via nasal cannula), is associated with reducing health care cost, reduced admissions to ICU (due to adverse clinical outcomes) and reduced endotracheal intubation rates in infants with bronchiolitis (Franklin et al., 2019).

It is important to maintain fluid balance in infants with bronchiolitis, and the protective role of breast milk has been proven against bronchiolitis (Bulkow et al., 2002; Carbonell-Estrany et al., 2004; Lanari et al., 2013; Li et al., 2017). Therefore, it is recommended to continue breastfeeding (frequent small feeds) in mild and clinically stable infants with bronchiolitis (O'Brien et al., 2019). IV therapy is widely used in many centers, but its use is reported to be reserved for severe clinical illness when oral or nasogastric (NG) feeding is not tolerated (Valla et al., 2019). On the other hand, NG feeds or oral fluids are also modestly used in mild to moderate bronchiolitis and in the recovery phase (Caballero et al., 2017; Da Dalt et al., 2013; Kugelman et al., 2013). It has been well documented that providers should carefully monitor the serum electrolyte levels with IV hydration therapy to prevent hyponatremia and SIADH (syndrome of inappropriate secretion of anti-diuretic hormone). Hyponatremia is a known complication of fluid overload related to excessive and hypotonic IV fluid administration; if not carefully monitored, IV fluid administration may result in adverse clinical outcomes in infants hospitalized with bronchiolitis. This may

be less of an issue as providers have moved away from the use of hypotonic fluids in these patients. (Dawson et al., 1993; Hodge and Chetcuti, 2000; Panitch, 2003a; Shein et al., 2017).

The use of antibiotics, corticosteroids and bronchodilators was not beneficial in the typical presentation of viral bronchiolitis and did not change the course of the disease (Panitch, 2003a). However, administration of nebulized epinephrine in outpatients was reported to improve the clinical symptoms and reduced hospital admission rate but was of no benefit in admitted patients with bronchiolitis (Ralston et al., 2014). A few studies also showed that nebulization of hypertonic saline (3%) decreased LOS in inpatients but did not improve clinical outcomes in the outpatients setting (Caballero et al., 2017; Castro-Rodriguez et al., 2015). The role of inhaled epinephrine and nasal decongestant has been studied in one double-blind, randomized controlled trial (RCT) in Israel. The study compared the efficacy of these two regimens in two treatment groups (one group got inhaled epinephrine and other group was given the nasal decongestant xylometazoline) with respect to LOS, need of IV fluids, need for supplemental oxygen and clinical severity score. The study reported no significant difference between the treatment groups in any of the outcomes and concluded that nasal decongestant is as safe and justified in treatment of acute bronchiolitis as is inhaled epinephrine (Livni et al., 2010). However, its use has not been recommended in several clinical guidelines due to insufficient evidence to prove the efficacy of inhaled epinephrine and nasal decongestants in management of bronchiolitis, both in inpatient and outpatient settings.

The role of chest physiotherapy, suctioning, antivirals, and immunoglobulins have also been widely studied but not proven to be of benefit in infants with bronchiolitis, except in severe clinical conditions, certain immune deficiency conditions and co-morbidities (Grover et al., 2011; Panitch, 2003a). Immuno-prophylaxis with palivizumab (a humanized monoclonal antibody) to combat RSV in bronchiolitis has proven to reduce hospitalization rates, but its use is limited to high risk patients, primarily due to its high cost (Da Dalt et al., 2013; Ralston et al., 2014). Non-evidence-based management of bronchiolitis has been documented both by emergency physicians and pediatricians. Ho et al. conducted a large nation-wide cross-sectional study on infants under two years of age, hospitalized with bronchiolitis in Taiwan. The study aimed to assess the practice patterns in management of acute bronchiolitis in the ED and showed high rates of diagnostic interventions used by emergency physicians and pediatricians in the ED, pointing towards non evidence-based practice patterns in management of acute bronchiolitis (Ho et al., 2015).

### Chapter 1.5.2 Bronchiolitis Guidelines on Diagnosis

A summary of clinical practice guideline recommendations on diagnosis and treatment of bronchiolitis is described in Table 1-2. These guidelines are carefully formulated and are based on best available evidence (Australasian bronchiolitis guideline, 2016; Baraldi et al., 2014; Friedman et al., 2014; NICE, 2015; NSW, 2018; O'Brien et al., 2019; SIGN, 2006; Ralston et al., 2014; Turner et al., 2008).

Viral testing: Most of the guidelines do not recommend routine viral testing to determine the viral etiology (e.g. nasopharyngeal (NP) swab for rapid nuclear polymerase chain

reaction to detect possible organism). NICE guidelines do not mention viral testing, whereas Italy and SIGN (Scottish) guidelines recommend rapid RSV testing in infants who need hospitalization to reduce unnecessary antibiotic use and for the purpose of cohorting.

Chest radiograph: Most guidelines do not recommend routine chest radiography except in the cases where diagnosis is uncertain or if ICU admission is required due to severe illness. It has been reported that chest radiography in bronchiolitis is often inconclusive and may show nonspecific patchy areas of infiltration, perihilar or peribronchial widening and shadowing, and areas of atelectasis, which may mislead the clinician and result in unwarranted treatment with antibiotics for suspected pneumonia (Friedman et al., 2014; NICE, 2015; NSW, 2018).

Pulse Oximetry: Several guidelines do not comment on or evaluate oxygen saturation monitoring (pulse oximetry) (Australasian bronchiolitis guideline, 2016; Baraldi et al., 2014; O'Brien et al., 2019; SIGN, 2006; Turner et al., 2008). On the other hand, intermittent pulse oximetry is recommended by several guidelines, in high risk patients and in cases where oxygen saturation in room air is below <92% (Friedman et al., 2014; NICE, 2015; Ralston et al., 2014; SIGN, 2006).

Blood gas monitoring: Many guidelines do not recommend routine blood gas monitoring, and advise only to consider in situations of severe illness, severe respiratory distress or impending respiratory failure (Baraldi et al., 2014; Friedman et al., 2014; NICE, 2015; SIGN, 2006; Turner et al., 2008). A few guidelines do not discuss blood gas monitoring in bronchiolitis (NSW, 2018; O'Brien et al., 2019; Ralston et al., 2014)

Complete blood count and blood culture: Most of the guidelines do not recommend routine blood testing (complete blood count or blood cultures).

The available clinical practice guidelines encourage clinicians not to perform any diagnostic interventions except in certain conditions as explained above. However, these guidelines emphasize proper assessment of infants and young children presenting with bronchiolitis, including evaluation for clinical signs of severity (in particular to the feeding status, increased work of breathing or respiratory distress) and recommend managing on these lines in order to save time from unnecessary diagnostic interventions and better treat the patient in time to reduce adverse clinical outcomes. As fever may be a feature of bronchiolitis, and in neonates (< 28 days of age), the presence of fever (or other worrisome features) may signal serious infection, different guidelines (designed to rule out serious infection) may be followed in this age group (Friedman et al., 2014). To a lesser extent, these considerations also apply to the infant less than eight weeks of age (O'Brien et al., 2019).

**Chapter 1.5.3 Bronchiolitis Guidelines on Treatment**

In milder forms of the disease, it is recommended to manage bronchiolitis on an outpatient basis. That means at-home supportive care with instructions to parents to maintain nutrition and watch for deterioration of the symptoms, such as a significant decrease in oral intake or feeding, inability to feed, persistent vomiting due to respiratory difficulty or agitation, lethargy or sleepiness, and apnea. The parents are instructed to return to the primary care physician or ED on appearance of the above symptoms. Hospitalization is advisable based on the clinical assessment of the severity of the illness,

and also in certain high risk infant groups, such as: premature infants (gestational age <37 weeks), severe neurological abnormalities, immunodeficiencies, bronchopulmonary dysplasia and in infants with congenital heart disease. (Australasian bronchiolitis guideline, 2016; Hodge and Chetcuti, 2000; NSW, 2018). The available guidelines described the recommendations on certain pharmacological and non-pharmacological treatments to assist clinicians in managing admitted infants and young children with acute bronchiolitis.

Supplemental oxygen: Most guidelines recommend administering supplemental oxygenation if oxygen saturation is below 90-92% (in room air), if the child's oxygen saturation persistently drops below 90% during feeding or if child develops severe respiratory distress.

Suctioning: Deep suctioning is not recommended. Superficial suctioning or nasal suctioning of short interval is considered in case of respiratory distress or feeding difficulty to clear blocked nasal passages of secretions to improve breathing or feeding.

Nebulized hypertonic saline: The nebulization of hypertonic saline is not recommended by most guidelines. It may be considered if the hospital stay is longer than 72 hours.

Chest physiotherapy: None of the guidelines recommends routine chest physiotherapy. However, chest physiotherapy can be considered in patients with existing co-morbidities such as spinal muscular atrophy or severe tracheomalacia.

Cool mist or aerosolized saline: This is not recommended by any guideline.

Nebulized epinephrine/adrenaline: The guidelines do not recommend the routine use of nebulized epinephrine.

Corticosteroids: Administration of corticosteroids is not recommended by any of the guidelines.

β-agonists/ bronchodilators: All the guidelines recommend against the routine use of inhaled bronchodilators/ β-agonists. However, AAP's, Australia's and Italy's guidelines suggested to consider trial of a single dose of β-agonist bronchodilator in children with family history of asthma or children older than 9 months with recurrent wheezing.

Antibiotics: Use of antibiotic agents is not recommended except in cases when there is a strong evidence of superimposed secondary bacterial infection.

Antivirals (e.g. ribavirin): Use of antiviral medicines is not routinely recommended by any of the guidelines.

Hydration and nutrition: NICE and Scottish guidelines recommend NG or orogastric (OG) feeding over IV hydration as a method of rehydration in admitted children. The rest of the guidelines recommend use of either NG feeding or IV fluids for treatment of dehydration in children admitted with bronchiolitis.

**Chapter 1.5.4 Adherence to Guidelines**

All the guidelines emphasize supportive care in the form of treating dehydration and maintaining oxygen levels as the mainstay of treatment in admitted children. Supplemental oxygen via nasal prongs, face mask, CPAP, face tent, or humidified HFNC therapy is beneficial (Baraldi et al., 2014; Friedman et al., 2014; NICE, 2015; NSW, 2018). NG feeding with expressed breast milk or formula is recommended in children who cannot maintain oral fluids or feeds. If IV fluids are used, isotonic fluids (e.g. 0.9% NS) are preferred and IV fluid monitoring is recommended to avoid adverse

complications of fluid overload due to excessive IV fluid and hyponatremia due to over-secretion of antidiuretic hormone (SIADH) and hypotonic fluids (Baraldi et al., 2014; Friedman et al., 2014; Ralston et al., 2014).

Kirolos et al. in their systematic review of 32 clinical practice guidelines (from 1996 to 2017) showed consensus against the use of various diagnostic testing in bronchiolitis, as well as the use of pharmacological therapies such as corticosteroids, antivirals, and antibiotics. Most of the guidelines emphasized proper hydration either via NG tube feeding or IV fluids. However, there was significant variation on the use of nebulized epinephrine, nebulized hypertonic saline and inhaled bronchodilators. Many guidelines recommended use of these therapies in hospitalized patients with bronchiolitis (Kirolos et al., 2019).

Despite well-established guidelines for the management of bronchiolitis, there is a lack of consistent use of the guidelines, resulting in wide variation and over-utilization of diagnostic and medical interventions not routinely recommended. Florin et al. in their cross-sectional study conducted in the United States (US) in 43 pediatric hospitals over a five years period (2007-2012), a year after the AAP guidelines publication, examined the variations in utilizations of five resources (corticosteroids, antibiotics, albuterol (salbutamol), nebulized racemic epinephrine and chest radiography) in infants aged ≤12 months, and admitted with bronchiolitis. The researchers reported wide variations in following treatment guidelines established by the AAP, although there was a significant decrease in the use of chest x-ray and corticosteroids over the study period. Furthermore, utilizing all five resources led to a significant increased LOS (Florin et al., 2014).

On the other hand, Barr et al. in their study conducted surveys of pediatricians from all the hospital trusts in UK in 2015 (the year of publication of the NICE guidelines) and 2017 and compared the responses. There was significant adherence and practice improvement in infants admitted with bronchiolitis in the UK after the NICE published guidelines (Barr et al., 2018). Also, significant adherence to the Scottish clinical guidelines (SIGN) was reported in Wales. This study first did an audit of compliance with national guidelines and the audit was repeated after the implementation of an educational bundle on a supportive approach in management of infants presenting with bronchiolitis aged 12 months and under. There was a significant decrease in the use of chest radiography, viral testing and pharmacological treatments as specified in the SIGN guidelines, and the mainstay of treatment remained supportive therapy with fluids and non-invasive respiratory support (Murch et al., 2015).

Another large retrospective cohort study was conducted in eight countries, at 38 pediatric EDs of study hospitals. All the study hospitals were members of pediatric emergency research networks (PERN). The countries included Canada, US, Spain, Portugal, UK, Ireland, Australia, and New Zealand (NZ). The study aimed to characterize the hospitalizations of infants aged <12 months with bronchiolitis between January and December 2013, who were not treated with evidence-based supportive therapies as recommended to date by published clinical practice guidelines. These evidence-based supportive therapies recommended by clinical bronchiolitis guidelines included IV or NG hydration, supplemental oxygen, and airway support (i.e., HFNC, non-invasive ventilation or mechanical ventilation). The study also assessed the use of

pharmacotherapies and chest radiography against the recommendations of clinical guidelines. It was reported that more than 30% of the hospitalized infants did not receive evidence-based supportive therapies and there was significant variation in the use of non-recommended pharmacotherapies such as inhaled epinephrine, salbutamol, hypertonic saline, and corticosteroids in all the study centers. The study concluded that more work was necessary to identify the best practices at the international level, based on evidence-based clinical guideline recommendations in management of infants admitted with bronchiolitis. This would also help to reduce the huge burden of health care costs related to these non-recommended interventions at international levels as well (Schuh et al., 2017).

**Chapter 1.6 Disease Burden**

Bronchiolitis is one of the most common causes of hospital admission in infants and children under two years of age (Deshpande and Northern, 2003; Friedman et al., 2014; Oakley et al., 2017; SIGN, 2006) and causes significant morbidity. The mortality is relatively low and has declined over last 15-20 years (AAP, 2006; Babl et al., 2008; Nair et al., 2010; Ralston et al., 2014). However, the rates of hospitalization due to bronchiolitis have been rising during the past decade, possibly, in part, due to increased use of pulse oximetry rather than more severe illness (Schuh et al., 2014). Hospitalization due to bronchiolitis in infants has increased over the past 30 years from 1% to 3% of all infants with bronchiolitis (AAP, 2006; Friedman et al., 2014; NICE, 2015; Ralston et al., 2014). In Canada, 35 in 1,000 infant hospital admissions are due to bronchiolitis, and the rates have doubled over the past 15 years (Dutton, 2009; Plint et al., 2009). In 1993, the

cost of bronchiolitis in Canada was estimated at $23 million, which adds to the economic burden and health care cost per annum in Canada (Dutton, 2009; Langley et al., 1997; Langley et al., 2003; Plint et al., 2009). There were estimates of 34 million new cases of RSV-associated acute LRT infection, with 3.4 million admissions to hospitals and approximately 199,000 deaths due to RSV-associated acute LRT infection, per year worldwide, in children under 5 years of age. That study also reported that more than 95% of those deaths were in developing countries (Nair et al., 2010).

In the US, there are approximately 100,000 annual hospitalizations due to bronchiolitis in infants under 12 months of age, with an estimated health care cost of $1.73 billion. Interestingly, a cross-sectional analysis of national data from 2000 to 2009 in the US showed a significant decline in bronchiolitis hospitalizations, along with increased ED visits due to bronchiolitis (Hasegawa et al., 2013; Hasegawa et al., 2014).

In Norway, the annual mean incidence of hospital admission due to RSV bronchiolitis in infants under 12 months of age was reported as 21.7 per 1000 infant admissions (Fjaerli et al., 2004), whereas in England it was 24.2 per 1000 infant admissions (Murray et al., 2014). In Australia, it was reported that approximately 13,500 infants were admitted to hospital with a diagnosis of bronchiolitis each year, accounting for 56% of all hospital admissions for infants (O'Brien et al., 2019).

The mortality from bronchiolitis is low and death rates have decreased from 21.47 to 1.82 (per 100 000 children), in infants from 1979 to 2000 in England and Wales (Panickar et al., 2005). In England, the mortality rate due to RSV bronchiolitis in infants under 12 months of age was 8.4 per 100,000 population (Fleming et al., 2005).

## Chapter 1.7 Rationale for Our Study

As described earlier in this chapter, the severity of bronchiolitis is variable with most patients managed as outpatients. However, in a large number of cases, hospitalization is required, commonly due to concern for increased work of breathing, the need for supplemental oxygen or the inability to take oral fluids (the latter often related to manifestations of work of breathing, including increased respiratory rate). If oral hydration (formula or breast feeding) is deemed inappropriate, the options are either NG or OG feeds versus IV fluids (AAP, 2006; Ralston et al., 2014). Approximately 30% of infants hospitalized with bronchiolitis require fluid replacement (Friedman et al., 2014). There is a significant variation in the diagnosis and management of infants and young children presenting with bronchiolitis (Florin et al., 2014; Kirolos et al., 2019). These practice variations have more to do with tradition and medical culture than evidence (Brand and Vaessen-Verberne, 2000; Wang et al., 1995). Several guidelines recommend NG hydration over IV as a first line in admitted patients. For example, NICE guidelines in the UK suggest the use of NG or OG feedings initially unless in respiratory failure. This is also recommended in the Scottish guidelines (NICE, 2015; SIGN, 2006).

Poor oral intake is common in infants admitted with bronchiolitis. In North America, these infants are routinely given IV fluids (Ralston et al., 2014; Srinivasan et al., 2017). However, in other locales (Europe and NZ), they are often given NG feeds using formula or breast milk (Babl et al., 2008; Brand and Vaessen-Verberne, 2000; Oakley et al., 2013; Oakley et al., 2016). Of note, NG hydration with formula or breast milk provides not only fluids but also optimal nutritional for the infant (Kugelman et al., 2013; Weisgerber et al.,

2013). NG feeding was also the most used method of rehydration (96%) in infants admitted with bronchiolitis in Netherlands (Brand and Vaessen-Verberne, 2000). A study in UK reported that NG feeding was not associated with any unfavorable outcomes and none of the infants admitted with acute viral bronchiolitis were treated with IV hydration (Unger and Cunnigham, 2008).

The overuse of the IV route in conditions other than bronchiolitis, such as mild to moderate dehydration in gastroenteritis, has been well-documented (Freedman et al., 2011; Goldman et al., 2008). There is evidence to support NG hydration in restoring physiological nutrition in young children admitted with gastroenteritis, most probably by facilitating and improving water and solute absorption from the gut. NG hydration facilitates faster recovery, decreased LOS, lower illness-related secondary complications and significant lower annual health care cost in young children with gastroenteritis as compared to IV hydration (Fonseca et al., 2004; Nager and Wang, 2002; Yiu et al., 2003).

There is no consensus about choosing the mode of rehydration in bronchiolitis. Even though NG tube insertion is attained easily compared to an IV line, especially in dehydrated infants, there is concern of aspiration risk with the NG route in bronchiolitis (Khoshoo and Edell, 1999). However, there is a research gap when it comes to evidence around NG feeding in this population. A few studies showed that NG tube feeding has a possibility of causing airway compromise due to the small upper airway and increase in nasal or other airway resistance, leading to increased work of breathing, and that this is more evident in younger and preterm infants (Greenspan et al., 1990; Stocks, 1980).

However, to date there is a lack of strong evidence against use of NG hydration over IV hydration in infants with bronchiolitis infants in the literature.

The Pediatric Research in Emergency Departments International Collaborative (PREDICT) is a research collaborative of eleven major institutions with large EDs in Australia and NZ, and it includes all tertiary pediatric centers as well. Babl et al conducted a pilot study in 2005 at eleven PREDICT sites. Of the 83 doctors surveyed, 45% reported using IV hydration, 49% NG hydration and 6% NG or IV hydration (depending on severity of the illness) as an initial treatment in acute bronchiolitis. The study also stated that methods of rehydration in infants admitted with bronchiolitis should be addressed through more comparative studies or randomized trials. In addition, the study concluded that there is a wide variation in clinical practice for the management of bronchiolitis in Australia and NZ, and there were no detailed guideline criteria at any centre to determine which mode of hydration should be preferred for fluid replacement (Babl et al., 2008). In a case series of 37 infants admitted with acute viral bronchiolitis and dehydration in the Northern hospital in 2001 in Victoria, Australia, NG hydration was well tolerated without any incident of adverse clinical outcomes. Two cases were reported to have deteriorated due to progression of illness and removing the NG tube did not result in clinical improvement (Sammartino et al., 2002).

Kennedy and Flanagan conducted a review of evidence for fluid management in children admitted with bronchiolitis and reported that there was marked variation in rehydration strategies practiced, but NG hydration was used in many pediatric units (Kennedy and Flanagan, 2005). They further concluded that “In infants with bronchiolitis,

there is no good quality evidence that rehydration by the NG route is more or less safe than the IV route. A randomized controlled trial is needed". Another study was conducted by Vogel et al. who investigated the management of bronchiolitis admissions in NZ hospitals. This study reported that significant variations existed in management of bronchiolitis amongst the hospitals and that overall, of the 65% children requiring fluid replacement, only 21% received NG hydration and this proportion varied among all facilities (Vogel et al., 2003).

There are very few researchers who have examined the role of NG versus IV hydration in infants with bronchiolitis. Oakley et al. conducted a multicenter, open RCT in hospitals of Australia and NZ (Oakley et al 2013). The study examined the effect of NG hydration versus IV hydration on LOS. The study also investigated the incidence of any complications or adverse effects of either method of rehydration, including, but not limited to, pulmonary aspiration, electrolyte imbalances, infection or replacement of IV line or NG tube, local complication at IV line or NG tube site, duration of each therapy, and parental satisfaction and feedback with the method of rehydration at discharge and one week post-discharge through a questionnaire. Subjects for the study were children younger than 12 months of age and older than 8 weeks, admitted with diagnosis of bronchiolitis from 2009 to 2011 (April-October every year for three bronchiolitis seasons). The study excluded infants younger than 8 weeks due to the more severe presentation of bronchiolitis attributed to their very young age; children older than 12 months of age were excluded because of the possibility of diagnoses other than bronchiolitis, such as asthma. Randomization was allocated through a computer-

generated allocation sequence and could be done at the time of admission or during the hospital stay if at any time non-oral rehydration was deemed necessary by the treating pediatrician. A total of 759 infants were randomized (381 for NG hydration, 378 for IV hydration). Oakley et al. found out that there was no significant difference in mean LOS between the groups (86.6 hours, standard deviation (SD 58.8) for NG hydration versus 82.2 hours (SD 58.8) for IV hydration, p=0.30). In addition, development of any adverse effects, need for mechanical ventilation, or transfer to ICU did not differ between both treatment groups. Only two infants in the IV hydration group and four infants in NG hydration group had LOS longer than 14 days (mean LOS > 14 days was considered significant) and that was unrelated to the study interventions. It was also shown that the success rate of the first attempt at insertion was higher for the NG hydration group (85% for NG versus 56% for IV hydration group (p= <0.0001)). Moreover, the change of therapy to alternative hydration was greater in IV hydration group, with 95 infants versus 50 infants in NG hydration group (p= <0.0001). The parental feedback to both therapies and hospital visits or readmission after discharge did not differ between the groups and few parents reported local adverse effects, such as bruising at IV line site or sore nose at the NG tube site. The study concluded that both methods of rehydration are effective and appropriate in infants with bronchiolitis. However, NG tube insertion has a higher success rate at insertion with fewer attempts to establish access as compared to an IV line (Oakley et al., 2013).

Another clinical trial was conducted by Kugelman et al. on infants less than six months of age admitted with acute bronchiolitis. The study investigated the clinical

outcomes related to NG feeding versus IV hydration and hypothesized that better nutrition is acquired through NG feeding with breast milk or formula milk compared to IV fluids. It was an open, randomized, prospective, controlled pilot study. The study excluded infants who had severe respiratory distress or impending respiratory failure, poor ventilation with pCO2 >45mm Hg or a blood gas with pH <7.3. The study measured the clinical outcomes of duration of supplemental oxygen and LOS in both treatment groups (NG hydration versus IV hydration). A total of 51 infants were randomized (IV hydration = 20, NG hydration = 31). The study reported no difference between the treatment groups in terms of duration of supplemental oxygen (p= 0.95) and LOS (p= 0.12). NG feeding was not associated with any adverse effect such as aspiration of worsening of respiratory status. The study concluded that NG feeding is feasible and has comparable clinical outcomes when compared to IV hydration in infants admitted with acute bronchiolitis who require non-oral rehydration therapy, with NG feeding providing more physiologic nutrition with expressed breast milk or formula milk (Kugelman et al., 2013).

The use of NG hydration in infants younger than 2 months of age was described by Oakley et al. in another study, which investigated whether NG hydration could be safely used in younger infants (less than two months of age) admitted with bronchiolitis. In this retrospective cohort study conducted at three centers in Australia and NZ over three bronchiolitis seasons, researchers assessed the type of hydration (NG versus IV) and examined adverse clinical outcomes, including ICU admission and the need for mechanical respiratory support. The study showed that out of 211 infants younger than

two months old admitted with bronchiolitis and needing non-oral rehydration, 69% were given NG hydration compared to 31% who were treated with IV hydration. The study reported no significant difference in the rate of adverse events (pulmonary aspiration, apnea, bradycardia), LOS, duration of non-oral fluid treatment and admission to ICU between the treatment groups, with NG feeding having a smaller proportion of shift to an alternate method (IV hydration) (Oakley et al., 2016).

One of the reasons for not using NG hydration was a lack of awareness and knowledge about this method of hydration as reported by Srinivasan et al. The main aim of that study was to run a quality improvement (QI) initiative through education and to survey stakeholders (nurses and physicians), coupled with system-based interventions (by assuring the availability of NG tube kits in ED), in order to increase the use of NG hydration from 0% to at least 20%, in children admitted with bronchiolitis aged 1 to 23 months, at their tertiary care hospital. The baseline data (January 2015-April 2015) on NG hydration was compared with post QI initiative data (January 2016- April 2016). It was shown that NG hydration increased from 0% to 58% during this QI initiative and there were no adverse outcomes attributed to this method of rehydration. The study also stated that post-QI initiative, a higher proportion of HCPs were willing to use NG feeding in eligible infants (63% nurses, 95% physicians post-QI versus 13% and 20% pre-QI respectively). From a parental feedback survey, the majority (80%) would have considered NG tube feeding for rehydration in their children if they were readmitted (Srinivasan et al., 2017).

Along with better nutrition delivered through NG hydration, NG tube feeding used for rehydration was associated with lower health care costs compared to IV hydration in infants admitted with bronchiolitis. Oakley et al. conducted an economic analysis (cost minimization study) of a previous RCT done on 759 infants (2009-2011). The baseline data was acquired from a previous RCT by Oakley et al. on infants aged 8 weeks to under 12 months (Oakley et al., 2013). The study aimed to investigate whether IV hydration had lower costs (hospital and intervention-specific costs) as compared to NG hydration. The study described that intervention cost related to IV hydration was higher ($113) as compared to NG hydration ($74) with a cost difference of $39 per child, and that NG hydration had lower cost across all study sites. The study concluded that, overall, NG hydration is cost effective, has a higher success rate with fewer attempts at insertion, is well tolerated and has comparable outcomes compared to IV hydration in hospitalized infants with bronchiolitis. Therefore, this mode of rehydration therapy should be taken into consideration given the large numbers of bronchiolitis admissions in infants and young children annually across the world (Oakley et al., 2017).

Weisgerber et al. investigated the relationship between caloric intake and its impact on LOS with bronchiolitis in infants under 12 months of age during 2004-2005. In their retrospective chart review, poor oral intake along with no proper nutritional support was associated with prolonged hospital stay (Weisgerber et al., 2013). Nutritional management in patients with bronchiolitis has been poorly studied and current practices are based on experience and personal preferences. In a very recent study conducted in Western European French-speaking countries (Belgium, France and Switzerland), the

researchers assessed the pediatricians' practices with respect to nutritional management in young children (infants less than three months old) admitted with bronchiolitis (Valla et al., 2019). Data on nutritional management of bronchiolitis admissions during spring 2018 was collected through a cross-sectional survey of pediatricians in general pediatric wards or EDs. The study mainly focused on advice given to the parents for at-home nutritional support, in-hospital nutritional management and preferred methods of hydration (enteral or IV). Valla et al. found that enteral feeding (NG or OG feeding) was practiced commonly (50%), and nutritional support with breast milk was a preferred choice for enteral feeding in admitted infants. They further stated that the severity of the respiratory distress was the withholding or discontinuation factor for oral or enteral feeding in most cases. In addition, the study found that nurses and parents were more reluctant to utilize NG tube insertion compared to pediatricians. Furthermore, in most health care facilities, there were no written protocols on nutritional management of bronchiolitis in admitted patients and about 25% of pediatricians reported having little or no knowledge about the potential complication of hyponatremia associated with IV fluid overload. The study evaluated the number of available international guidelines (23 countries) on bronchiolitis management and reported that most of the guidelines lacked detailed descriptions and recommendations on nutritional management in bronchiolitis. Valla et al. concluded with an emphasis on the need for detailed bronchiolitis guidelines with respect to nutrition and management of hydration and recommended more research should be conducted on rehydration and nutritional practices among pediatricians around the world (Valla et al., 2019).

A group of pediatric university hospitals in Western France (HUGO) updated the French guidelines on bronchiolitis published in 2001 to new evidence-based clinical practice guidelines (2012). Since the implementation of the HUGO guidelines, there has been a statistically significant decline in use of diagnostic intervention (NP swab, chest radiography), continuous supplementary oxygen administration, and use of antibiotics and other medicines in the infants less than 12 months of age admitted with bronchiolitis. This was shown by Benhamida et al. in their study on management of bronchiolitis, pre- and post-HUGO guideline implementation. The study examined rehydration practices (NG versus IV) for bronchiolitis management in inpatients and found a significantly increased trend of NG feeding compared to IV fluids after the implementation of HUGO guidelines. In addition, there was a decrease in health care cost related to bronchiolitis attributed to a decline in over-investigations and overtreatment (Benhamida et al., 2017).

Adding to the parental stress of a having a child in respiratory distress admitted to the hospital is the stress of observing the child undergo a painful invasive procedure, such as IV cannulation. While NG tube placement is also uncomfortable, it arguably may be less invasive and more reliably accomplished (Oakley et al., 2013). It may be assumed that parents would prefer IV cannulation, but this may be more a reflection of HCPs familiarity with this method of hydration than actual parent preference. Ideally, if both methods are associated with similar outcomes, parental preferences should play a large role in decision-making. At present, the option of NG hydration is generally not provided to parents in many settings. Our study will look at both the morbidity of current practices but also will describe parents' perspectives in order to help provide direction for future

research in the field. Our research, while preliminary, will be a necessary first step in empowering parents to become partners in directing the care of their children when faced with this very common, expensive and distressing illness. If, in future, parents are given the opportunity to make an informed choice, and if NG hydration is selected as the preferred option, not only might this reduce the pain that the child experiences, but also provide the infant the benefits of physiologically more appropriate nutrition during the illness. In addition, it may potentially improve the parents' satisfaction with the medical experience by allowing them to contribute in a meaningful way to this important decision regarding the medical care of their child. The results from our study could influence patterns of practice and will be a gateway to more research around these practices. Given that in a real world situation, physician and nurse preferences play a large role in how treatment options are presented to parents, it is also important to understand from these HCPs what barriers exist to offering choices of hydration method to parents and what local factors must be taken into consideration. Thus, the HCPs surveys and interviews will provide valuable information and put our study in a better local context.

## Chapter 1.8 Research Questions and Study Objectives

### Chapter 1.8.1 Research Question

Primary research question

Would parents of infants in Newfoundland and Labrador accept NG feeds as an alternative to IV fluids in infants admitted for bronchiolitis?

Secondary research question

What are the attitudes of health care providers (HCPs) at the Janeway Children's Hospital toward NG and IV hydration in infants with bronchiolitis?

### Chapter 1.8.2 Objectives

This study had three objectives.

1) The first objective was to characterize the attitudes towards NG feeding as an alternative to IV fluids among parents of children who have been admitted with bronchiolitis and received IV therapy. This objective addressed the main research question.
2) The second objective was to characterize the treatment of infants admitted with bronchiolitis in the Janeway Children's Hospital; in particular, the use of IV therapy or NG hydration. This would give some context to the main research question.
3) The third objective was to assess the attitudes of health care providers at the Janeway towards consideration of NG hydration as an option when treating infants with bronchiolitis who are unable, or in whom it is inadvisable, to take oral fluids. This objective addressed the secondary research question.

### Chapter 1.8.3 Hypothesis

<u>The primary hypothesis</u> to be tested by this study was the following:

Given a scenario where IV access is difficult (at least 2 failed attempts), at least 30% of parents of infants < 12 months of age (at the time of admission) would consider NG

hydration if suggested by their doctor. This would be a strong argument in favor of offering these patients an alternative to NG feeds, if there were no contraindications. This hypothesis assumes that parents will be somewhat reluctant to favor a relatively unfamiliar approach (NG hydration), but this will be mitigated by drawbacks (infant distress) related to the current practice (IV hydration).

A secondary hypothesis was that acceptance of this method of hydration is more likely among parents of younger infants < 6 months of age than in parents of infant 6 months to one year.

## Chapter 1.9 Tables

**Table 1-1 The Modified Respiratory Index Score (RIS)**

| **Severity score** | **0** | **1** | **2** | **3** |
|---|---|---|---|---|
| Respiratory rate (breaths per minute)<br>< 3 months<br>3 - <12 months<br>1 - 2 years | <br>-<br>-<br>- | <br>30-60<br>25-50<br>20-40 | <br>61-80<br>51-70<br>41-60 | <br>>80<br>>70<br>>60 |
| Chest retractions | None | Mild subcostal/intercostal | Subcostal/intercostal | Suprasternal or grunting or nasal flaring or head bobbing |
| Wheezing | None | End-expiratory wheeze only | Expiratory wheeze only | Inspiratory and expiratory wheeze or diminished breath sounds |
| Mental status | Normal | Mild irritability when disturbed | Agitated or restless when disturbed | Lethargic/drowsy or inconsolable |

**Table 1-2 Summary of Clinical Practice Guidelines for Bronchiolitis**

| **Diagnosis** | **NICE (UK), 2015[1]** | **CPS (Canada), 2014[2]** | **AAP (US), 2014[3]** | **Australia, 2008[4]** | **SIGN (Scotland), 2006[5]** | **Italy, 2014[6]** | **NSW, 2018[7]** | **Australasia, 2019[8] [9]** |
|---|---|---|---|---|---|---|---|---|
| Viral testing | NE | NRR; only if cohorting admitted patients | NRR | NRR; consider only in febrile younger infants or diagnosis unclear | Rapid RSV testing recommended in infants who require admission, or for cohorting | Rapid RSV testing recommended for cohorting and decreasing antibiotics use | NRR | NRR |
| Chest radiography | NRR except if ICU admission required | NRR except if diagnosis unclear or condition deteriorates, or diagnosis other than bronchiolitis suspected | NRR except if ICU admission required or signs of complications e.g. pneumothorax | NRR except if diagnosis uncertain, severe illness or severe respiratory distress | NRR except uncertain diagnosis or atypical disease course | NRR | NRR | NRR |
| Oxygen Saturation/ Pulse Oximetry | Only intermittent O2 saturation checks recommended | NR; intermittent checks consider in high risk patients | NRR if $O_2$ saturation is >90% in room air | NE | Intermittent checks on every child presenting to hospital | NE | NE | NE |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Blood gas monitoring | NRR; consider in severe illness, severe respiratory distress or failure | NRR; consider in severe respiratory distress or failure | NE | NRR; do in severe disease; consider in moderate disease | NRR; consider in severe illness, severe respiratory distress or failure | NRR | NE | NE |
| Blood test/ complete blood count | NRR | NR | NR | NE | NR | NRR | NR | NR |
| Blood culture | NRR | NRR | NE | NRR | NRR | NRR | NR | NR |
| **Treatment** | **NICE (UK), 2015** | **CPS (Canada), 2014** | **AAP (US), 2014** | **Australia, 2008** | **SIGN (Scotland), 2006** | **Italy, 2014** | **NSW, 2018** | **Australasia, 2019** |
| Supplemental Oxygen | Only if $O_2$sat is <92% persistently | Use when $O_2$sat is <90% to keep it ≥ 90% | NR if $O_2$sat is > 90% without acidosis | Consider if $O_2$sat is < 90-92%, | Use if $O_2$sat ≤ 92% or infant has severe respiratory distress | Use if persistently $O_2$sat < 90-92% | Use if persistently $O_2$sat < 92% | Use if persistently $O_2$sat < 92% |
| Suctioning | Do not perform routinely; use if apnea persists; consider upper airway suction if respiratory distress or feeding difficulties | Only superficial nasal suctioning to clear secretions; avoid long interval between suctioning and deep suctioning | Deep suctioning on routine basis not beneficial; insufficient data to comment or recommend | Nasal suctioning might be trialled | Only superficial nasal suctioning to clear secretions if nasal blockage causing respiratory distress | Only superficial suctioning recommended | Nasal suctioning NRR; consider superficial nasal suctioning in patients with moderate disease to improve feeding | Nasal suctioning NRR; consider superficial nasal suctioning in patients with moderate disease to improve feeding |
| Nebulized Hypertonic Saline | NR | NR in outpatients and Eds; consider in | NR in EDs: consider in inpatients with long | NE | NE | Recommended | Do not use/ NR | Do not use/ NR |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | inpatients with long length of hospital stay | length of hospital stay >72 hours | | | | | |
| Chest Physiotherapy | NRR unless infant has relevant co-morbidities e.g. spinal muscular atrophy or severe tracheomalacia | NR | NR | NR | NR if infant is not admitted to intensive care unit | NR | Is not indicated/ NR | Is not indicated/ NR |
| Cool mist or saline aerosol | NE | NR | NE | NRR | NE | Insufficient evidence | NE | NE |
| Nebulized Epinephrine | NR | NRR; monitored trial could be done | NR | NRR | NR | NR | NR except in arrest or peri-arrest situations | NR except in arrest or peri-arrest situations |
| Corticosteroids | NR | NR | NR | NRR | NR | NR | NR | NR |
| β- agonist bronchodilators | NR | NR | NR | NRR; consider carefully monitored trial in infants > 9 months old with recurrent wheeze | NR | NRR; consider carefully monitored trial | NR | NR |
| Antibiotics | NR | NR; indicated in case of secondary bacterial infection in presence of strong evidence | NR; indicated in case of secondary bacterial infection in presence of strong evidence | NR; consider if secondary bacterial infection is present. | NR | NR; indicated in case of secondary bacterial infection in presence of strong evidence | Not indicated including Azithromyc-in | Not indicated including Azithromycin |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Antivirals (i.e. Ribavirin) | NE | NR | Not mentioned | NRR | NR | NR | Not indicated | Not indicated |
| Hydration/Nutrition | Give fluids by nasogastric (NG) or orogastric (OG) tube first in infants who can not take enough oral fluids; give isotonic IV fluids to those who can not tolerate OG or NG fluids or impending respiratory failure | NG feeding or intravenous (IV) fluids in infants who cannot maintain oral intake or hydration | NG feeding or IV fluids in infants who cannot maintain oral intake or hydration | NG or IV fluids for infants who cannot maintain hydration due to respiratory distress or inability to feed | Consider NG feeding (over IV) in infants who cannot maintain oral intake or hydration | NG feeding or IV fluids in infants who cannot maintain oral intake or hydration | If non-oral hydration is needed either NG or IV hydration | If non-oral hydration is needed either NG or IV hydration |

| | |
|---|---|
| AAP | American Academy of Pediatrics |
| Australasia | Australia and New Zealand (NZ) |
| CPS | Canadian Pediatric Society |
| ED | Emergency Department |
| NICE | National Institute for Health and Care Excellence |
| NE | Not evaluated |
| NR | Not recommended |
| NRR | Not routinely recommended |
| NSW | New South Wales |
| SIGN | Scottish Intercollegiate Guidelines Network |
| UK | United Kingdom |

Table 1-1 References

(1) NICE, 2015

(2) Friedman et al., 2014

(3) Ralston et al., 2014

(4) Turner et al., 2008

(5) SIGN, 2006

(6) Baraldi et al., 2014

(7) NSW, 2018

(8) O'Brien et al., 2019

(9) Australasian bronchiolitis guideline, 2016

# Chapter 2 Retrospective Chart Review

## Chapter 2.1 Study Design

This study had two parts:

a) Quantitative part
   - Retrospective chart review
   - Surveys of parents
   - Surveys of the Health Care Providers

b) Qualitative part
   - Interviews of Health Care Providers

This section of the thesis describes primarily the retrospective chart review portion.

## Chapter 2.2 Study Population

The Janeway Children's Hospital and Rehabilitation Centre (the "Janeway") is a tertiary care hospital in Newfoundland and Labrador (NL). It is an academic hospital, associated with Memorial University of Newfoundland, located in St John's, NL. It has an ED with approximately 35,000 visits annually, and as expected, children frequently present with bronchiolitis each year, especially during winter and early spring months (The Janeway Children's Hospital Foundation, 2018). These children present to the ED either as a result of a parent or guardian seeking care for the child or as a result of a referral from another hospital or community physician. In either instance, they may

present to triage or arrive by ambulance. Additionally, children with bronchiolitis may be transferred directly to the ward or pediatric intensive care unit (PICU) without being seen in the ED. The population of interest was children less than one year of age at the time of admission, admitted to Janeway with bronchiolitis over the two-year period from May 1, 2016 to April 30, 2018. The selection of duration and calendar months for this study were chosen because in Canada the bronchiolitis season usually begins in late autumn and lasts four to five months (November to April) (Friedman et al., 2014; Tercier, 1983), and we anticipated that using this time period would minimize the time between a child's admission and the parental survey.

### Chapter 2.3 Inclusion and Exclusion Criteria

The cases were screened for the following criteria.

Inclusion criteria:

1) Age less than one year at the time of admission.
2) Admitted to Janeway Children's Hospital between May 1, 2016 and April 30, 2018.
3) Discharge diagnosis of bronchiolitis by the attending physician; or diagnosis of asthma with positive NP swab of a typical bronchiolitis pathogen (RSV or HMPV); or clinical diagnosis of pneumonia with wheeze on examination and a negative or non-diagnostic chest radiograph.

For the purpose of this study, the age of the patient was limited to less than one year due to the high incidence of bronchiolitis in this age group and a greater likelihood of uncertainty as to the diagnosis in the one to two year age group. The purpose of including

infants with discharge diagnoses other than “bronchiolitis” under certain conditions as outlined above was to include infants with wheezing episodes that likely represent cases of bronchiolitis but are coded with a different respiratory discharge diagnosis. Specifically, some infants who present with wheeze are also given a diagnosis of first episode of asthma or pneumonia. Non-radiologists may be more likely to interpret a chest radiograph in this age group as pneumonia, and that diagnosis may be documented, whereas a radiologist might interpret the changes to be more consistent with a viral bronchiolitis. Therefore, we considered children with a positive NP swab and chest radiological examination not diagnostic of pneumonia (as reported by a radiologist) to be consistent with a diagnosis of bronchiolitis in these admitted patients. Similarly, infants with a diagnosis of asthma, but who were positive for a typical bronchiolitis pathogen (RSV or HMPV), we considered as bronchiolitis. The expanded inclusion criteria allowed us to enroll the maximum patients who would reasonably be classified as bronchiolitis.

Exclusion criteria:

1) Expired from the index illness
2) Expired from other causes
3) Endotracheal intubation performed during admission

**Chapter 2.4 Study Outcomes**

The study outcomes are as follows:

**Primary Outcome:** Proportion of infants (or cases) treated with NG hydration.

**Secondary Outcomes**:

1. Proportion of cases treated with IV hydration.

2. Proportion of cases with local complication at IV line site.
3. Proportion of cases who had multiple attempts at IV placement.
4. Proportion of cases positive for RSV.
5. Proportion of cases who had chest radiography done.
6. Proportion of cases administered with supplemental oxygen during the hospital stay.
7. Proportion of cases treated with IV antibiotics.
8. Mean duration of IV placement (in hours) during hospital stay.
9. Mean duration of ED stay (in minutes).
10. Mean LOS (in hours).

**Chapter 2.5 Sample Selection**

A list of Janeway hospital admissions for infants less than one year of age at time of admission, admitted with a diagnosis of bronchiolitis, asthma or pneumonia, was obtained by querying the electronic health records using Meditech for the two-year period May 1, 2016 to April 30, 2018. The data was derived by using ICD-10 code J21 for bronchiolitis, codes J12 through J18 for pneumonia and codes J45 and J46 for asthma. We also reviewed a list of positive respiratory virus tests to identify cases with incorrectly coded discharge diagnoses. This process allowed us to develop a list of possibly eligible cases, each of which was assigned a screening identification (ID) number. If, on review of the medical record, all eligibility criteria were met, the eligible case was given a study ID number. The screening and study IDs could only be linked to the medical record with a separate key document.

## Chapter 2.6 Data Extraction and Handling

For each case with a study ID number identified, the electronic health record was examined for chart review. The data on all the variables as listed in the data extraction form was recorded manually on the data extraction sheet (Appendix A). The following data were recorded on each eligible case: route of hospital admission, whether directly to an inpatient location or via the ED; age of the infant in months (also recorded in days for purpose of analysis); weight in kilograms (kg); gender; initial vital signs location (ED triage or inpatient); heart rate in beats per minute; blood pressure in millimeter of mercury (mmHg); respiratory rate in breaths per minute; temperature (degrees Celsius); oxygen saturation (%); co-morbidities; triage code; time (24 hour clock) and date of triage; time of arrival to inpatient location; initial inpatient location (ward/PICU/neonatal intensive care unit (NICU)); transfer at any time to PICU or NICU or ward; record of NP swab and results; record of chest radiography and results; details on supplementary oxygen; whether NG feeds administered or not; type of feed through NG (expressed breast milk, formula milk or other fluid); IV line placement; initial IV fluids (type); complications of IV placement (local at IV site); IV fluid bolus (volume in milliliters and time duration in minutes); details on IV placement and IV replacement attempts (number of times); whether or not IV medication was administered; details on IV medication (such as IV antibiotic and steroid name, dose, interval (hours), number of doses); details on first, second and third antibiotic administered; total duration of IV placement (hours); inpatient hospital LOS in hours and length of ED stay (minutes). The data extraction sheet was signed and dated by the author. The final data was transferred from data extraction sheets

into a Microsoft Access (Redmond, Washington) database and then exported into IBM SPSS Statistics Version 24 (Armonk, New York).

## Chapter 2.7 Statistical Analysis

IBM SPSS Version 24 (Armonk, New York) was used to do all analysis on the data. The descriptive analysis of categorical data was done by using number and percentages, and for continuous data by using mean, median, interquartile range and SD.

## Chapter 2.8 Ethical Considerations

A full approval for this research study was granted by the Health Research Ethics Board (HREB) of Newfoundland and Labrador (Appendix B). Institutional approval was given by Memorial University of Newfoundland. A full approval for this study was also granted by Research Proposals Approval Committee (RPAC) of the Regional Health Authority, Eastern Health (Appendix C). All study documents were stored securely by Dr. Robert Porter in room 412, 4$^{th}$ floor Janeway Hostel. None of the paper or electronic data on infants can be identified without linking the study ID number to the Health Care Numbers or other personal identifiers. The identifiers for parental surveys and of HCP surveys were removed by using study ID numbers as well. The HCP interviewee identities were also kept confidential and identified by designations such as emergency or ward nurse 1or 2, emergency physician/ pediatrician 1 and 2 etc.

## Chapter 2.9 Results

### Chapter 2.9.1 Sample Selection Chart Reviews

A total of 144 cases less than one year old at time of admission, admitted to the Janeway, from May 1, 2016 to April 30, 2018, were screened and each case was assigned a screening ID number. After applying the eligibility criteria, 101 cases were identified as eligible for enrollment into the study and full chart review (43 cases were excluded due to not meeting the eligibility criteria). Each eligible case was given a study number. A detailed review of the medical record for each case was done and required information was recorded. The total number of cases that had an IV line placed and were given IV fluids for hydration as a treatment of dehydration admitted for bronchiolitis were identified to be 54. These 54 cases were eligible for the parental survey as well as chart review. This is summarized in Figure 2-1.

### Chapter 2.9.2 General Characteristics of Cases

The age of the infants ranged from 6 to 341 days, median of 112 days, with mean age of 129 days and SD as 93.8 (Figure 2-2 shows age distribution of the cases). Weight of the infants ranged from 2.87 to 10.70 kg, median of 7.83 kg, with a mean of 6.24 kg and SD as 2.15 (Figure 2-3 is a scatter plot for age and weight distribution of cases). Male infants comprised of 65.3% of the cases. Discharge diagnosis was bronchiolitis for 100 cases (99%) and asthma with positive NP swab for one of the cases (1%). Of the total 101 cases, 91 (90%) were admitted through ED and 10 infants (9.9%) were admitted directly to the inpatient ward. Co-morbidities were reported in nine cases (8.9%), with some cases

having multiple co-morbidities. The documented co-morbidities were as follows: plagiocephaly; VACTERL (vertebral defects, anal atresia, cardiac defects, tracheo-esophageal abnormalities, renal anomalies, and limb abnormalities); obstructive hydrocephalus, spastic quadriplegia, post-meningoencephalitis bilateral infarcts; corrected transposition of the great arteries, ventriculoseptal defect; uncomplicated umbilical granuloma; pulmonary atresia, right diaphragm paralysis, seizure disorder; chronic lung disease; Taussig-Bing anomaly, interrupted aortic arch, atrial ectopic tachycardia; and hypospadias. Table 2-1 summarizes the characteristics of the cases.

**Chapter 2.9.3 Triage, Initial Vital Signs and Inpatient Location of cases**

Pediatric Canadian Triage and Acuity Scale (PedCTAS) guideline is followed at the Janeway Hospital for triage (PedCTAS, 2001; Warren et al., 2008). Children presenting to Janeway Hospital ED are triaged and assigned a CTAS level ranging from 1 (immediate/resuscitation) to 5 (non-urgent). This corresponds to the time to medical care goal. For instance, for patients assigned CTAS level 2 (C-2), there is a time for medical care goal of 15 minutes; this goal is 30 minutes for CTAS level 3 and 60 minutes for patients assigned CTAS level 4 (PedCTAS, 2001; Warren et al., 2008). The time to medical care goal is supplemented with fractile response goals as a part of PedCTAS guidelines. Fractile response goals of 95%, 90%, 85% and 80% for levels 2, 3, 4 and 5. This means, for example, for the patients who are triaged at level 2, the time to medical care should be within 15 minutes of triage 95% of the time and within 30 minutes of triage 90% of the time for the patients triaged at level 3 (PedCTAS, 2001). Table 2-2

summarizes PedCTAS categories (C-1 to C-5) and time to medical care for patients in each of the five triage categories.

Triage code was recorded for 89 cases out of 91 who were admitted through ED. It was coded as “2” for 59 (66.3%) and “3” for 30 (33.7%) cases. Of the 101 eligible cases, mean initial oxygen saturation for the infants was 96% (in room air) with SD of 3.8. Temperature was recorded in degrees Celsius had a mean of 37.2 (SD 0.74) and ranged from 36 to 39.9. Temperature route was ‘axillary’ in 59 (59%), ‘rectal’ in 28 (28%) and ‘tympanic’ in 13 (13%) of the cases. Initial inpatient location for admitted cases was ward for 90 infants (89.1%) and PICU for 11 infants (10.9%). Of the total 101cases, 10 cases (10%) were transferred to any other inpatient location (PICU, NICU, Ward) from their initial inpatient location (Table 2-1).

### Chapter 2.9.4 Diagnostic Interventions

Of the 101 eligible cases, NP swab was performed on 94 (93.1%) of the cases and was positive for RSV in 64 (68.1%), enterovirus in eight (8.5%) , HMPV in six (6.4%), PIV type 1 in two (2.1%) and adenovirus in one (1%) of the cases. NP swab was negative in seven cases (7.4%). Chest radiograph was performed in 74 cases (73%). The diagnostic interventions with results are summarized in Table 2-3.

### Chapter 2.9.5 Management of the Cases Admitted with Bronchiolitis

The primary outcome for the chart review was the proportion of cases treated with NG hydration. When the records were reviewed for the maintenance of hydration, of the 101 cases, only four cases (4%) had NG tube placed and were given NG feeds or fluids.

The type of feeds given through the NG tube was expressed breast milk for two and formula milk for the other two cases. The infants who had NG feeds also had IV lines placed and were given IV initial maintenance fluids as well. Of the total 101 cases, an IV line was placed at the Janeway in 54 (53.5%) of the infants and another two cases (2%) had an IV line in place when they presented at an inpatient location at Janeway after being referred from another location for hospital admission for their management of bronchiolitis (secondary outcome). Most of the infants (45 cases, 83.3%) who had an IV line and were given initial IV maintenance fluids received 5% dextrose in normal saline (D5NS) as IV fluid, three (5.6%) were given 10% dextrose in normal saline (D10NS), two (3.7%) were given 5% dextrose in 0.45% normal saline (D5½NS) and one infant (1.9%) had IV normal saline (NS). Out of 54 infants, 19 (35.2%) had an initial bolus of IV fluid (ranging from 30-200ml) over a period of 15-60 minutes (in 13 cases (68.4%) over 60 minutes, in three cases (15.8%) over 30 minutes, in two cases (10.5%) over 20 minutes and in one case (5.3%) over 15 minutes time). IV medications were given to 27 cases (48.2%) out of 56 cases. This includes two cases who had already an IV line placed when being referred to Janeway for further management. Of the 27 cases who had IV medications, IV antibiotics (secondary outcome) were administered to 26 cases (96.3%) and IV steroids were administered to two out of 27 cases (7.4%). These findings are summarized in Table 2-4. We also examined cases aged <28 days, with respect to IV hydration and IV antibiotic treatment. Of the total 101 cases, 14 cases (14%) were <28 days old, and 13 (93%) of these had an IV line placed and were given IV fluid hydration. IV antibiotics were given to six cases (46.2% of the 13 cases who had an IV line placed).

Of those ≥ 28 days (87 cases), 41 cases (47%) had IV line placed, 40 (98%) of these received IV hydration, and 20 cases received IV antibiotic (49% of the 41 cases who had an IV line placed).

Of the 101 cases, 54 (53.5%) of the cases received supplementary oxygen at some point during their hospital stay.

We further investigated the findings of chest radiographs, in particular for the cases who had IV antibiotic treatment during their hospital stay. For the purpose of this study, we adopted the chest radiography interpretation definitions as described by Schuh et al. They classified chest radiograph findings of the patients with bronchiolitis into three categories: 1) *Simple* radiographs characterized by prominent bronchial markings and peribronchial infiltrates with or without atelectasis, or hyperinflation; 2) *Complex* radiographs characterized by airway disease without lobar consolidation; or 3) *Inconsistent* (with bronchiolitis) radiographs characterized by lobar consolidation or cardiomegaly (Schuh et al., 2007). We found that out of the 26 cases who had IV antibiotic treatment, chest radiographs were classified as normal (no pathology) for seven cases (27%), simple for 11 (42.3%), complex for six (23%), and inconsistent for only two cases (7.7%).

**Chapter 2.9.6 Details on Intravenous Line**

Table 2-5 summarizes the details of the IV line. Local complications (swelling, edema, local tissue infiltration) at the IV line site were reported in 11 cases out of 54 (20.4%) (Figure 2-4). The details on the number of attempts at successfully placing an IV line were recorded for 42 cases (77.7%) out of 54. For the remaining cases (12 out of 54)

we could not find records on the number of attempts for successful IV placement. Of the 42 cases, 28 cases (66.7%) had an IV line successfully placed on the first attempt, in five cases (11.9%) after two attempts, in two cases (4.8%) after three attempts, in three cases (7.14%) after four attempts, in two cases (4.8%) after five attempts, in one case (2.4%) after seven attempts and in the another case (2.4%) IV access was attained after nine attempts (Figure 2-5). From detailed review of all the cases, we were able to find the records on IV replacement for 50 (out of 56) infants who had an IV line in place and for remaining 6 cases we could not find the records for whether the IV line was replaced or not. The IV line was replaced for 18 cases (36%) out of those 50 cases. (Figure 2-6). Furthermore, the IV line was replaced one time in sixteen cases (88.9%), twice in one case (5.6%) and four times in one case (5.6%) (Figure 2-7).

### Chapter 2.9.7 Length of Hospital Stay, Length of ED Stay and Duration of IV Line Placement

Of the total 101 eligible cases, the median inpatient LOS was 49 hours, with interquartile range of 67 hours and mean as 79 hours (SD 150.1) (Figure 2-8). Length of ED stay was available for 90 out of 91 cases and had a mean of 270 minutes (SD 98.9). (Figure 2-9). Total duration of IV line placement for 54 cases was for a median of 48 hours with interquartile range as 40 hours (Figure 2-10). One outlier had an IV line placed for more than 500 hours. This infant was a 218 day old male admitted with bronchiolitis, who had multiple co-morbidities, including atrial ectopic tachycardia, Taussig-Bing anomaly and interrupted aortic arch. He was administered maintenance IV fluids throughout his hospital stay.

## Chapter 2.10 Tables

**Table 2-1 Characteristics of Cases (n=101)**

| Characteristics | Value |
|---|---|
| Discharge diagnosis: bronchiolitis: n (%) | 100 (99) |
| asthma with positive NP swab: n (%) | 1 (1) |
| Gender: male n (%) | 66 (65.3) |
| Age in days: mean (SD) | 129 (93.8) |
| Weight in kilograms: mean (SD) | 6.24 (2.15) |
| Route of admission: | |
| ED: n (%) | 91 (90.1) |
| Direct to inpatient location: n (%) | 10 (9.9) |
| Vital signs location: | |
| ED triage: n (%) | 91 (90.1) |
| Inpatient: n (%) | 10 (9.9) |
| Co-morbidities: n (%) | 9 (8.9) |
| Triage codes reported on number of cases: n (%) | 89 (97.8) |
| Code 2: n (%) | 59 (66.3) |
| Code 3: n (%) | 30 (33.7) |
| Temperature in degrees Celsius: mean (SD) | 37.2 (0.74) |
| Temperature route: n (%) | |
| Rectal | 28 (28) |
| Axillary | 59 (59) |
| Tympanic | 13 (13) |
| Missing or not documented | 1 (1) |
| Initial Oxygen saturation in room air %: mean (SD) | 96 (3.8) |
| Initial inpatient location | |
| Ward: n (%) | 90 (89.1) |
| Pediatric intensive care unit: n (%) | 11 (10.9) |

| | |
|---|---|
| Cases transferred to other inpatient location from initial inpatient location (ward, neonatal intensive care unit, pediatric intensive care unit): n (%) | 10 (10) |

**Table 2-2 PedCTAS categories (C-1 to C-5) and time to medical care**

| CTAS Category (C1-C5) | Time to Medical Care (minutes) | Fractile Response (%) |
|---|---|---|
| 1 -Resuscitation | Immediate | 98 |
| 2 -Emergent | 15 Minutes | 95 |
| 3- Urgent | 30 Minutes | 90 |
| 4- Less Urgent | 60 Minutes | 85 |
| 5- Non-Urgent | 120 Minutes | 80 |

**Table 2-3 Diagnostic interventions (n=101)**

| Characteristics | Value |
|---|---|
| Cases on which nasopharyngeal (NP) swab was done (RPCR): n (%) | 94 (93.1) |
| Results of NP swab: n (%) | |
| RSV (respiratory syncytial virus) | 64 (68.1) |
| Enterovirus | 8 (8.5) |
| Human metapneumovirus (HMPV) | 6 (6.4) |
| Parainfluenza virus (PIV) type 1 | 2 (2.1) |
| PIV type 2 | 1(1.1) |
| PIV type 3 | 1 (1.1) |
| Influenza A | 1 (1.1) |
| Adenovirus | 1 (1.1) |
| Negative | 7 (7.4) |
| Cases who had chest radiography: n (%) | 74 (73) |

**Table 2-4 Management of Cases Admitted with Bronchiolitis (n=101)**

| Characteristic | Value |
|---|---|
| Supplementary oxygen administered: n (%) | 54 (53.5) |
| Nasogastric (NG) tube placed: n (%) | 4 (4) |
| Type of fluid through NG tube: | |
| Expressed breast milk: n | 2 |
| Formula milk: n | 2 |
| Intravenous (IV) line placed (at Janeway): n (%) | 54 (53.5) |
| IV placed already in place at presentation at Janeway: n (%) | 2 (2) |
| Initial maintenance IV fluid administered in cases with IV: n (%) | |
| 5% dextrose in normal saline (D5NS) | 45 (83.3) |
| 10% dextrose in normal saline (D10NS) | 3 (5.6) |
| 5% dextrose in 0.45% normal saline (D5½NS) | 2 (3.7) |
| Normal saline (NS) | 1 (1.9) |
| Other/Unknown | 2 (3.7) |
| No IV fluids | 1 (1.9) |
| IV fluid as bolus in milliliters (30-200ml): n (%) | |
| Cases who had bolus of IV fluids n (%) | 19 (35.2) |
| Over 60 minutes | 13 (68.4) |
| Over 30 minutes | 3 (15.8) |
| Over 20 minutes | 2 (10.5) |
| Over 15 minutes | 1 (5.3) |
| IV medication administered: n (%) | 27 (48.2) |
| Antibiotics | 26 (96.3) |
| Steroids | 2 (7.4) |

**Table 2-5 Details of Intravenous Therapy (n=54)**

| Characteristic | Value |
|---|---|
| Local IV site complications (swelling, edema, infiltration): n (%) | 11 (20.4) |
| Number of IV placement attempts: n (%) | 42 (77.7) |
| Number of attempts before the successful IV placement: n (%) | |
| 1 | 28 (66.7) |
| 2 | 5 (11.9) |
| 3 | 2 (4.8) |
| 4 | 3 (7.14) |
| 5 | 2 (4.8) |
| 7 | 1 (2.4) |
| 9 | 1 (2.4) |
| IV line replaced (n=50 documented cases): n (%) | 18 (36) |
| Number of times IV line was replaced: n=18 | |
| Once: n (%) | 16 (88.9) |
| Twice: n (%) | 1 (5.6) |
| Four times: n (%) | 1 (5.6) |

## Chapter 2.11 Figures

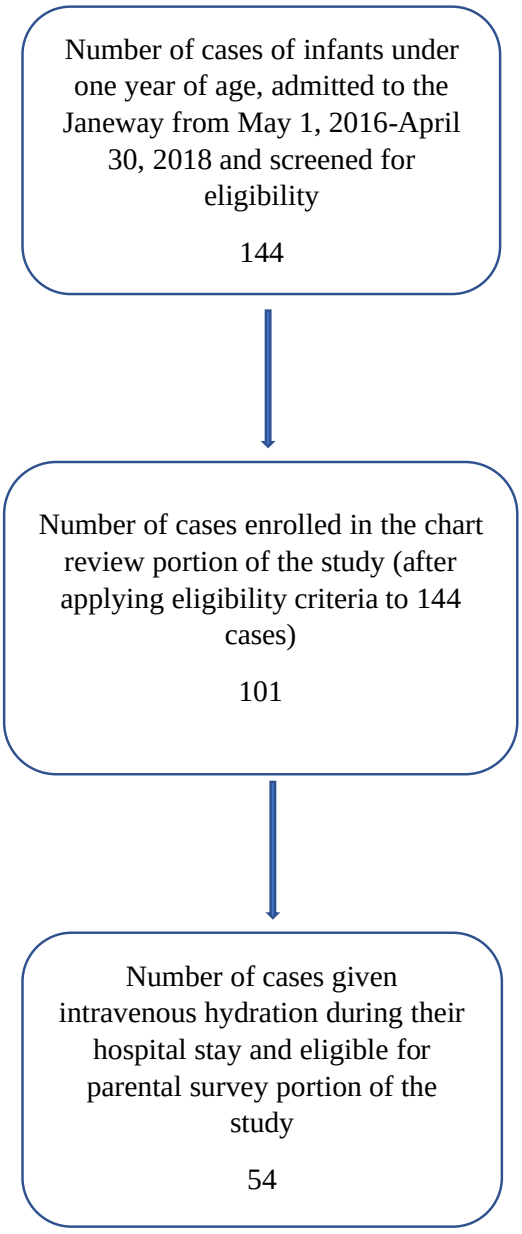


**Figure 2-1 Flow Chart of Sample Selection**

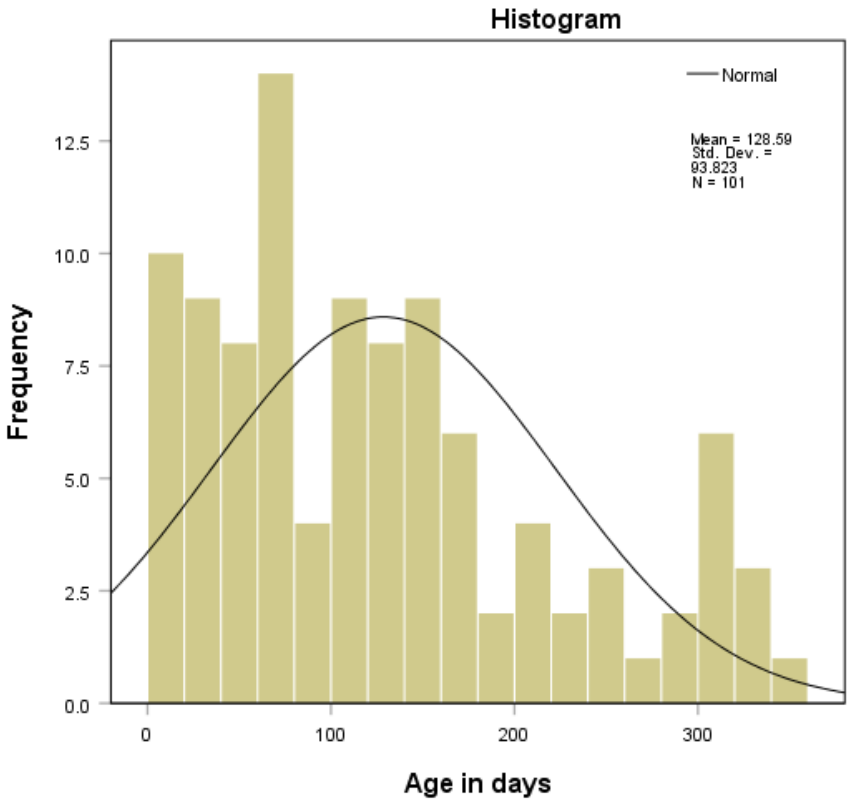


**Figure 2-2 Age distribution of the cases**

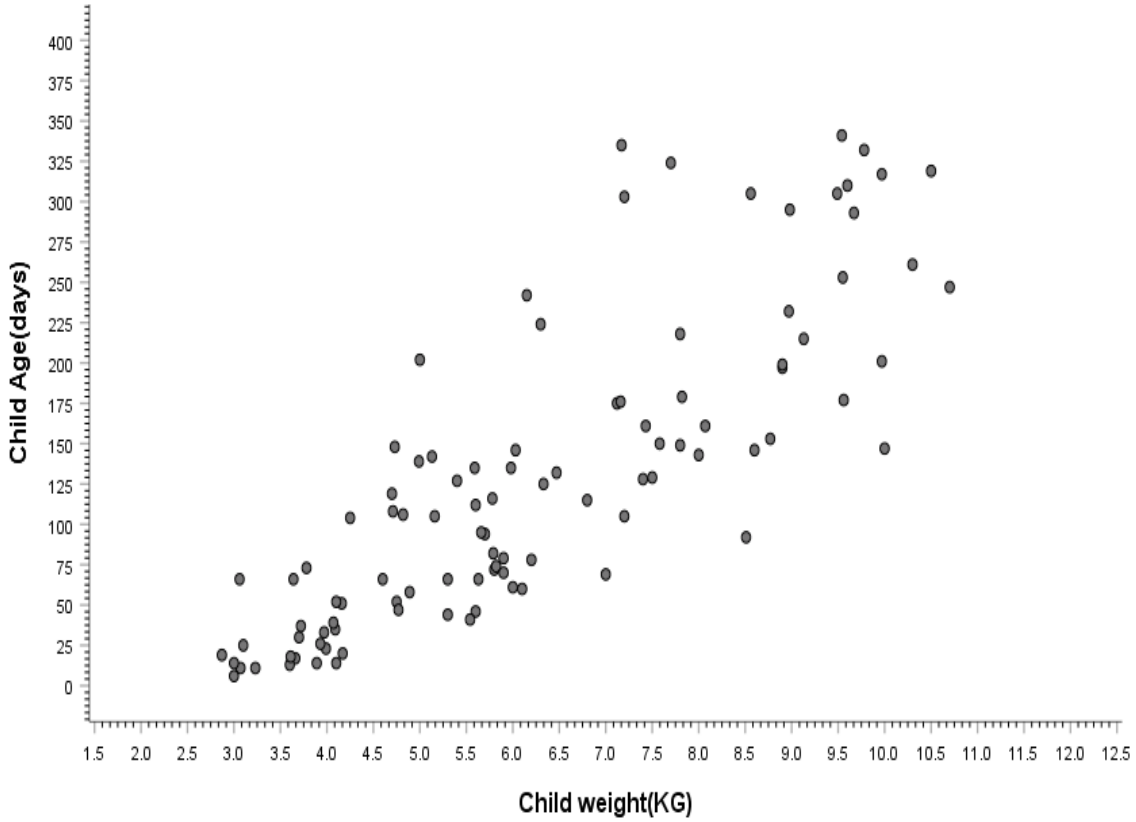


**Figure 2-3 Scatter plot for infants' weight and age distribution**

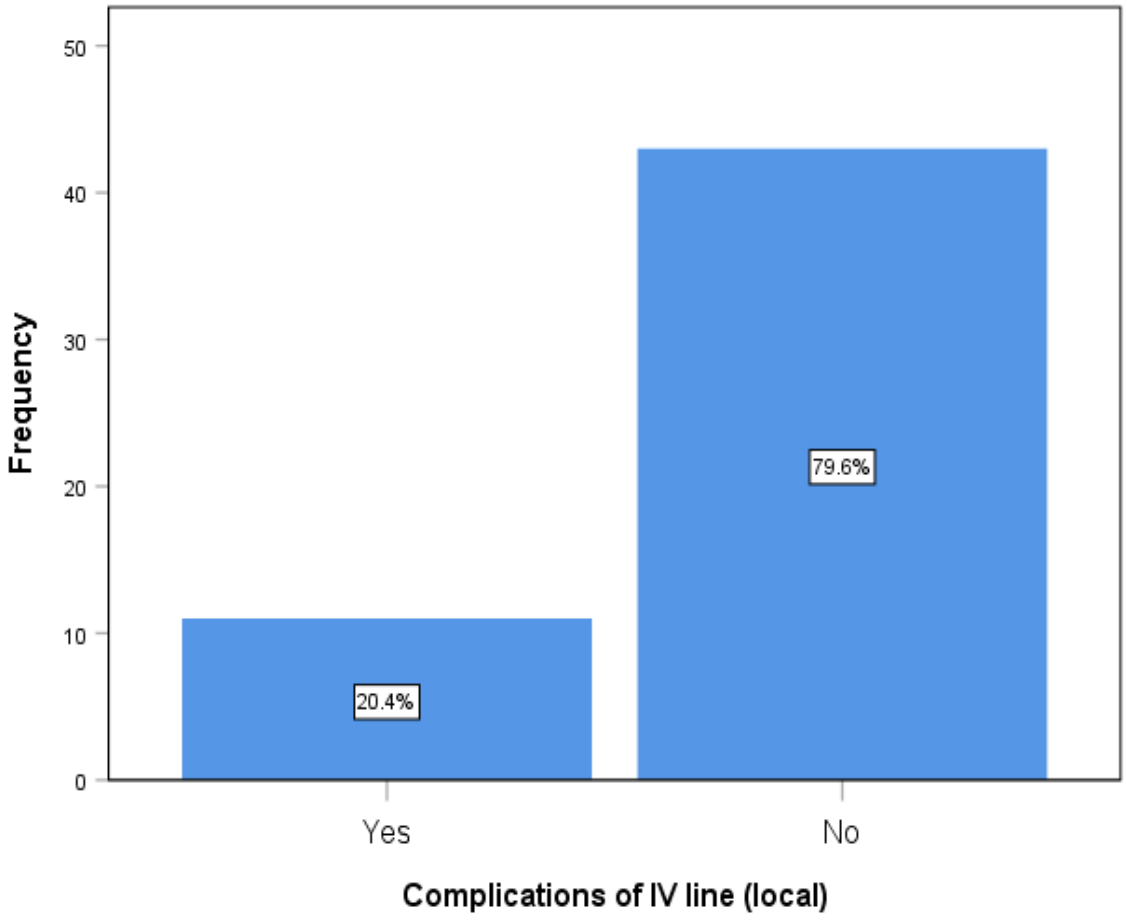


**Figure 2-4 Frequency of local complications at IV line site**

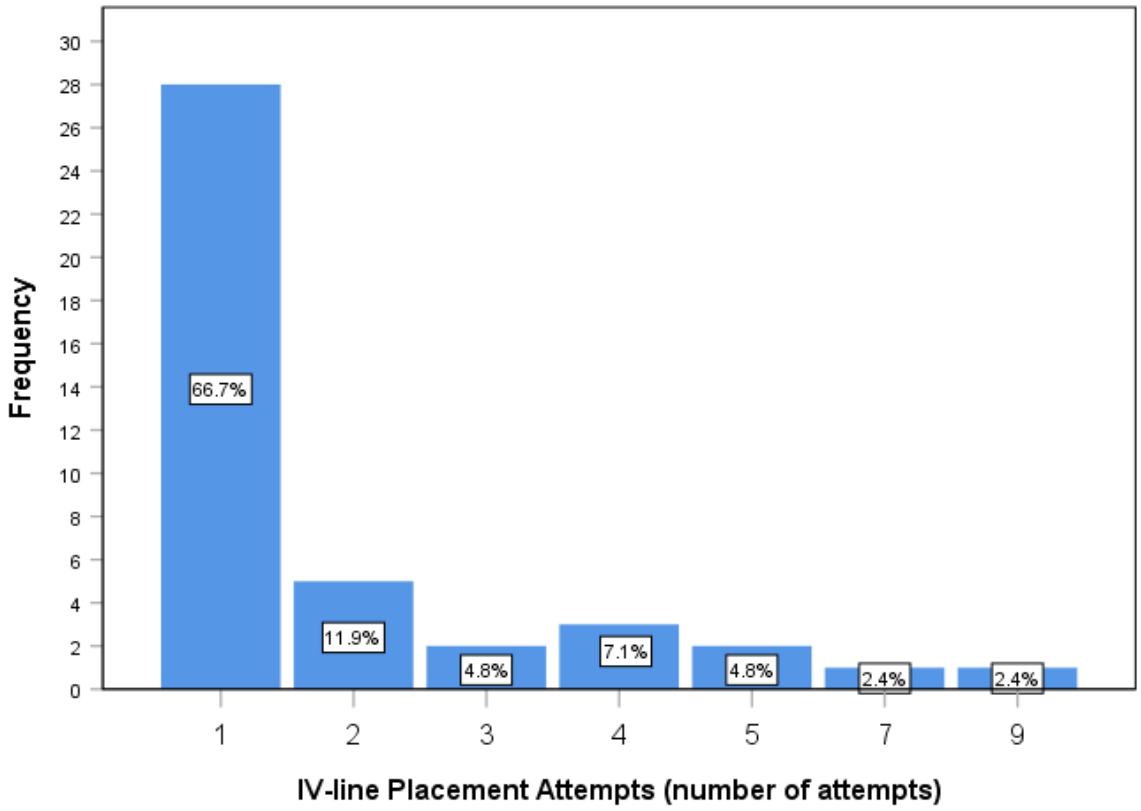


**Figure 2-5 Number of attempts to obtain successful IV access**

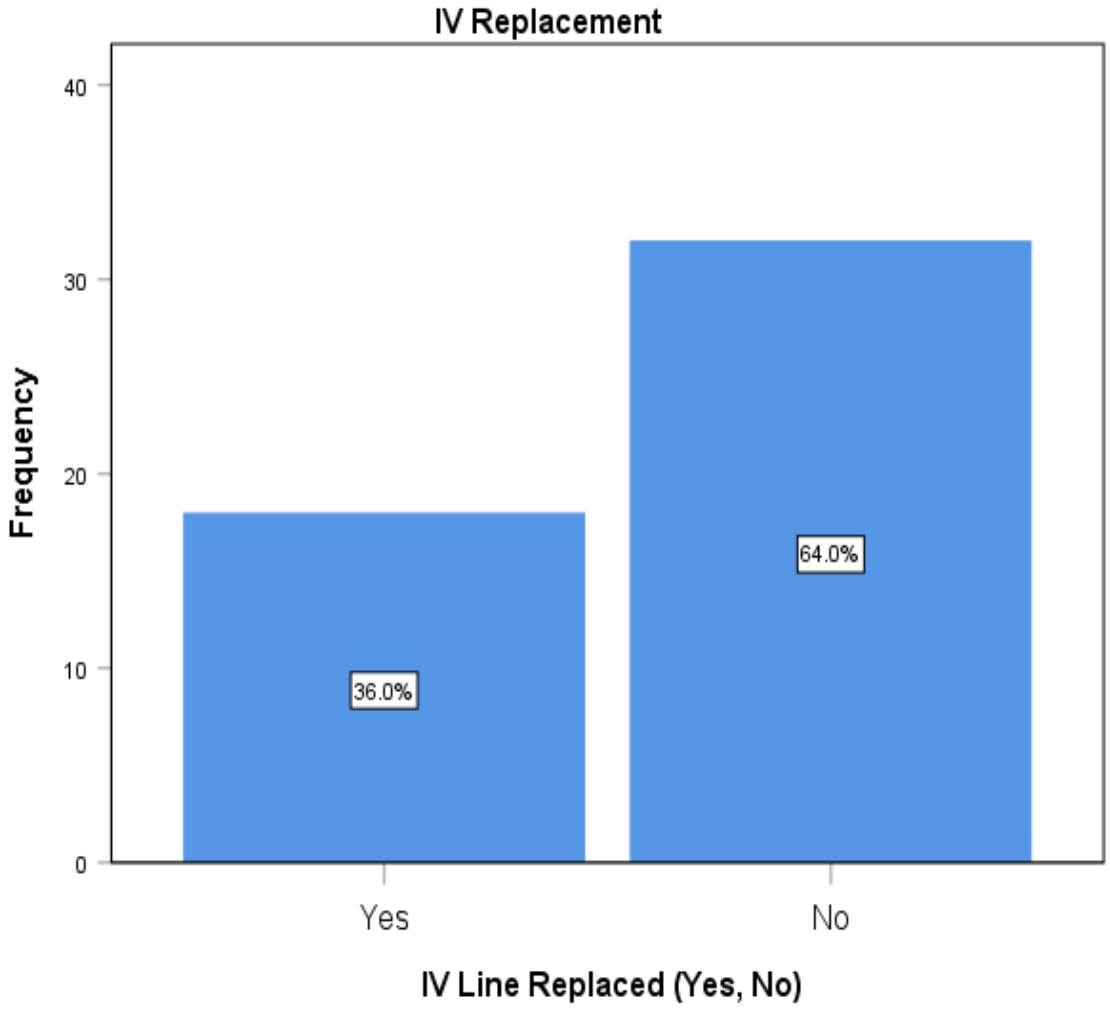


**Figure 2-6 Overall frequency of IV line replacement**

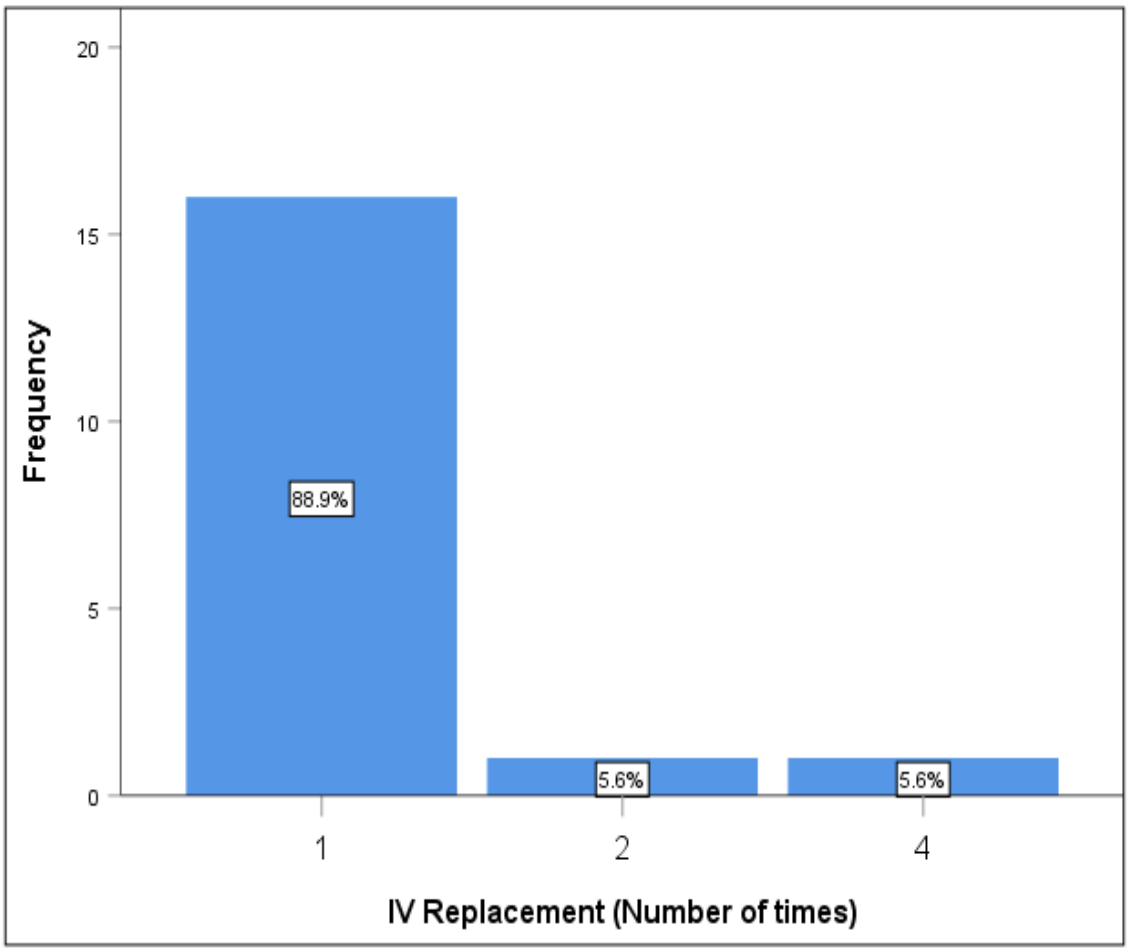


**Figure 2-7 Frequency of IV line replacement in individual cases**

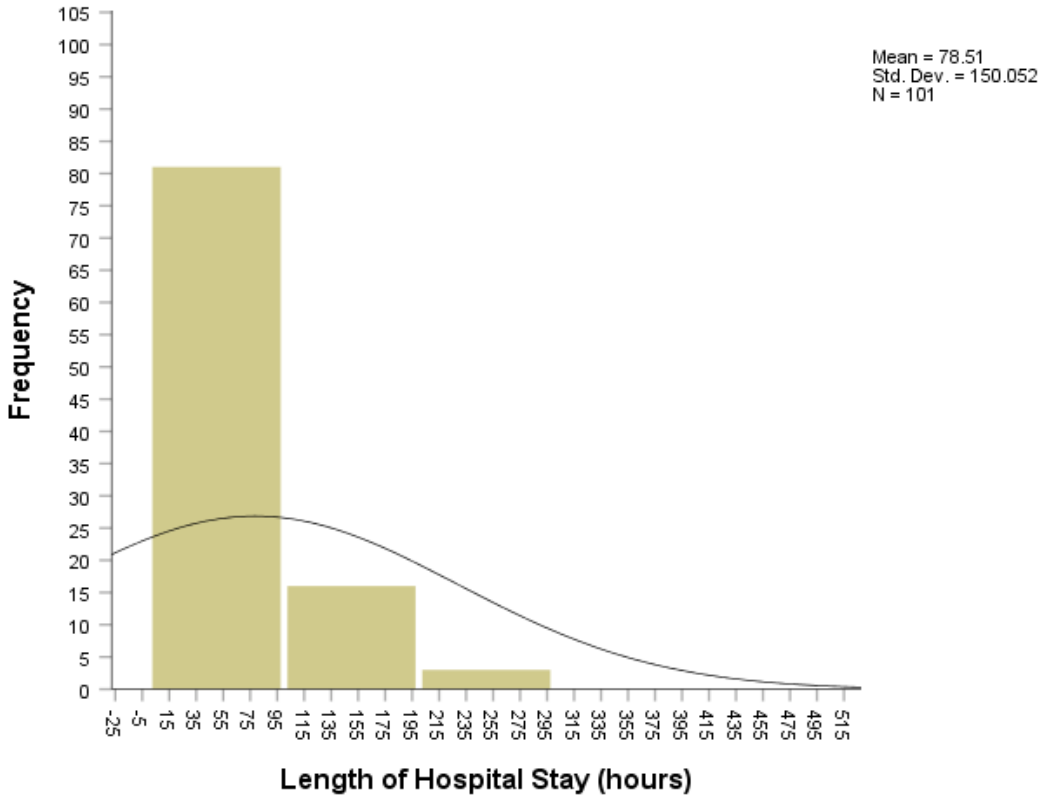


**Figure 2-8 Total length of hospital stay**

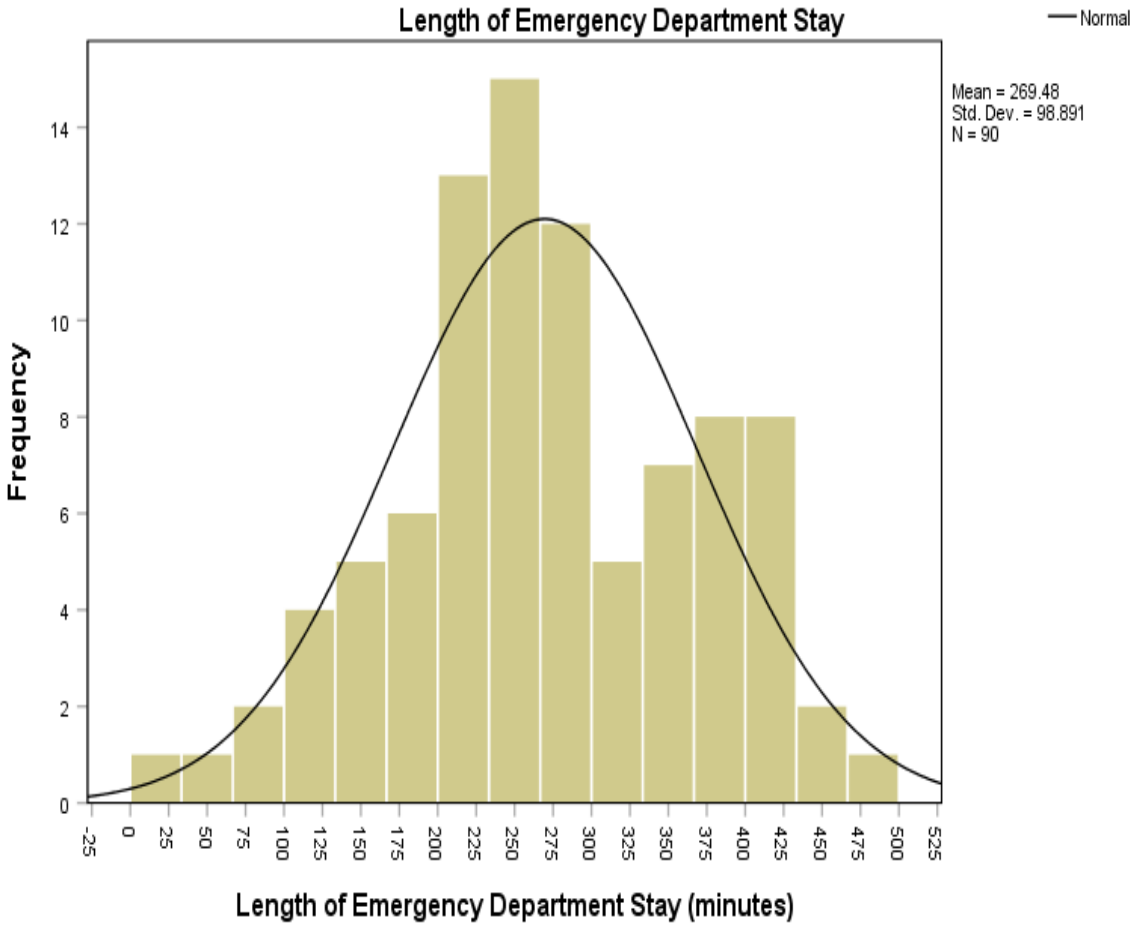


**Figure 2-9 Length of ED stay**

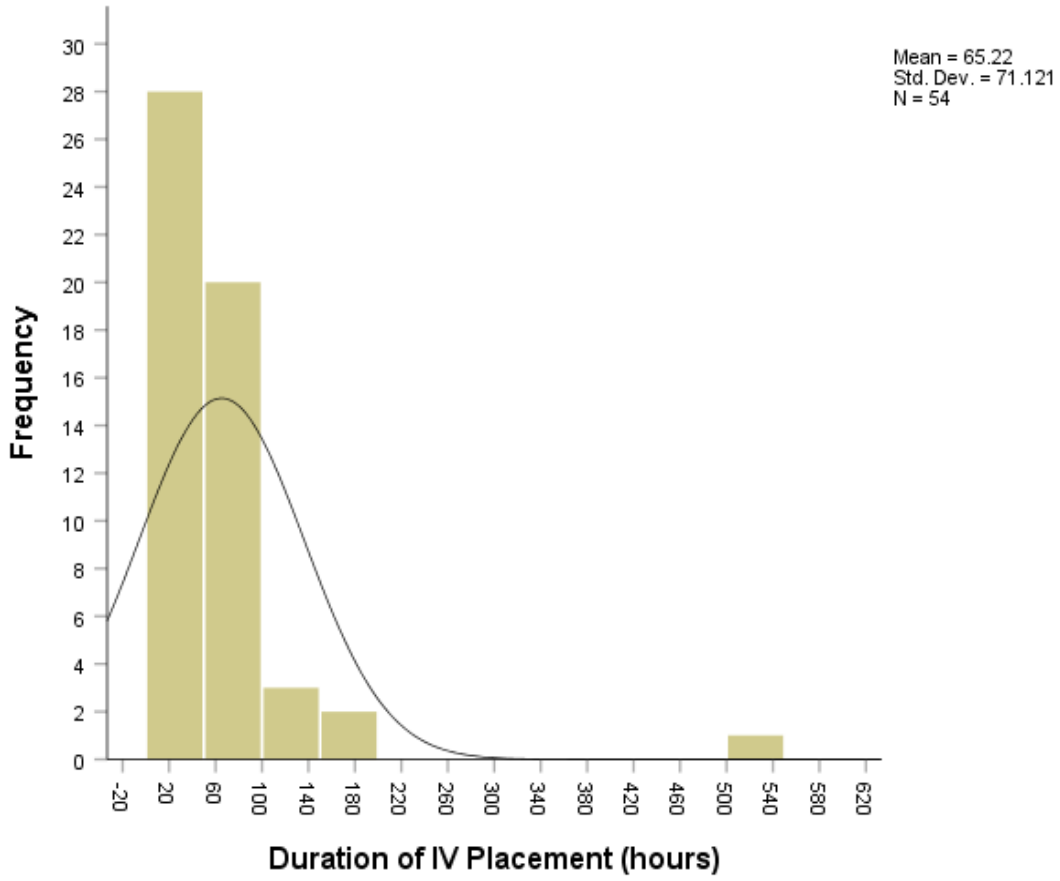


**Figure 2-10 Duration of IV line placement**

# Chapter 3 Surveys

## Chapter 3.1 Parental Surveys

### Chapter 3.1.1 Study Population

Surveys were mailed out to the parents of the infants who had an IV line placed and were given IV fluids for hydration during their course of admission at Janeway for the two-year study period.

### Chapter 3.1.2 Study Outcomes

The following outcomes addressed the main research question along with primary and secondary hypotheses of this study.

Primary Outcome

The primary outcome was the proportion of parents who would consider NG hydration as an alternative to IV hydration if suggested by their treating pediatrician in cases of multiple unsuccessful attempts at IV placement.

The secondary outcomes were as follows:

1. The proportion of parents of infants (younger than six months of age at the time of admission) who would consider NG hydration as an alternative to IV hydration if suggested by their pediatrician.
2. Parents' perspectives on the importance of nutritional value of fluids delivered to their infant (breast milk or formula versus IV fluids).

### Chapter 3.1.3 Sample Size

We hypothesized that at least 30% of the parents would find NG feeding to be an acceptable alternative to IV hydration in case of difficult IV access. Using a power of 0.8 and a type 1 error rate of 0.05, and an estimated true proportion of parents finding this acceptable of 0.5, a sample size of 35 cases was needed. Assuming a 50% response rate, we needed to survey parents of 70 infants. This was determined using the calculator at http://powerandsamplesize.com/Calculators/Test-1-Proportion/1-Sample-1-Sided.

### Chapter 3.1.4 Parental Survey Questionnaire

Surveys were mailed out to parents of infants who were admitted with bronchiolitis to Janeway Children's Hospital from May 1, 2016 to April 31, 2018 and had an IV line placed and were given IV fluids therapy (Appendix D). Parental surveys were identified by the study numbers of the eligible infants. A brief introduction to bronchiolitis and guidelines on management of hydration for those infants who are unable to drink or tolerate oral fluid preceded the survey questions. The NG tube placement was explained by a sketch of an infant. The parents who completed and returned the survey were considered to have consented to participate in the study, and this was clearly printed on the survey.

The survey questionnaire was jointly developed by Dr. Robert Porter and Saima Saqib. Once developed, input was requested from Dr. Kevin Chan (the Co-Clinical Chief (Child) of the Children and Women's Health Program at Eastern Health) and Dr. Rana Aslanova (Research Manager Janeway Pediatrics Research Unit) and from a nurse who was also a parent of a young child. The survey was comprised of four questions with sub-

questions. Parents were requested to record their answer by circling one of the options provided. Depending on the question, the responses were scored as: yes, no, or don't recall; extreme distress, high distress, moderate distress, minimal distress or no distress; extremely likely, very likely, moderately likely, somewhat likely, or not likely at all; very important, important, undecided, unimportant, or very unimportant. The survey questionnaire explored the recollections of the parents with respect to whether the IV insertion was successful on first attempt and whether reinsertion was required as well as the parents' perception of the distress of the child during insertion. It explored parents' receptiveness to NG fluids as an option in different circumstances and also queried their perceptions around the importance of the following factors in choosing a method for hydration: nutrition in the fluids delivered to their infant, discomfort related to insertion and ongoing placement, and success rate for insertion. Parents were also welcomed to write any comments at the end of the survey.

### Chapter 3.1.5 Mail-Out Package for Parental Survey

For parental convenience, the mailout survey package included a self-addressed stamped return envelope for the completed survey. Also, a signed introduction letter about the study and its purpose, from the Co-Clinical Chief (Child) of the Children and Women Health Program, Eastern Health, accompanied the package (Appendix E). This introductory letter reassured the parents/guardians of the confidentiality of their identity through the use of study numbers instead of names or other identifiers. To get an optimal response a reminder survey was mailed out after four weeks to the parents from whom we did not get a response. This reminder parental survey package also included a self-

addressed stamped return envelope and a reminder introduction letter from the Co-Clinical Chief (Appendix F), along with the survey questionnaire.

### Chapter 3.1.6 Parental Survey Data Handling

The completed survey data was transferred from the survey questionnaires into a Microsoft Access (Redmond, Washington) database, which then was exported into IBM SPSS Statistics version 24 (Armonk, New York).

### Chapter 3.1.7 Statistical Analysis

IBM SPSS version 24 (Armonk, New York) was used to do all analysis on the data. This portion of the project produced mostly ordinal data, which was described with proportions. For our primary hypothesis, the ordinal data were dichotomized in order to construct a single proportion with a confidence interval (CI). For our secondary hypothesis, the groups were compared with Mann Whitney U test.

### Chapter 3.1.8 Results

#### Chapter 3.1.8.1 Parental Survey Questionnaire Responses

The parental responses to the survey questionnaire are summarized in Table 3-1. We hoped to survey 70 parents, but we had only 54 eligible cases after completing the detailed chart reviews. A total of 54 surveys were mailed to the parents of infants who had an IV placed and were treated with IV fluids as a method of hydration. The completed survey was returned by 17 parents, for a response rate of 31.5%, lower than anticipated.

Following is a review of the responses of the parents from the survey questionnaire one by one, quoting the questions from the actual parental survey.

***Question 1:***

**“**Our records indicate that your child had an intravenous inserted during an admission for a breathing problem sometime between May 2016 and April 2018. We are interested in your opinion as to the experience of IV access (if your child was admitted more than once, please reflect on the **first** admission for bronchiolitis where an IV was needed)”.

a. Was IV access obtained on the first attempt? (circle one)

The parents had to choose one from options: 1) Yes; 2) No; or 3) Do not recall.

The majority of the parents (76.5%) reported that the IV line was not inserted at first attempt, whereas 17.6% responded that is was successful on first attempt and another 5.6% responded that they did not recall whether it was attained on the first attempt or not.

b. At any time during your visit did the IV have to be reinserted? (circle one)

The parents had to choose one from options: 1) Yes; 2) No; or 3) Do not recall.

More than half of the parents (58.8%) said that the IV line had to be reinserted in their child, with 41.2% not having a reinsertion done.

c. Thinking about when your child first got the IV inserted for this admission, how would you describe your child’s distress from the insertion of the IV? (circle one)

The parents had to choose one from options: 1) Extreme distress; 2) High distress; 3) Moderate distress; 4) Minimal distress; or 5) No distress.

Most of the parents felt it to be quite distressing for their child while having IV line inserted, with a cumulative response of about 65% (35.3% responded as ‘extreme distress’; and 29.4 % as ‘high distress’). Another 17.6 % parents reported their child’s distress to be ‘moderate’. On the other hand, approximately 18% considered the placement of the IV line to be associated with ‘minimal’ distress for their child. Figure 3-1, Figure 3-2 and Figure 3-3 demonstrate the parental responses for question 1.

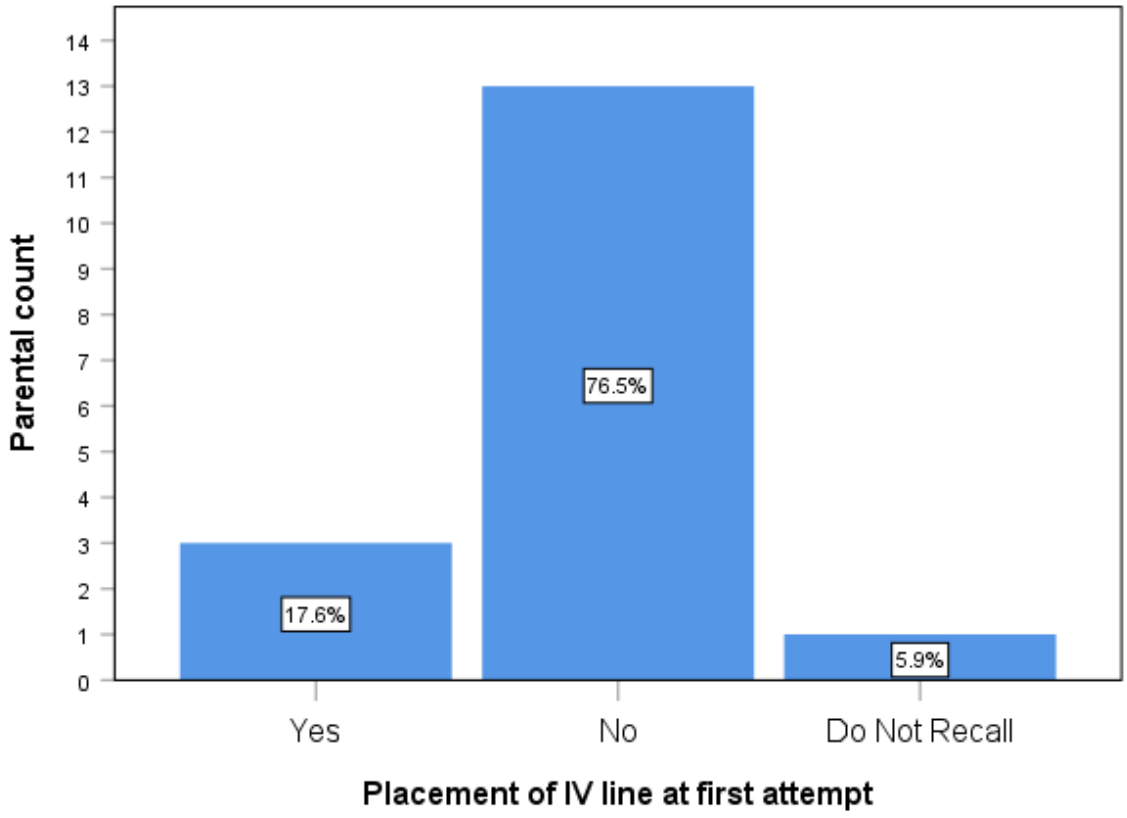


**Figure 3-1 Parental response for IV line placement in first attempt**

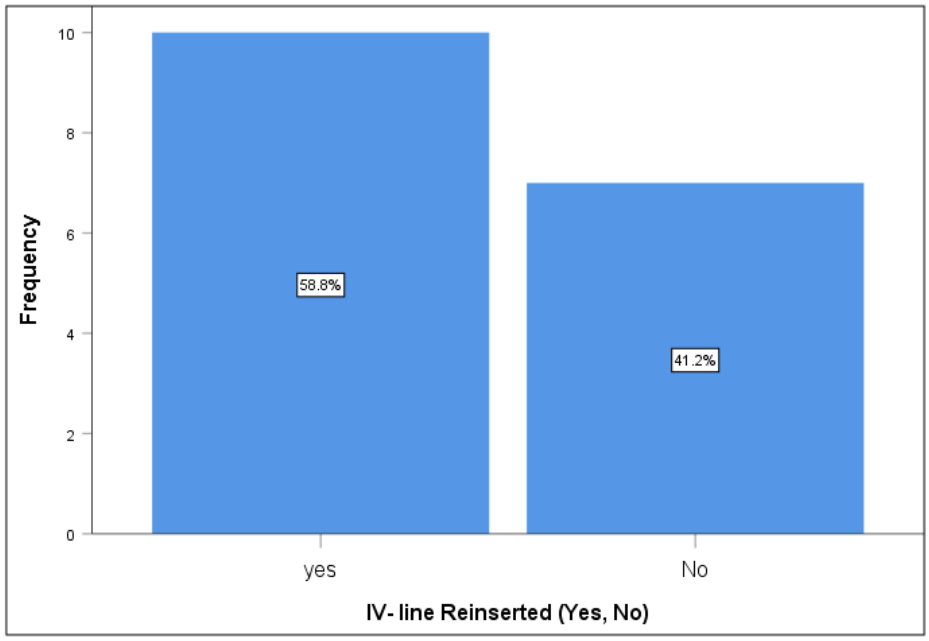


**Figure 3-2 Parental response for IV line reinsertion (Yes or No)**

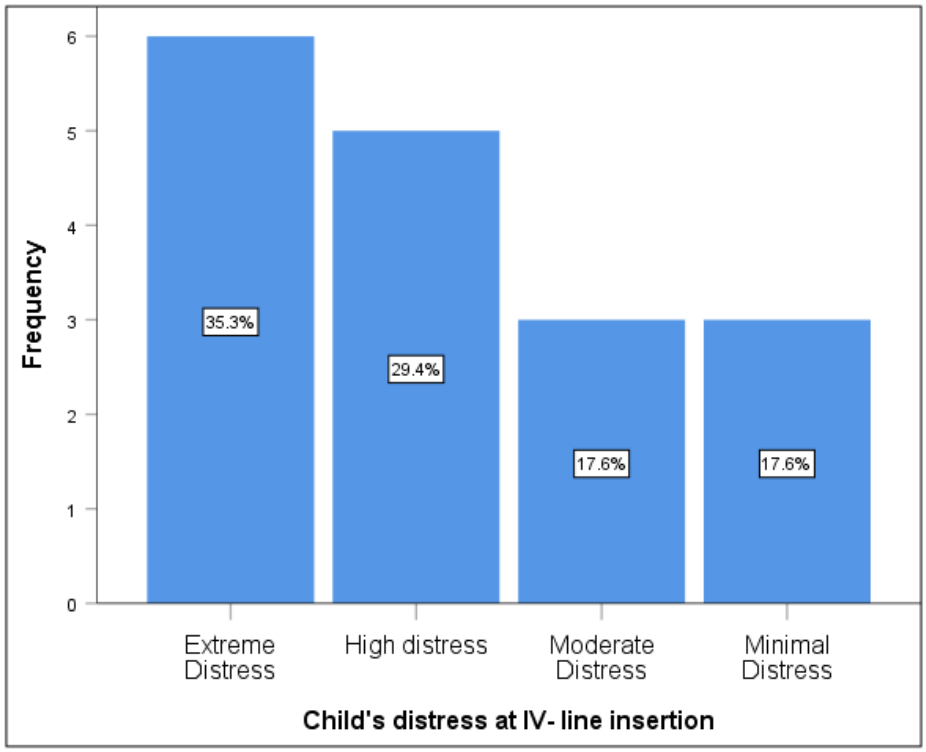


**Figure 3-3 Level of child's distress at IV line insertion as perceived by parents**

***Question 2:***

"If your pediatrician had offered you the option of nasogastric (NG) feeding INSTEAD of IV treatment, would you consider the option? (circle one)"

The parents had to choose one from options: 1) Extremely likely; 2) Very likely; 3) Moderately likely; 4) Somewhat likely; or 5) Not likely at all.

Collectively, one third of the parents would consider NG feeds as an alternative to IV treatment if it were suggested by their pediatrician (29.4% cumulative percent; with 23.5% as 'extremely likely' and 5.9% as 'very likely'). Another one third of the parents

(29.4%) would be ‘moderately likely’ to consider NG feeds as an alternative to IV treatment and 23.5% of the parents chose the response, ‘somewhat likely’. However, 17.6% of the parents chose the option ‘not likely at all’ on consideration of NG feeds over IV fluids as first choice for hydration. Figure 3-4 demonstrates the parents’ response for question 2.

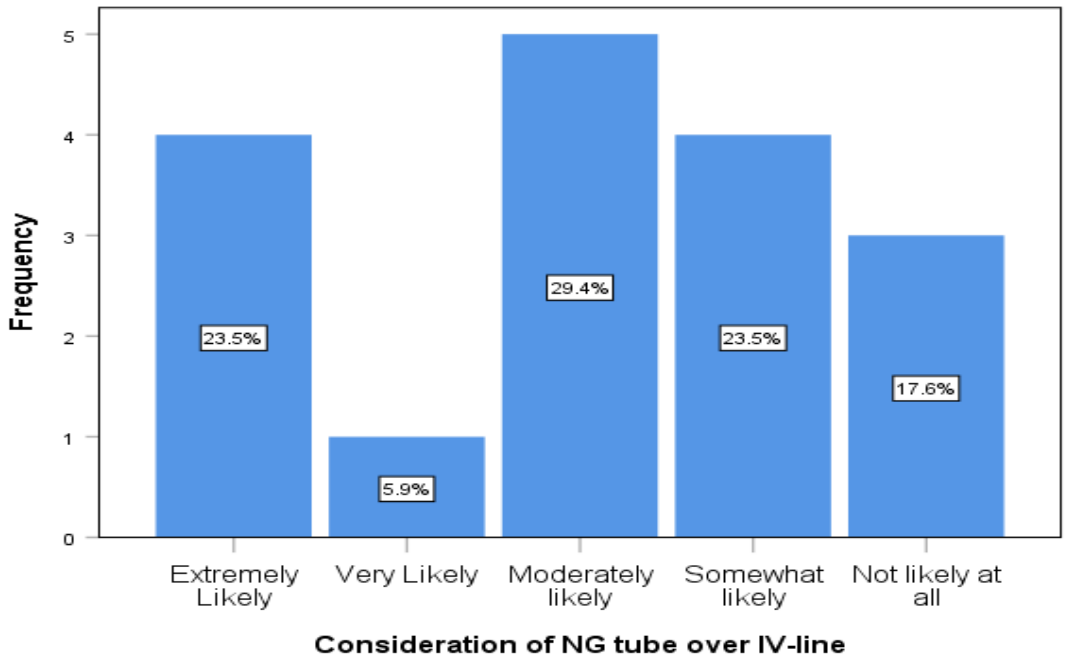


**Figure 3-4 Parental response for considering NG tube over IV**

***Question 3***:

“If your child had more than one unsuccessful attempt at IV access, would you consider NG feeding as an alternative? (circle one)”

The parents had to choose one from options: 1) Extremely likely; 2) Very likely; 3) Moderately likely; 4) Somewhat likely; or 5) Not likely at all.

The parental acceptance of NG feeds as an alternative to IV treatment after more than one unsuccessful attempt at an IV access was high (cumulatively 53%; with 41.2% as ‘extremely likely’ and 11.8 % ‘very likely’). Approximately a quarter of the parents (23.5%) also seems to be quite acceptive of NG feeds with the response of ‘moderately likely’. 17.6% of parents were ‘somewhat likely’ to consider NG feeds after unsuccessful attempts at IV placement for their sick child and a small proportion of the parents (5.9%) chose ‘not likely at all’ when asked whether they would accept NG feeds as an alternative to IV treatments after unsuccessful attempts on attaining an IV access. Figure 3-5 demonstrates the parents’ response for question 3.

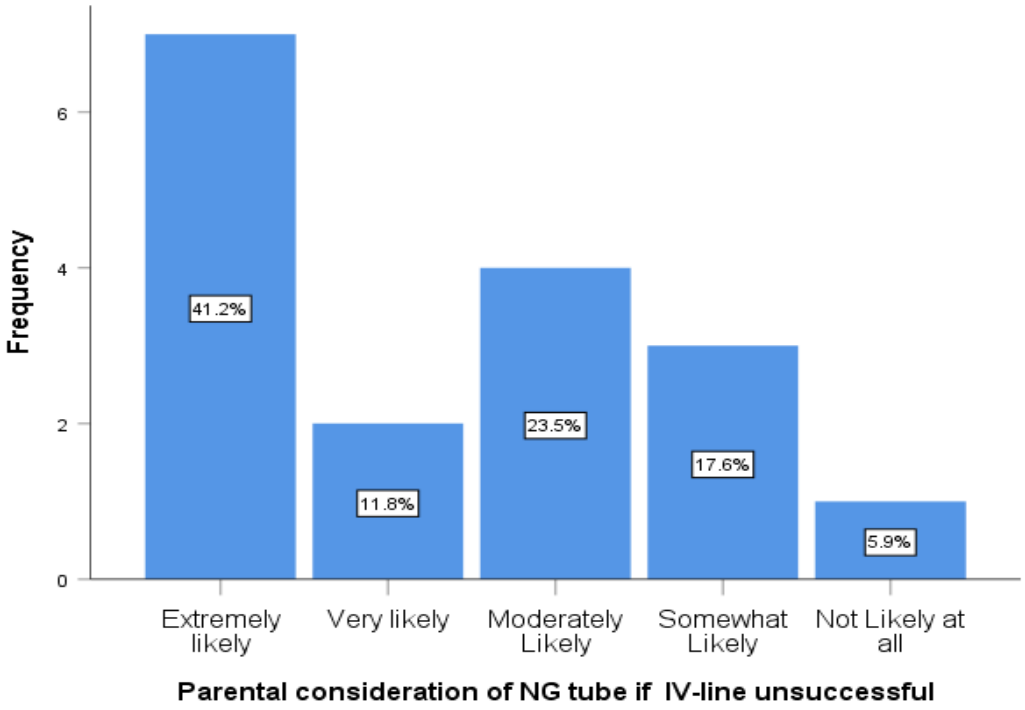


**Figure 3-5 Parental response for considering NG tube over IV in case of > 1 unsuccessful attempt at IV placement**

***Question 4:***

The last question focused on the importance of certain factors from the parent's point of view. Factors explored were: nutrition delivered through either method of hydration; discomfort of insertion and due to ongoing presence of either NG tube or IV line; and success rate of first attempt on either NG tube or IV line. The question was, "In choosing a method for providing fluids to an infant who cannot feed for a few days due to a breathing problem, how would you rate the importance of each of the following?"

a. Nutrition delivered to the baby (breast milk or formula vs. IV fluids).

The parents had to choose one from options:1) Very important; 2) Important; 3) Undecided; 4) Unimportant; or 5) Very unimportant.

Two third of the parents (76.5%) rated nutrition delivered to their child in this situation as 'very important'. The rest of the parents (23.5%) reported nutrition delivered to the baby to be 'important'.

b. Discomfort of insertion of IV or NG tube.

The parents had to choose one from options: 1) Very important; 2) Important; 3) Undecided; 4) Unimportant; or 5) Very unimportant.

More than half of the parents (52.9%) rated the discomfort of insertion of IV or NG tube as 'very important' and 35.3% would rate as 'important'. Only a small proportion of the parents would not consider the discomfort of insertion of NG tube or IV line as an important factor ('undecided' for 5.9% and 'unimportant' for 5.9%).

c. Discomfort due to the ongoing presence of an IV or NG tube.

The parents had to choose one from options: 1) Very important; 2) Important; 3) Undecided; 4) Unimportant; or 5) Very unimportant.

More than half of the parents (52.9%) would rate the discomfort of the ongoing presence of IV or NG tube as ‘very important’ and 35.3% would rate it as ‘important’ to them. Only a small proportion of the parents would not consider the discomfort of ongoing presence of NG tube or IV line as an important factor (‘undecided’ for 5.9% and ‘unimportant’ for 5.9%).

d. Success rate of first attempt (either IV or NG tube insertion).

The parents had to choose one from options:1) Very important; 2) Important; 3) Undecided; 4) Unimportant; or 5) Very unimportant.

The success rate of first attempt at either NG tube or IV line placement was an important factor for the parents, with 64.7% responding with ‘very important’ with 35.3% rating it as ‘important’. Figure 3-6, Figure 3-7, Figure 3-8, Figure 3-9 demonstrate the parents’ responses for question 4.

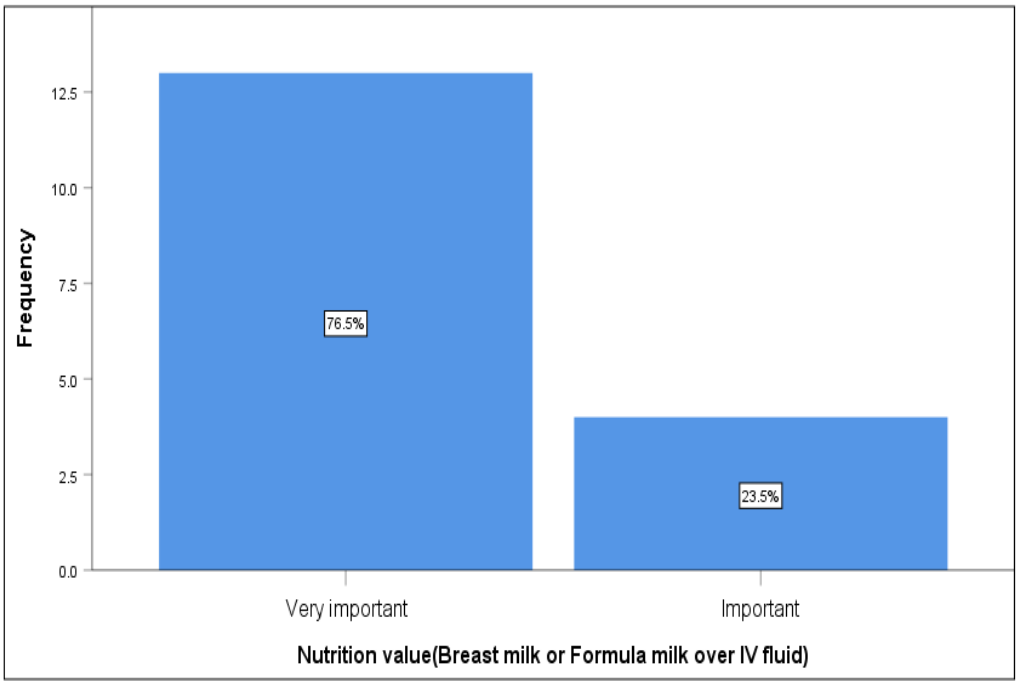


**Figure 3-6 Parental response for importance of nutrition delivered to baby (breast milk or formula versus IV fluids)**

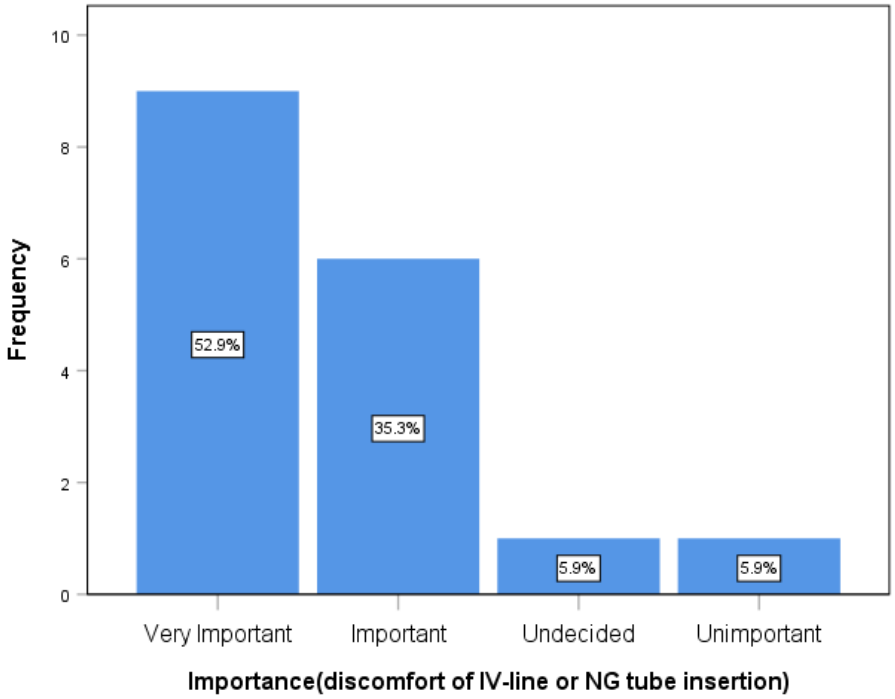


**Figure 3-7 Parental response on importance of discomfort of insertion of IV or NG tube**

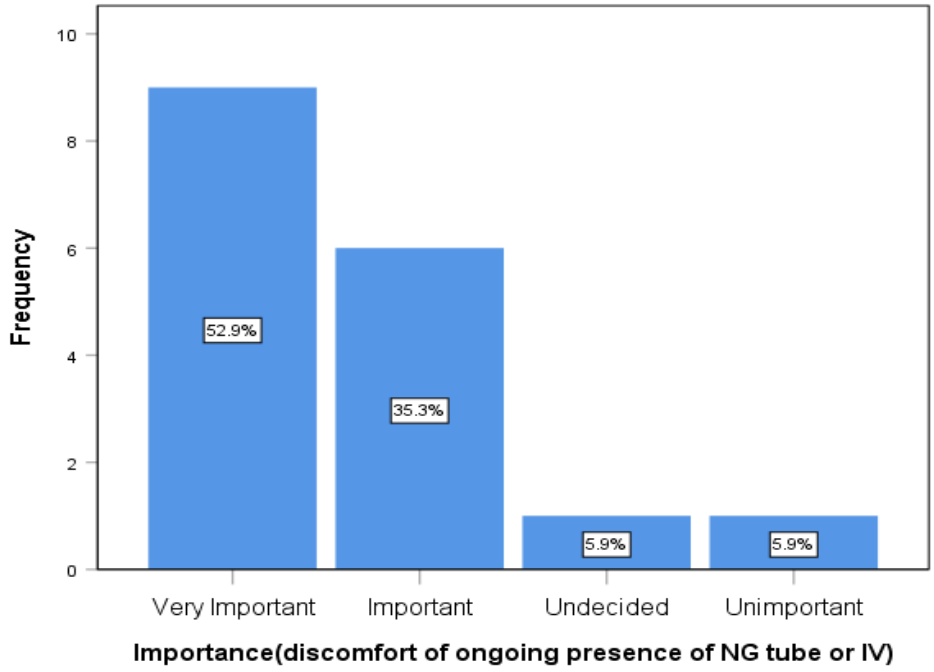


**Figure 3-8 Parental response on importance of discomfort of ongoing presence of IV line or NG tube**

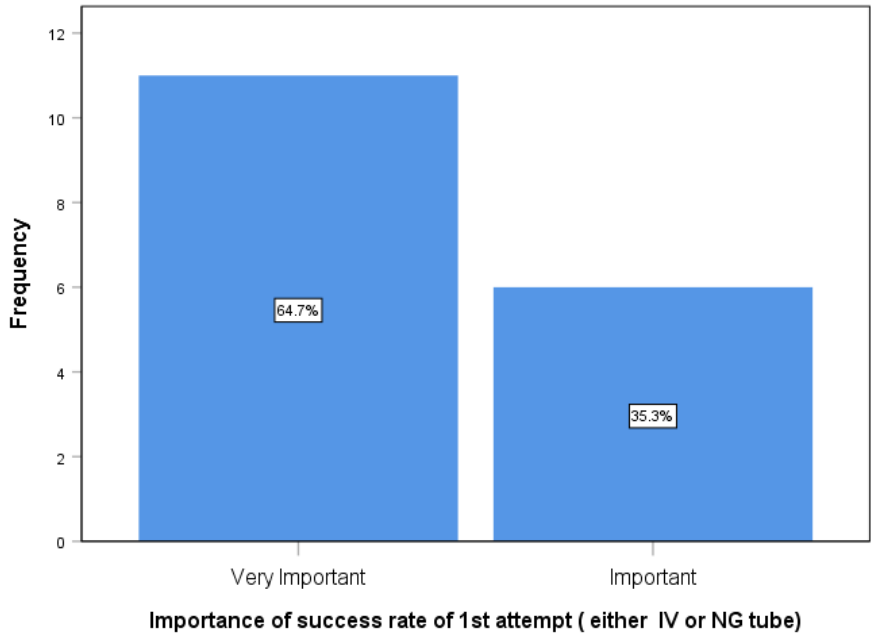


**Figure 3-9 Parental response on importance of success rate of first attempt (either IV or NG tube)**

### Chapter 3.1.8.2 Comments of the Parents from Survey

This section will quote the comments that some of the parents/guardians who completed the survey wrote at the end the survey. Most of the comments left by the parents/guardians reflected the discomfort and mental stress that they experienced while having seen their sick child going through pain or distress with IV line placement. One comment referred to perceived different levels of skill among different groups of HCPs when it came to IV insertion. In particular, NICU nurses were thought to be more experienced at IV line placement than ED or ward nurses by parent-A, who commented, “If antibiotics are required, isn't an IV still needed? NICU nurses were requested for IV; they are more experienced than emergency or ward nurses”. This parent was also raising a question about need of IV line if antibiotics are required otherwise. One parent

commented on nasal discomfort due to the presence of an NG tube as being important. This parent, parent-B, said, “While it was difficult to deal with IV, I feel I would be hesitant if there was ongoing nasal discomfort for NG”. Parent-C said that, “IV insertion was for IV antibiotics”.

Adding to the stress of parents whose children in respiratory distress are admitted to the hospital is the stress of observing their infant undergo a painful invasive procedure, such as IV cannulation. This experience was shared by a parent-D, who said, “It was traumatizing for her and me. It took so long for IV insertion and when it came out, it had to be reinserted”. Another participant, parent-E, expressed a similar sentiment related to observing his child going through IV cannulation by saying, “IV was inserted after so many attempts (hands, feet and finally successful on head), high distress for me and him”. A very unpleasant experience was depicted in a comment from one of the parents, who said, “took 16 attempts to get IV into my 3-month-old. I definitely would have wanted NG after that experience”. Having your child in respiratory distress and agitation, then seeing your child going through painful IV cannulation procedure could lead to a distressed state of mind in a parent too, as reflected in a comment of parent-F, who wrote, “Very difficult to recall, as I myself was distressed and sleep deprived”. An NG tube is also uncomfortable but is less invasive and more reliably accomplished, as one parent-G, shared by saying, “Watching premature twin without any discomfort while on NG more satisfying. IV cause scarring and discomfort”.

A parent who may have an infant with multiple hospital admissions due to any condition and had exposure to IV cannulation procedure might be comfortable with an IV

line placement, as parent-H, wrote, “Always prefers IV over NG, as this patient does not like NG. Overall attitude is much better with IV”. It can be very satisfying for a mother to be able to breastfeed her sick child, as is evident from the parental survey response in the section on importance of nutrition delivered through breast milk or formula milk. Representative of this satisfaction is a comment left by a parent-I, saying, “Infant was able to breastfeed while using IV”. A positive attitude towards considering NG tube as an alternative to IV fluids is also shown, where a parent- J, expressed in her comment that, “I would have chosen whatever methods ensured that my child was fed. I was able to breastfeed. If I wasn’t, I would prefer NG feed with breast milk as my first choice.” Another parent also seemed concerned about poking the child again in case of IV reinsertion as the parent- K said, “Don’t feel IV was uncomfortable while inserted. Fact that IV had to be reinserted, causing discomfort again”.

**Chapter 3.1.8.3 Outcomes**

a. Primary outcome

The proportion of parents considering of NG feeds as alternative to IV treatment after more than one unsuccessful attempt at an IV access was defined for the sake of this study as those rating ‘extremely likely’ or ‘very likely’. This proportion was 53.0% (41.2% ‘extremely likely’ and 11.8 % ‘very likely’) with a 95% confidence interval (CI) of (26.5, 79.4) (Figure 3-10).

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Parents Accepting NG | 17 | 100.0% | 0 | 0.0% | 17 | 100.0% |

**Descriptives**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| Parents Accepting NG | Mean | | .5294 | .12478 |
| | 95% Confidence Interval for Mean | Lower Bound | .2649 | |
| | | Upper Bound | .7939 | |
| | 5% Trimmed Mean | | .5327 | |
| | Median | | 1.0000 | |
| | Variance | | .265 | |
| | Std. Deviation | | .51450 | |
| | Minimum | | .00 | |
| | Maximum | | 1.00 | |
| | Range | | 1.00 | |
| | Interquartile Range | | 1.00 | |
| | Skewness | | -.130 | .550 |
| | Kurtosis | | -2.267 | 1.063 |

**Figure 3-10 Parents' acceptance for NG hydration**

b. Secondary outcome

Out of total 17 completed parental surveys, 14 surveys were from the parents of infants who were younger than six months of age at the time of admission. When the responses of parents of these younger infants were analyzed, it was found that more than half of the parents would consider NG tube feeding or NG hydration in case of unsuccessful IV attempts with a cumulative percent of 57% (response as 'extremely likely

for 42.9% and ‘very likely’ for 14.3%). When the data on parental response of infants older than six months (3 parental surveys) was analyzed, it was found that one third (one parent) would consider NG hydration in case of unsuccessful IV attempts if suggested by their doctor (33.3% as extremely likely). However, the difference between two parental groups was not statistically significant when analyzed for Mann Whitney U test (U= 17.5, N1=14, N2=3, p=0.64, 2-tailed significance). Therefore, we can say that, from our data, there is no evidence to support a difference between parents of infants younger than 6 months and parents of infants aged six months to less than one year, with respect to accepting NG feeds as an alternative to IV fluids in case of unsuccessful attempts at attaining at an IV access (Figure 3-11 and Figure 3-12 for proportions and Figure 3-13 for Mann Whitney test).

With respect to parents’ perceptions about the importance of nutrition delivered to the infant via breast milk or formula milk versus IV fluids, 76.5% rated as ‘very important’ and 23.5 % of the parents rated as ‘important’. Thus, there was universal agreement about the importance of nutrition in this setting.

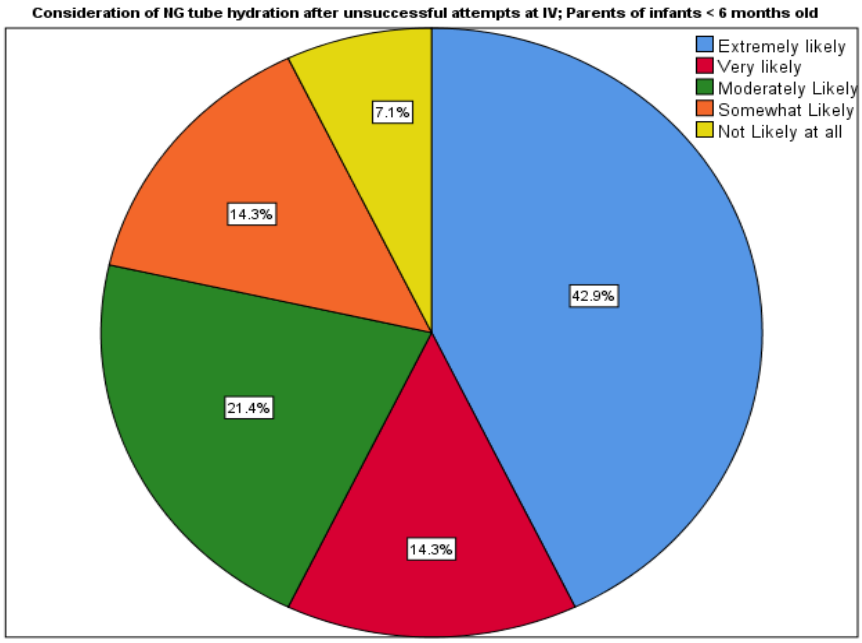


**Figure 3-11 Parental consideration of NG tube feeding after > 1 unsuccessful attempt at IV line placement (infants aged less than 6 months)**

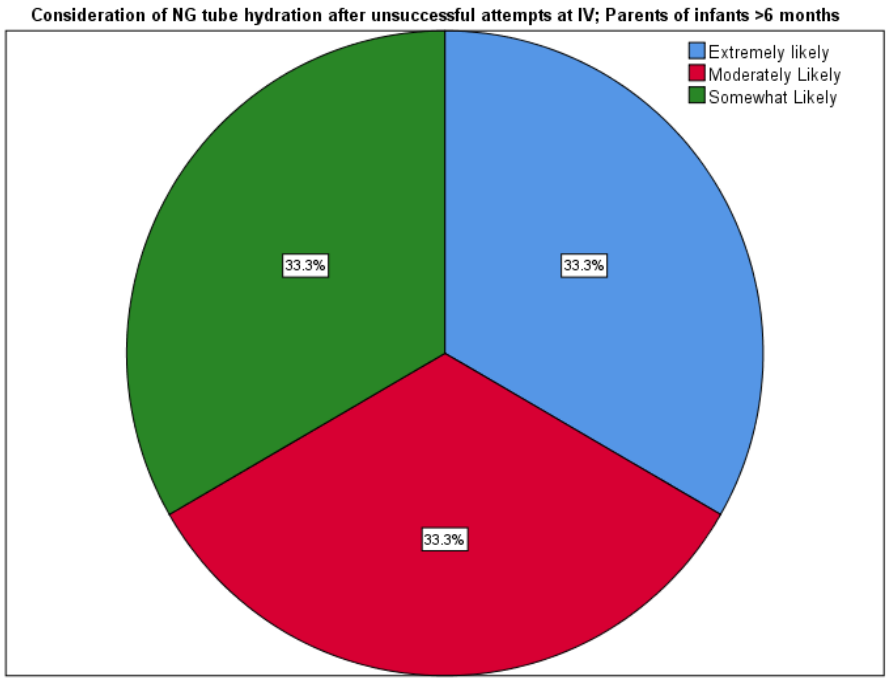


**Figure 3-12 Parental consideration of NG tube feeding after > 1 unsuccessful attempt at IV line placement (infants aged more than 6 months)**

**Descriptive Statistics**

| | N | Mean | Std. Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Parents accepting NG if IV unsuccessful | 17 | 2.35 | 1.367 | 1 | 5 |
| Age | 17 | 1.18 | .393 | 1 | 2 |

## Mann-Whitney Test

**Ranks**

| | Age | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Parents accepting NG if IV unsuccessful | <6m | 14 | 8.75 | 122.50 |
| | >6m | 3 | 10.17 | 30.50 |
| | Total | 17 | | |

**Test Statistics[a]**

| | Parents accepting NG if IV unsuccessful |
|---|---|
| Mann-Whitney U | 17.500 |
| Wilcoxon W | 122.500 |
| Z | -.461 |
| Asymp. Sig. (2-tailed) | .644 |
| Exact Sig. [2*(1-tailed Sig.)] | .676[b] |

a. Grouping Variable: Age

b. Not corrected for ties.

**Figure 3-13 Acceptance of NG hydration (Parents of infants younger than 6 months versus parents of infants aged 6 months to 1 year)**

## Chapter 3.2 HCP (Pediatrician) Surveys

### Chapter 3.2.1 Study Population and Sample Size

The sample for the HCPs (pediatricians) survey included any pediatrician at the Janeway Children's Hospital who agreed to participate, had admitting privileges and had admitted at least one infant with bronchiolitis from May 1, 2016, until the time the surveys were distributed (December 2018). This latter criterion was not confirmed by the investigators; however, it was listed as an inclusion criterion on the survey introductory letter. For the HCPs survey, we hoped to survey approximately 12 to 15 pediatricians and anticipated a high rate of response.

### Chapter 3.2.2 Study Outcomes (Pediatricians Surveys)

The outcomes from the survey portion of the project were designed to address the secondary research question.

Primary Outcome

The primary outcome was the proportion of the HCPs considering NG feeds as an alternative to IV fluids in infants with difficult IV access.

Secondary Outcome

The secondary outcome was the HCPs' perspectives on the importance of the nutritional value of fluids delivered to infant (breast milk or formula versus IV fluids).

### Chapter 3.2.3 HCP (Pediatricians) Survey Questionnaire

The HCPs survey questionnaire was jointly developed by Dr. Robert Porter and Saima Saqib and feedback was requested from a pediatrician (who was not eligible to be

surveyed) in the Child Health Program. Survey questionnaires (Appendix G) were sent to the pediatricians at Janeway as part of a survey package. The sample was identified based on the eligibility as described earlier in section 3.2.1 and a list of Janeway pediatricians. Each survey package included the survey questionnaire, an introduction letter and consent to participate, along with a self-addressed return envelope. The introduction letter explained the purpose of the study along with the contact information of the author and supervisors. The pediatricians were assured of confidentiality of their responses and identity. The pediatricians were considered to have consented to participate if they completed and returned the survey. (See Appendix H for HCPs survey introduction letter and consent to participate). To remove the identifiers, each survey was given a study number. The surveys were comprised of 6 questions with sub-questions. Pediatricians were requested to record their answer by circling one of the options provided. Depending on the question, some responses were scored as: extremely likely; very likely; moderately likely; somewhat likely or not likely at all. Others were scored as: extremely important; very important; moderately important; somewhat important; or not important at all.

The questionnaire was comprised of questions exploring the likelihood of considering NG feeds in a 2 month old infant admitted with wheeze, nasal congestion and mild respiratory distress, either initially or after multiple unsuccessful IV placement attempts; and the likelihood of considering NG feeds in a similar 11 month old with multiple unsuccessful attempts at IV placement. The pediatricians were requested to rate the importance of certain factors in choosing the method for providing fluids to an infant who cannot feed adequately orally due to viral bronchiolitis. Those factors included:

nutritional value of fluids (breast milk or formula versus IV fluids); discomfort due to insertion and on-going presence of IV or NG tube; success rate of first attempt for NG or IV insertion; familiarity with technique of insertion (NG or IV); and the logistics of delivering feeds/fluids to the infant. In response to questions on the levels of discomfort with insertion and maintenance of an NG tube versus an IV line in an infant who is less than 3 months old, the pediatricians were asked to choose one of the following options: NG much more uncomfortable; NG slightly more uncomfortable; about the same; IV slightly more uncomfortable; and IV much more uncomfortable. The questionnaire concluded with an opportunity to communicate comments if desired. The questionnaire response from the pediatricians was directly entered into IBM SPSS Statistics version 24 (Armonk, New York) for analysis.

## Chapter 3.2.4 Results of HCP Surveys

### Chapter 3.2.4.1 Health Care Providers Survey Questionnaire Responses

A total of 15 surveys were mailed to the pediatricians and eight (53.3%) completed surveys were returned. This chapter will discuss the pediatricians' responses to the survey questionnaire from question to question. Table 3-2 summarizes the pediatrician survey questionnaire responses.

***Question 1:***

"A 2-month old infant is admitted with wheeze, nasal congestion and mild respiratory distress. She is not feeding well and needs supplementary fluids. How likely would you

be to consider NG feeds as an option as long as an IV line is not needed for another reason? (circle one)"

The pediatricians had to choose one from options: 1) Extremely likely; 2) Very likely; 3) Moderately likely; 4) Somewhat likely; or 5) Not likely at all.

A varied response was shown from the pediatricians for considering NG tube feeding in a 2-month-old infant admitted with bronchiolitis. One quarter would strongly consider NG tube feeding in such infant ('extremely likely', 25%). About 38% (37.5%) responded they would be 'somewhat likely' to consider an NG tube feeding in a 2-month-old sick infant. There was also 25% of responders said they would be 'not likely at all' to consider NG tube feeding in an infant who does not require an IV line for any other reason besides hydration. Figure 3-14 shows responses for question 1.

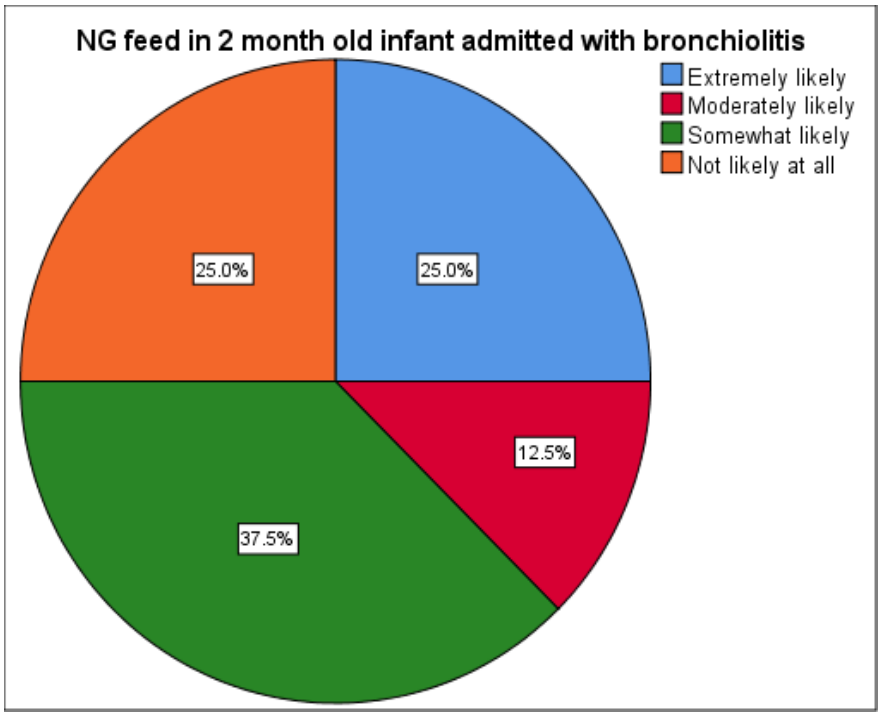


**Figure 3-14 Pediatricians' consideration of NG tube feeding in a 2-month-old infant admitted with bronchiolitis**

***Question 2:***

"If the infant above had 3 unsuccessful attempts at IV insertion, how likely would you be to consider NG feeds as an alternative to further attempts at IV access? (circle one)" The pediatricians had to choose from options: 1) Extremely likely; 2) Very likely; 3) Moderately likely; 4) Somewhat likely; or 5) Not likely at all.

About half of the pediatricians would consider NG tube feeding in a 2 month-old infant who had at least three unsuccessful attempts at an IV line placement (cumulative 50% with 25% 'extremely likely' and 25% 'very likely'). About 38% would be

'somewhat likely' to consider an NG tube feeding after multiple unsuccessful attempts at attaining an IV line. Figure 3-15 shows responses for question 2.

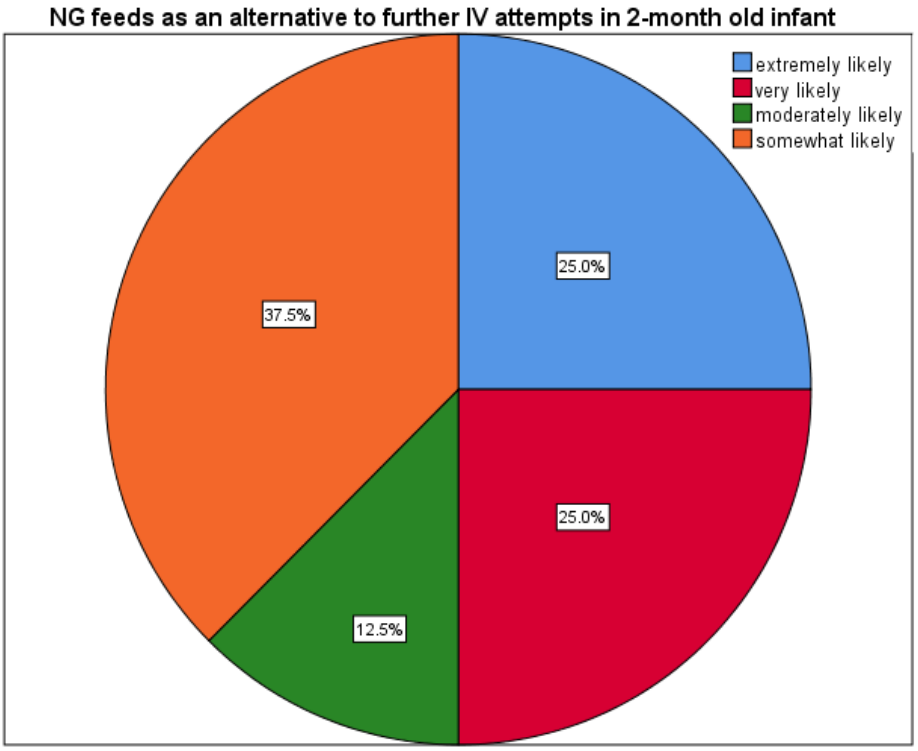


**Figure 3-15 Pediatricians' consideration of NG tube feeding in a 2-month-old infant admitted with bronchiolitis, after three unsuccessful attempts at IV line placement**

***Question 3:***

"If the infant presented in Question 2 (with 3 unsuccessful IV attempts) were an 11 month old, how likely would you be to consider nasogastric feeds as an alternative to further attempts at IV access? (circle one)"

The pediatricians had to choose from options: 1) Extremely likely; 2) Very likely; 3) Moderately likely; Somewhat likely; or 5) Not likely at all.

About half of the pediatricians would consider of NG tube feeding as an alternative to further IV attempts in a 11 month-old infant who had at least three unsuccessful attempts at an IV line placement ( cumulative of 50% with 25 % 'extremely likely' and 25 % 'very likely'). Another about 38% would say 'somewhat likely' to consider NG tube feeding after multiple unsuccessful attempts at attaining an IV line. Figure 3-16 shows responses for question 3.

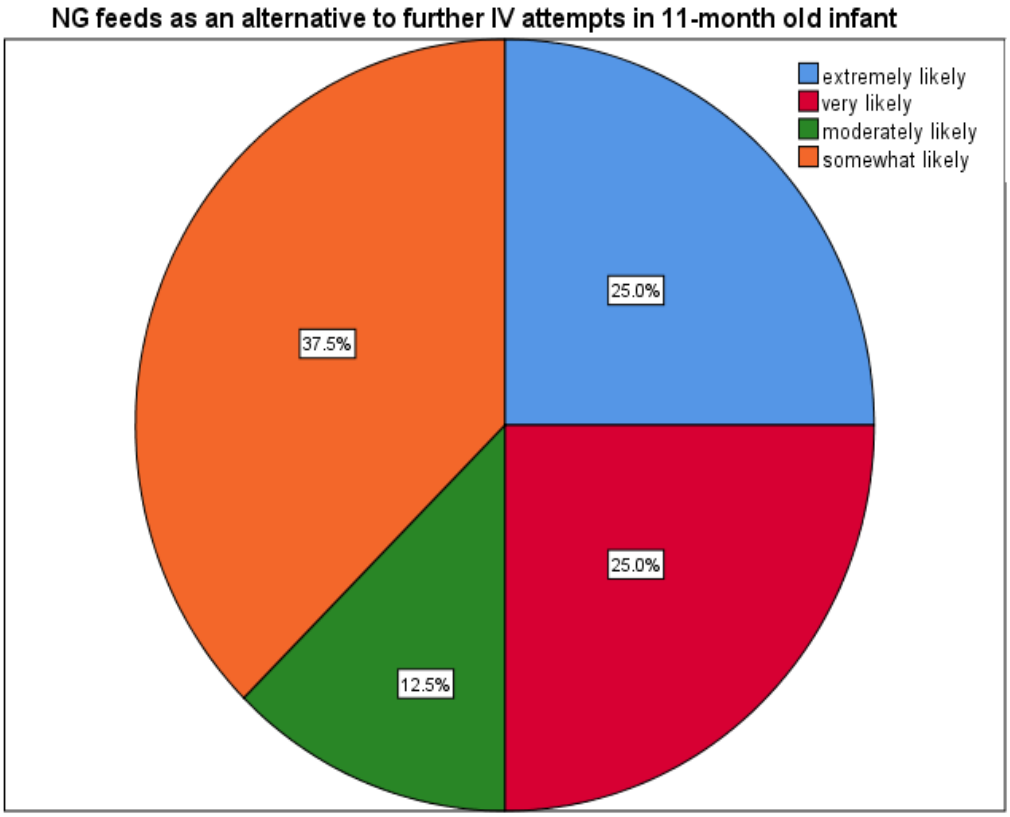


**Figure 3-16 Pediatricians' consideration of NG tube feeding in a 11-month-old infant admitted with bronchiolitis, after three unsuccessful attempts at IV line placement**

***Question 4:***

This question focused on the importance of certain factors from the pediatrician's point of view, such as nutritional value of fluids delivered through either method of hydration, discomfort of insertion and due to ongoing presence of either NG tube or IV line, success rate of first attempt on either NG tube or IV line, familiarity with technique of insertion, and, finally, the familiarity with logistics of delivering fluids or feeds. Figures 3-17 through 3-22 show responses for question 4.

"In choosing a method for providing fluids to an infant who cannot feed for a few days due to viral bronchiolitis, how would you rate the importance of the following factors? "

a. Nutritional value of fluid delivered to the baby (breast milk or formula vs. intravenous fluids)? (circle one)

The options listed were: 1) Extremely important; 2) Very important; 3) Moderately important; 4) Somewhat important; or 5) Not important at all.

Nutritional value of the fluid delivered to an infant proved to be of high importance from pediatricians' point of view as 25% responded, 'extremely important' and about 38% said 'very important'. Only a small proportion would not consider it as an important factor for an infant (12.5 % as 'not important at all').

b. Discomfort of insertion of IV or NG tube? (circle one)

The options listed were: 1) Extremely important; 2) Very important; 3) Moderately important; 4) Somewhat important; or 5) Not important at all.

Approximately 38% responded that discomfort of insertion of NG tube or an IV line is 'very important', 25% would consider it as 'moderately important' and another 25%

would consider it ‘somewhat important’. Only a small proportion would not consider it as an important factor for an infant (12.5 % as ‘not important at all’).

c. Discomfort due to ongoing presence of an IV or NG tube? (circle one)

The options listed were: 1) Extremely important; 2) Very important; 3) Moderately important; 4) Somewhat important; or 5) Not important at all.

Fifty percent of the pediatricians considered the discomfort of the ongoing presence of an IV or NG tube as ‘somewhat important’, 25% rated this factor as ‘moderately important’ and 12.5% rated it as ‘very important’. On the other hand, a small proportion would not consider it as an important factor for an infant (12.5 % as ‘not important at all’).

d. Success rate of first attempt (either IV or NG tube insertion)? (circle one)

The options listed were: 1) Extremely important; 2) Very important; 3) Moderately important; 4) Somewhat important; or 5) Not important at all.

Twenty five percent of the pediatricians considered the success rate at first attempt for NG tube or an IV line insertion as very important factor in the infant. Fifty percent would consider it as ‘moderately important’ and another 25% considered it to be ‘somewhat important’.

e. Familiarity with technique of insertion? (circle one)

The options listed were: 1) Extremely important; 2) Very important; 3) Moderately important; 4) Somewhat important; or 5) Not important at all.

A cumulative sum of 50% of pediatricians thought that familiarity with the technique of insertion of either an NG tube or an IV line is of high importance (37.5% as ‘very

important and 12.5% as ‘extremely important’). Approximately 38% indicated that familiarity with the technique of insertion is ‘moderately important’.

f. Familiarity with logistics of delivering fluids/feeds? (circle one)

The options listed were: 1) Extremely important; 2) Very important; 3) Moderately important; 4) Somewhat important; or 5) Not important at all.

Most of the pediatricians thought that the familiarity with the logistics of delivering fluids or feeds is of high importance (50% as ‘very important and 12.5% as ‘extremely important’). However, 12.5% would consider this factor as ‘moderately important’, 12.5% as ‘somewhat important’ and 12.5% as’ not important at all’.

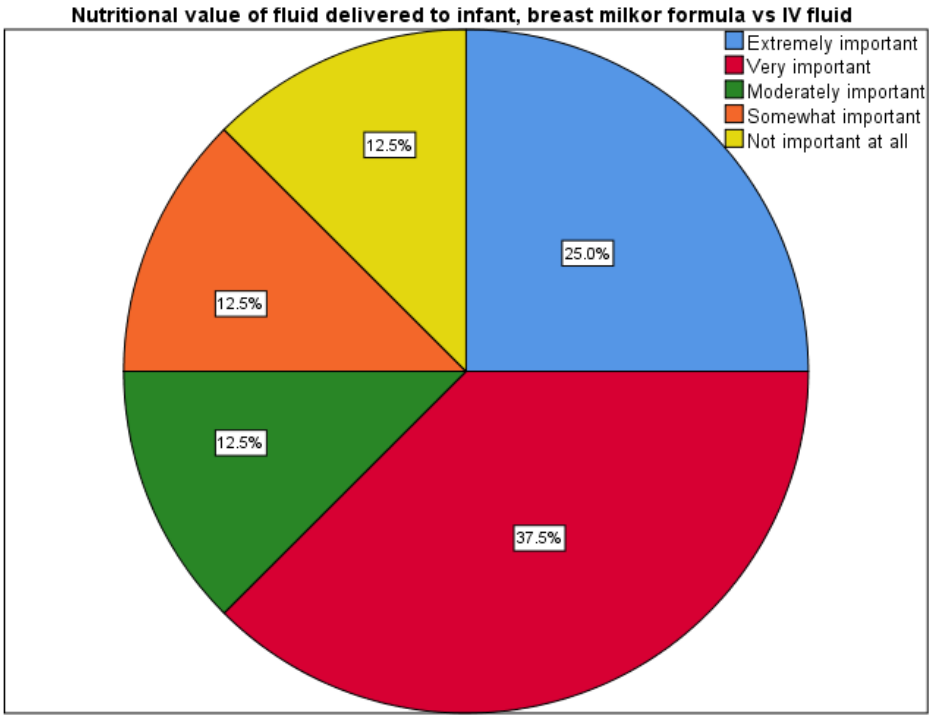


**Figure 3-17 Pediatricians’ rating of the importance of nutritional value of fluids delivered to baby (breast milk or formula versus IV fluids)**

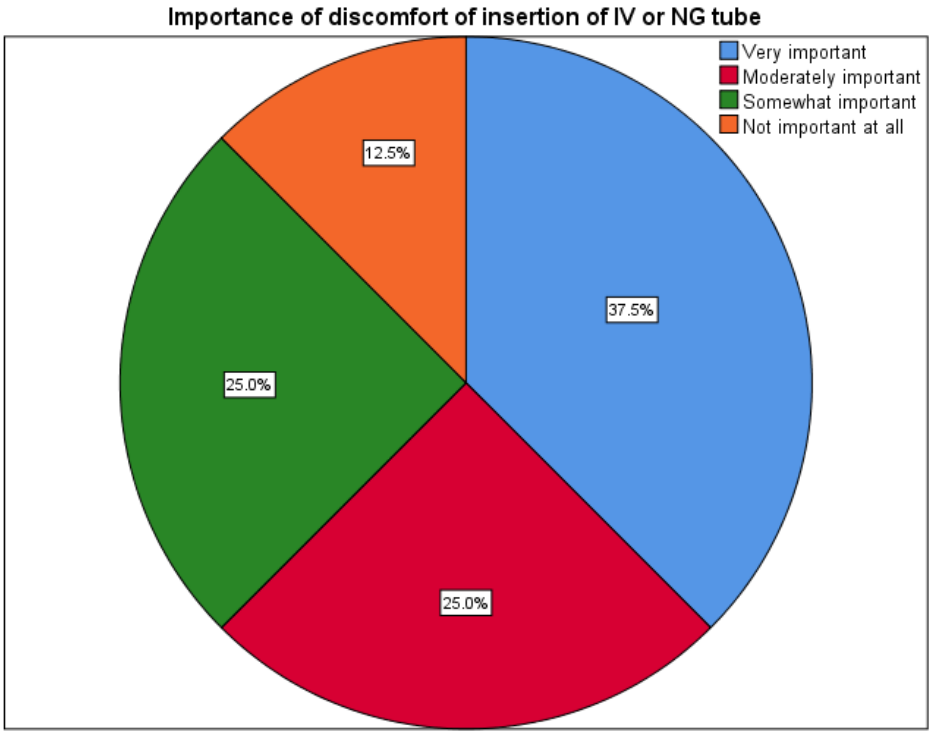


**Figure 3-18 Pediatricians' rating of the importance of discomfort of IV line or NG tube insertion**

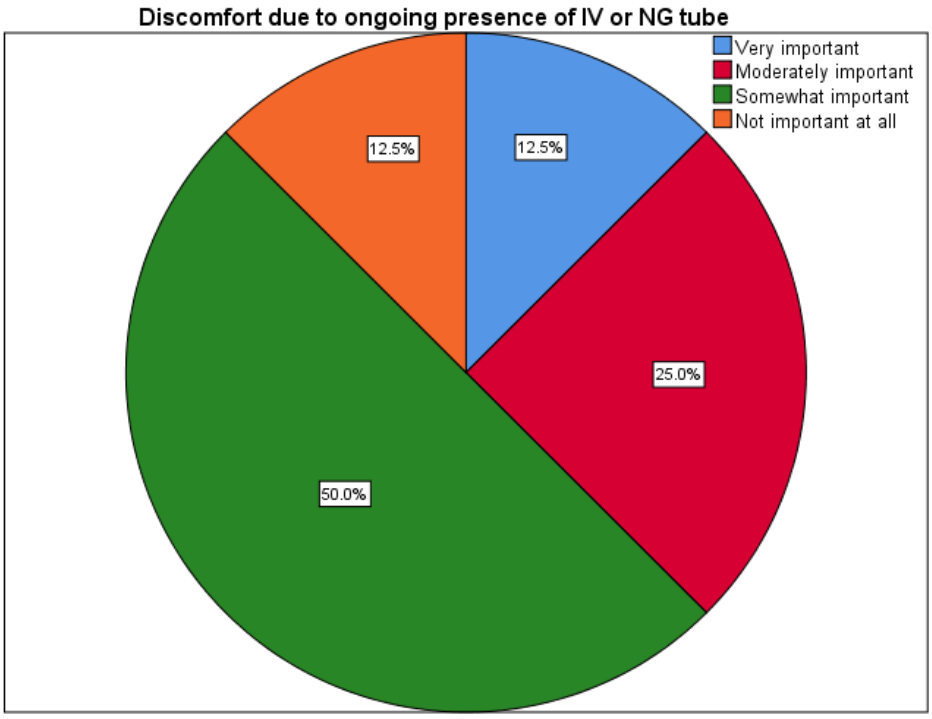


**Figure 3-19 Pediatricians' rating of the importance of discomfort due to ongoing presence of IV line or NG tube**

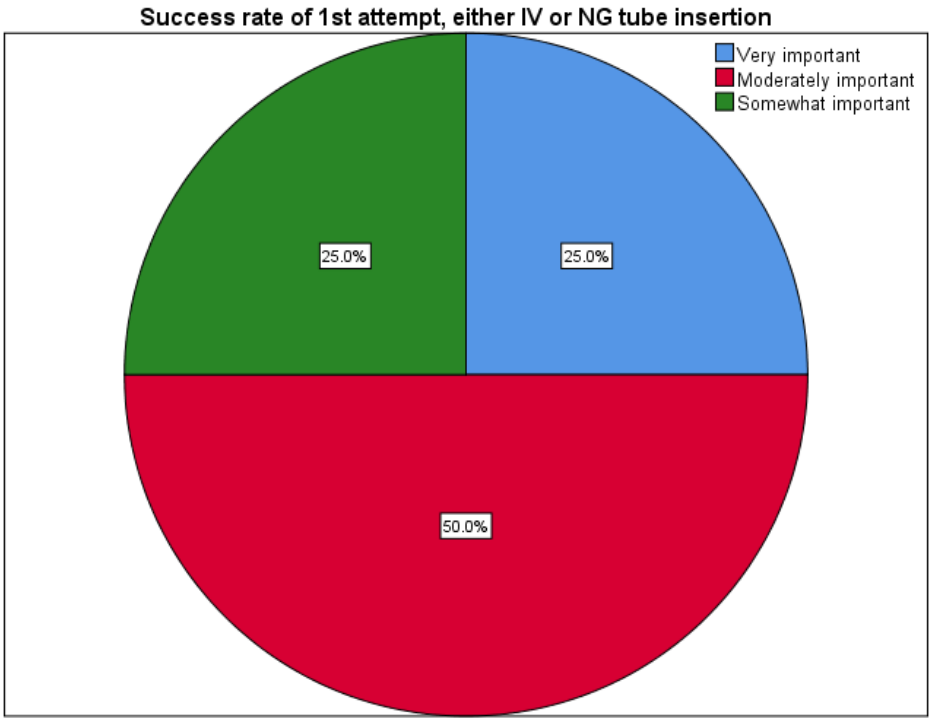


**Figure 3-20 Pediatricians' rating of the importance of success at first attempt (either IV line or NG tube insertion)**

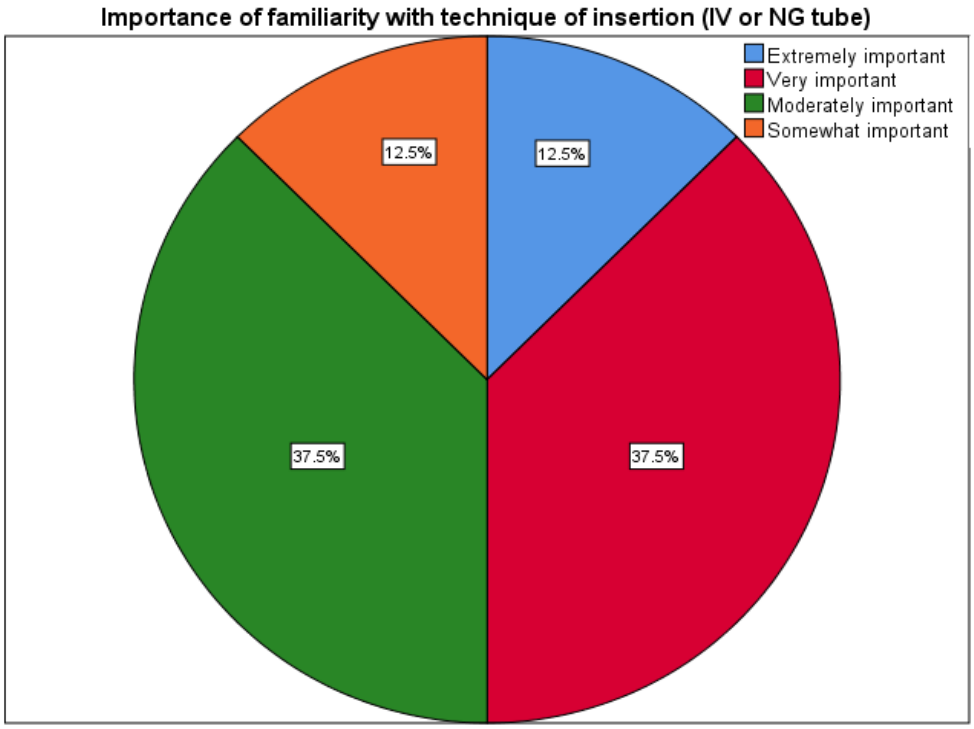


**Figure 3-21 Pediatricians' rating of the importance of familiarity with technique of insertion (either IV line or NG tube insertion)**

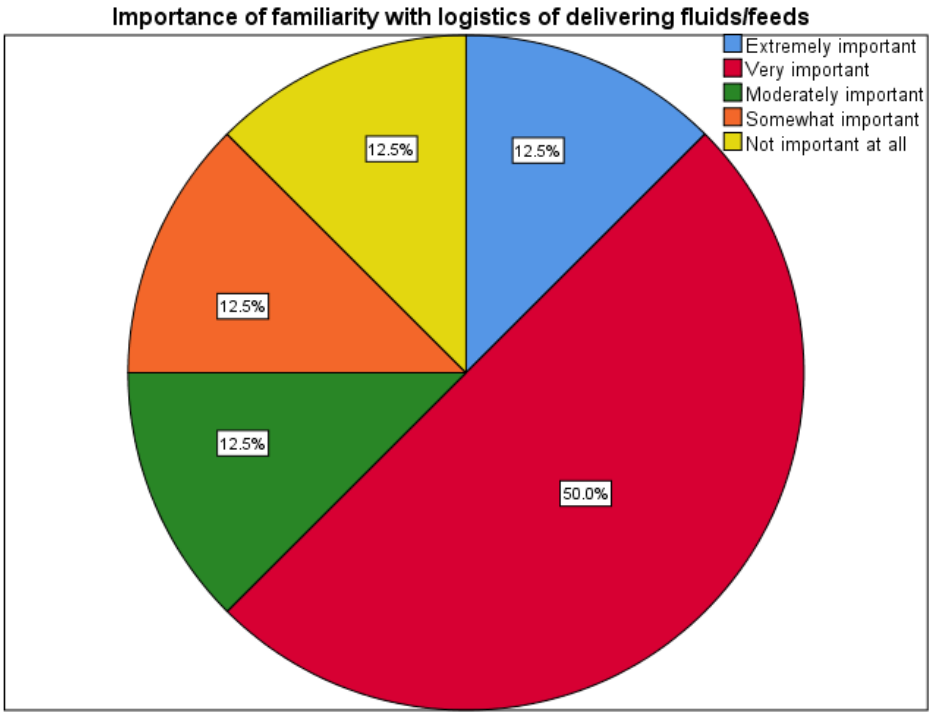


**Figure 3-22 Pediatricians' rating of the importance of familiarity with logistics of delivering fluids/feeds**

***Question 5:***

"How would you rate the discomfort of insertion of an NG tube in an infant less than 3 months old compared to an IV line? (circle one)"

The options listed were: 1) NG much more uncomfortable; 2) NG slightly more uncomfortable; 3) About the same; 4) IV slightly more uncomfortable; or 5) IV much more uncomfortable.

Most of the pediatricians were of the view that discomfort due to insertion of an NG tube as compared to an IV line, in an infant younger than 3-months old would be about

the same (87.5%). Only 12.5% said it as ‘IV slightly more uncomfortable’ as compared to an NG tube. Figure 3-23 shows responses for question 5.

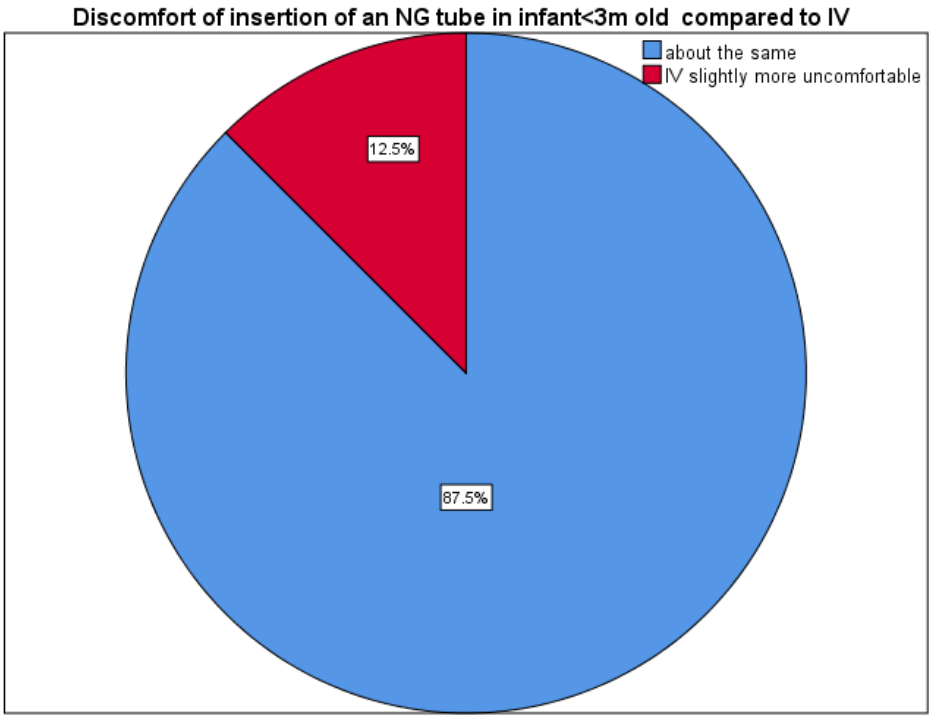


**Figure 3-23 Pediatricians rating of the discomfort of insertion of an NG tube versus an IV line in infant less than 3 months old**

***Question 6:***

“How would you rate the discomfort of maintenance of an NG tube in an infant less than 3 months old compared to an IV line? (circle one)”

The options listed were: 1) NG much more uncomfortable; 2) NG slightly more uncomfortable; 3) About the same; 4) IV slightly more uncomfortable; or 5) IV much more uncomfortable.

Seventy five percent of the pediatricians were of the view that discomfort due to maintenance of an NG tube as compared to an IV line, in an infant younger than 3-months old would be about the same, 12.5 % responded as 'NG slightly more uncomfortable' and another 12.5% considered it as 'IV much more uncomfortable" as compared to an NG tube. Figure 3-24 shows responses for question 6.

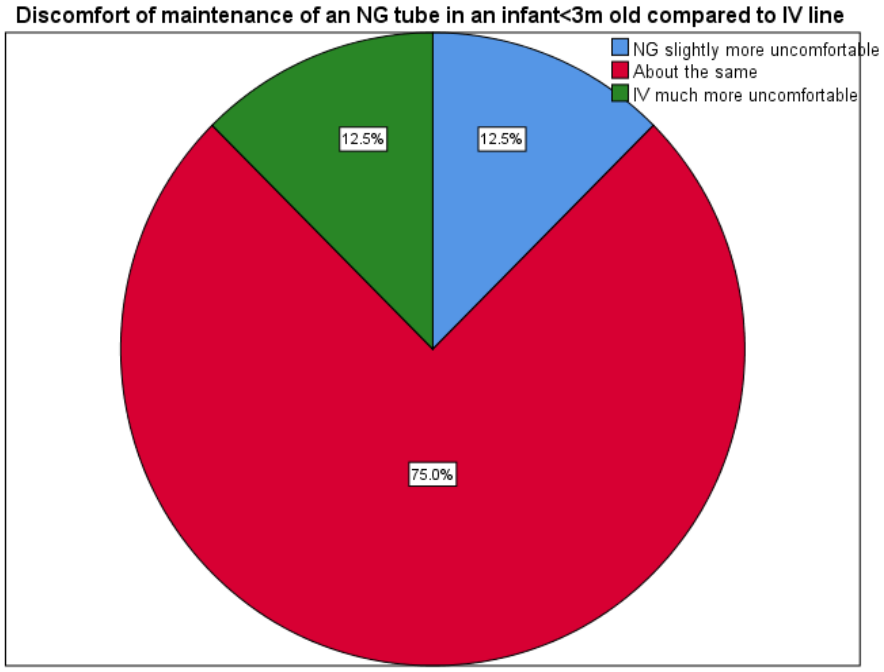


**Figure 3-24 Pediatricians rating of the discomfort of maintenance of an NG tube versus an IV line in infant less than 3 months old**

**Chapter 3.2.4.2 Outcomes (HCP Surveys)**

a. Primary Outcome

Of the eight completed HCPs surveyed, half of the pediatricians would consider NG tube feeding in a 2 month-old infant who had at least three unsuccessful attempts at an IV line placement (cumulative as 50% with 25% ‘extremely likely’ and 25% ‘very likely’). Also, half of the pediatricians would consider of NG tube feeding as an alternative to further IV attempts in a 11 month-old infant who had at least three unsuccessful attempts at an IV line placement (cumulative as 50% with 25 % ‘extremely likely’ and 25 % ‘very likely’).

b. Secondary Outcome

When pediatricians were asked about the importance of nutrition delivered to the infant via breast milk or formula milk versus IV fluids, 25% considered it to be ‘extremely important’ and 62.5 % of the pediatricians considered it as ‘very important’.

## 3.11 Chapter 3 Tables

**Table 3-1 Parental questionnaire responses**

n=54 (total number of surveys sent)

| Characteristic | Value |
|---|---|
| Survey response rate: n (%) | 17 (31.5) |
| IV line placed at first attempt: n (%) | |
| Yes | 3 (17.6) |
| No | 13 (76.5) |
| Do not recall | 1 (5.9) |
| IV reinserted: n (%) | 10 (58.8) |
| Perception of child's distress as IV line was inserted: n (%) | |
| Extreme distress | 6 (35.3) |
| High distress | 5 (29.4) |
| Moderate distress | 3 (17.6) |
| Minimal distress | 3 (17.6) |
| Likelihood to consider NG feeds as alternative to IV fluids: n (%) | |
| Extremely likely | 4 (23.5) |
| Very likely | 1 (5.9) |
| Moderately likely | 5 (29.4) |
| Somewhat likely | 4 (23.5) |
| Not likely at all | 3 (17.6) |
| Likelihood to consider NG feeds as alternative to IV fluids after multiple unsuccessful IV attempts: n (%) | |
| Extremely likely | 7 (41.2) |
| Very likely | 2 (11.8) |
| Moderately likely | 4 (23.5) |
| Somewhat likely | 3 (17.6) |
| Not likely at all | 1 (5.9) |
| Importance of nutritional value of fluid delivered to child (breast milk or formula milk versus IV fluids): n (%) | |
| Very important | 13 (76.5) |
| Important | 4 (23.5) |
| Importance of discomfort of insertion of IV or NG tube: n (%) | |
| Very important | 9 (52.9) |
| Important | 6 (35.3) |
| Importance of discomfort due to ongoing presence of IV or NG tube: n (%) | |
| Very important | 9 (52.9) |
| Important | 6 (35.3) |
| Importance of success at first attempt (either IV or NG tube insertion): n (%) | |
| Very important | 11 (64.7) |
| Important | 6 (35.3) |

**Table 3-2 Health Care Providers questionnaire responses**

n=15 (total number of surveys mailed)

| Characteristic | Value |
|---|---|
| Response rate: n (%) | 8 (53.3) |
| Likelihood to consider NG feed in 2-month old infant with bronchiolitis needing supplementary fluids: n (%) | |
| Extremely likely | 2 (25) |
| Very likely | 0 (0) |
| Moderately likely | 1 (12.5) |
| Somewhat likely | 3 (37.5) |
| Not likely at all | 2 (25) |
| Likelihood to consider NG feed in 2-month old infant with bronchiolitis needing supplementary fluids after 3 unsuccessful IV attempts: n (%) | |
| Extremely likely | 2 (25) |
| Very likely | 2 (25) |
| Moderately likely | 1 (12.5) |
| Somewhat likely | 3 (37.5) |
| Not likely at all | 0 (0) |
| Likelihood to consider NG feed in an 11-month old infant with bronchiolitis needing supplementary fluids after 3 unsuccessful IV attempts: n (%) | |
| Extremely likely | 2 (25) |
| Very likely | 2 (25) |
| Moderately likely | 1 (12.5) |
| Somewhat likely | 3 (37.5) |
| Not likely at all | 0 (0) |
| Nutritional value of fluid (breast milk or formula versus IV fluid): n (%) | |
| Extremely important | 2 (25) |
| Very important | 3 (37.5) |
| Moderately important | 1 (12.5) |
| Somewhat important | 1 (12.5) |
| Not important at all | 1(12.5) |
| Discomfort of insertion of IV or NG tube: n (%) | |
| Extremely important | 0 (0) |
| Very important | 3 (37.5) |
| Moderately important | 2 (25) |
| Somewhat important | 2 (25) |
| Not important at all | 1 (12.5) |
| Discomfort due to ongoing presence of IV or NG tube: n (%) | |
| Extremely important | 0 (0) |
| Very important | 1 (12.5) |
| Moderately important | 2 (25) |
| Somewhat important | 4 (50) |
| Not important at all | 1 (12.5) |
| Success rate of first attempt (either IV or NG tube: n (%) | |
| Extremely important | 0 (0) |
| Very important | 2 (25) |
| Moderately important | 4 (50) |
| Somewhat important | 2 (25) |

| | |
|---|---|
| Not important at all | 0 (0) |
| Familiarity with technique of insertion (IV or NG tube): n (%) | |
| Extremely important | 1 (12.5) |
| Very important | 3 (37.5) |
| Moderately important | 3 (37.5) |
| Somewhat important | 1 (12.5) |
| Not important at all | 0 (0) |
| Familiarity with logistics of delivering fluids: n (%) | |
| Extremely important: | 1 (12.5) |
| Very important | 4 (50) |
| Moderately important | 1 (12.5) |
| Somewhat important | 1 (12.5) |
| Not important at all | 1 (12.5) |
| Discomfort of insertion of NG tube in infant < 3 months old, compared to IV: n (%) | |
| NG much more uncomfortable | 0 (0) |
| NG slightly more uncomfortable | 0 (0) |
| About the same | 7 (87.5) |
| IV slightly more uncomfortable | 1 (12.5) |
| IV much more uncomfortable | 0 (0) |
| Discomfort of maintenance of NG tube in infant < 3 months old, compared to IV: n (%) | |
| NG much more uncomfortable | 0 (0) |
| NG slightly more uncomfortable | 0 (0) |
| About the same | 6 (75) |
| NG slightly more uncomfortable | 1 (12.5) |
| IV much more uncomfortable | 1 (12.5) |

# Chapter 4 Health Care Provider Interviews

## Chapter 4.1 Qualitative Research

Many research designs and methods are used to examine a phenomenon (Siegel, 2012). A qualitative methodological framework was used for this part of this study. One of the main characteristics of qualitative research is that it depends on human perceptions (Stake, 2010). We were curious and interested in knowing the reality as the participants of this study had experienced it (Creswell, 2014). Creswell (2013) states:

> …. individuals seek understanding of the world in which they live and work. They develop subjective meanings of their experiences.... These meanings are varied and multiple, leading the researcher to look for the complexity of views.... Often these subjective meanings are negotiated socially and historically. In other words, they are not simply imprinted on individuals but are formed through interaction with others (hence social constructivism) and through historical and cultural norms that operate in individuals' lives. (pp. 24-25)

Qualitative researchers use several approaches for data analysis. Some of the common analytical approaches are keyword analysis, constant comparison, content analysis, domain analysis and thematic analysis. For this study, a thematic analysis approach was used. According to Braun and Clarke (2006), thematic analysis helps a researcher in identifying, analyzing, and reporting patterns in the data. Savin-Baden and Major (2013) call it one of the best methods since it acknowledges that analysis happens at an intuitive level.

## Chapter 4.2 Interviews

Roulston (2010) describes that the interview method is the most used form of data collection in qualitative research. Some researchers view the interview method as the most flexible method in qualitative research (Cassell & Symon, 2004). One compelling reason to use the interview method as a data collection tool is that all participants are active subjects in qualitative research. According to Seidman (2013), interviews capture the experiences of the participants and understand them through their frame of references.

## Chapter 4.3 Recruitment and Sample size

The participants were recruited based on convenience and willingness to be interviewed. A detailed consent was provided to each participant, which they signed before the interview (Appendix I). The consent included: 1) contact information of the supervisor of this study; 2) introduction and background of the topic in the study; 3) purpose of the study; 4) length of time for the interview; and 5) possible risk and discomfort to the participant. The participants were informed about the voluntary involvement in the interview and that they could withdraw from the interview at any point during the interview. The participants were also assured of the protection of the privacy of their contact information and that their name and any identifiers would be removed by using pseudonyms. The participants were also informed that data would be collected through the interviews, that the interviews would be audio-recorded on a device and that the articles or reports published as a result of the study would not reveal the participants' names. They were informed and given contact information for Dr. Robert Porter and Health Research Ethics Authority if they needed any further information on the study.

The interviews were conducted using a guide that was developed by Dr. Robert Porter and Saima Saqib with feedback from a nurse in the Child Health Program who was not surveyed or interviewed.

The participants for semi-structured interviews of HCPs included admitting pediatricians, emergency physicians who do not admit patients (that is, who do not do inpatient work in addition to ED work), ward nurses and emergency nurses. The sample size for HCPs interview was anticipated to be approximately one or two each of emergency physicians, admitting pediatricians, ward nurses and emergency nurses. The recruitment of the participants and interviewing took three months as the interviews were conducted on the availability and convenience of the HCPs. An interview guide was used to conduct the interviews (Appendix J). Each interview lasted approximately 8-12 minutes.

**Chapter 4.4 Transcription**

Each recorded interview was conducted by Dr Robert Porter and transcribed by Saima Saqib using the web application oTranscribe (otranscribe.com). This is a free web application that facilitates the process of transcription of audio-recorded data. While using oTranscribe the computer keyboard performs most of the functions, such as a) controlling speed, b) forward/fast forward, c) rewind, d) play, e) bold fonts, f) italics, and also g) interactive timestamps. The data is saved automatically during the transcription process. In addition, the user can save the data in Word or by directly copy and pasting the transcribed text. It took four to five hours to transcribe each interview, as each of the recorded interviews was listened to many times and transcribed data were rechecked

several times to ensure the transcription accurately reflected the content of the interview. This process of transcribing helped to gain more understanding of the data and to develop skill in writing analytical memos. Researchers proclaim the benefits of self-transcription and recommend that all novice researchers should transcribe interviews themselves (Merriam & Tisdell, 2015).

## Chapter 4.5 Data Analysis

Data analysis is a very important stage in qualitative research. The purpose of data analysis is to look for important meanings and themes. According to Creswell (2012), "Analyzing qualitative data requires understanding how to make sense of text and images so that you can form answers to your research questions" (p. 236). Although a Computer Assisted Qualitative Data Analysis (CAQDAS) software package is available for qualitative researchers, I analyzed data manually to gain better understanding of the data analysis process, as this was my first research project. The data analyses were completed in different stages. At the first stage, the data was transformed into transcripts. All the data were saved in separate files. At the second stage, I familiarized myself with the data. In order to fully understand the data, I checked the interview data for accuracy by reviewing the interviews and by listening to the recorded interviews multiple times. Each transcript was thoroughly read multiple times. Detailed notes were made about each transcript. Then, the text of the transcripts was broken into meaningful units of analysis. These units were labelled as codes. After that, some categories were made. These categories were combined into subthemes. Finally, subthemes were combined into themes.

## Chapter 4.6 Outcomes

The main goal of the interviews was to attain a detailed understanding of participants' perspectives on NG hydration versus IV hydration is infants admitted with bronchiolitis. This addressed the secondary research question of the study: "What are the attitudes of HCPs at the Janeway Children's Hospital toward NG and IV hydration in infants with bronchiolitis?".

## Chapter 4.7 Findings

A total of six HCPs were interviewed, who practiced in different pediatric environments (the pediatric ward and the emergency department), and played different professional roles (nurse, emergency physician and pediatrician). The HCPs' numbers of years of professional practice varied from 6 years to 20 years. HCPs from different environments and practice type were purposefully selected to gain a better understanding of their perspectives on the topic. On the other hand, they all shared knowledge of and experience with the topic of the study question. Researchers describe the importance of purposive sampling (given typically small sample sizes) and state that purposive sampling is essential for better understanding of the phenomenon in qualitative research (Creswell, 2012).

For the purpose of protecting the identity of the interviewees (HCPs), the words 'participant' or 'they' will be mentioned instead of any names or identifiers. These words do not categorize the interviewees into any gender specifications or any professional category.

The following themes were identified as per the methodology described earlier:

1. Ideal method of hydration.
2. Suitability of NG tube hydration/feeding or IV hydration.
3. Pros and cons of IV versus NG tube hydration/feeding.
4. Implementation of NG tube hydration/feeding.

### Chapter 4.7.1 Ideal Method of Hydration

We were particularly interested in learning about the ideal method of hydration as perceived by HCPs. We asked participants what they thought was the ideal method of hydration for an infant with bronchiolitis who cannot take oral fluids but who does not require IV access for another reason. Most participants replied that NG hydration was the most appropriate method for this particular scenario, and some also supported their views by highlighting some of the benefits of using NG hydration over IV fluids. For example, one of the participants stated, “I think NG feeds, in nasogastric insertion would be my preference as long as the child or the baby isn't being given positive pressure either through high flow nasal prongs or BiPAP.” Another participant described NG hydration as preferable over IV and also explained a few perceived drawbacks of using IV fluid hydration, namely that IV is more invasive, could cause local infiltration, and involves monitoring of IV fluids and more laboratory tests on blood. They stated:

> I would like to see the NG in because I just think it is less cumbersome for the parents and less invasive for the child. Plus, I think there is more risk with the IV over the NG. One is the IV infiltration; with more fluids the patient is getting the

> extra blood work that's involved, whereas with NG I think it is more just placement, confirmation.

Only one participant had a different viewpoint in terms of how effective the NG hydration is, as they mentioned that they never used an NG tube in any patient. They stated, "I would be willing to try entero, having never done it I don't know the actual efficacy. So, I don't know if it will rehydrate as well and as quickly as intravenous." Another participant added to the discussion in support of NG hydration as an ideal method along with supporting his comment with advantages of NG tube feeding in terms of providing the nutrition in the form of breast milk or formula milk as compared to just IV fluids. They described:

> In that specific situation, I guess an NG feed makes more sense if they could just take breast milk or formula. That would be better than just normal saline. So, I think all things being equal I probably would be assuming if the kid did not find it too uncomfortable to have, then yeah, my preference will be to direct for an NG feed in that situation.

The participants were also keen to use NG hydration over IV even though in most circumstances NG is not practiced as commonly as is IV at the Janeway Children's Hospital. One of the participants elaborated:

> Ideally, [NG] I think would be NG appropriate, because as I am using IVs. I have thought about NG hydration in the past not necessarily for bronchiolitis but if IV access is not obtainable, I think it would be a good way to re-hydrate the patient, in turn it's going to make the IV stick a little bit easier if it is required rather than

> taking 4 -5 attempts to get an IV. With my experience, the majority of our rehydrations have been done with IV or orally, we don’t use NG very often.

**Chapter 4.7.2 Suitability of NG tube Hydration/feeding or IV Hydration**

The participants also pointed out that age, severity of the condition and certain congenital malformations in the patient who is admitted with bronchiolitis are important factors for determining whether NG hydration could be used safely or if IV hydration should be considered. Most of the participants were of the view that NG tube would be easily maintained and should be a preferred method of hydration if the patient is younger than one year of age as compared to the older patients. One of the participants said:

> Definitely the preemie babies that are used to the NG if they are difficult, they have had numerous pokes in the past, sometimes their veins are very scarred so IV is really hard to get. So, if they don’t require IV for an antibiotic for sepsis or anything like that, the NG would be the route.

Another participant described that, "I think that a NG is less invasive, less traumatic for the patient and possibly the parents involved. It’s easier to get a NG than it is for IV in an infant less than one year." A participant also pointed out the importance of proper education about NG tube both to parents and the staff, and mentioned that if there is adequate information given to the parents before passing an NG tube, it won't be difficult to take care of it as compared to a painful poke of IV line placement and its maintenance. They said, “The kids don’t like anything attached to themselves. So, if the teaching component comes with it, I don’t think it will be any more difficult to take care of it [NG] than the IV.” This participant further elaborated that the parents would be more

comfortable with NG tube if informed properly about NG hydration. Only one participant did not think that age is a deciding factor for the NG hydration. They said that they think that patients younger than one year of age are suitable candidates for NG hydration, but they have no personal experience of doing that or practicing that. However, they described further that if NG tube or IV line is properly secured and does not bother the patient then age should not be a determining factor when it comes to mode of hydration. That participant explained that:

> I always think that younger ones are going to do better with nasogastric tubes, this is purely out of experience but I feel like one year old or nine months old are gonna haul that too very quickly but we could say that for IVs as well. So, if they are nicely taped down and out of the way, I think it's fine. I don't think then there should be an age specification for them.

Another participant supported the views of the rest of the participants about the suitability of NG hydration in younger infants compared to the older. The participant said, "The age, I think it could have an impact, I mean the younger they are it could be more difficult for IV access."

Another important factor that the participants described is the severity of the condition, that is, how sick the child is. One participant was of the view that if the child has severe respiratory distress and requires supplemental oxygen in the form of nasal prongs or positive pressure ventilation, they are at risk of gastric distension or aspiration of gastric contents if an NG tube is in place, and therefore those are the patients in whom

we should be very careful or should not consider NG hydration but rather give IV hydration. The participant explained:

> The ones that we have seen or are seen with more severe bronchiolitis were either using high flow nasal prongs or were switching them over to some form of positive pressure ventilation before intubation. And those are the one that I think are risk of gastric distension and then having aspirations. Those I would caution against.

Another participants had similar views, saying, " I guess if they were clinically unstable, you might not want food in their belly, but you might want IV hydration, you might want to have an [IV] access just in case." Yet another participant, supporting the importance of clinical severity in favor of IV and against NG hydration, stated, “if they have respiratory distress; you think you might need to intubate, then it might be good just to have an IV for those reasons. So, then you could use it [IV] for your hydration on top of everything else.”

Half of the participants had different views on severity of the condition and NG hydration versus IV hydration. According to them, if the patient is sicker, has respiratory distress or is dehydrated then it would be advisable and easier to maintain an NG tube as compared to an IV. They further explained that IV placement in these patients would be difficult to obtain. One of them said, "I think NG is easier to put in the babies having respiratory difficulty or respiratory distress or dehydrated. When children are dehydrated sometimes getting the IV is sometimes 6 to 8 pokes." Another participant had a similar

view and said, "The sicker the patient, it would be more beneficial to rehydrate with the NG, because it would help [insertion of] IV if it is required afterwards."

So, it could be stated that the participants had mixed response when it comes to severity of the condition and NG tube hydration, some preferring NG hydration in sicker patients, some preferring IV hydration.

There was another important factor that was highlighted by the participants, and that was the presence of congenital malformations such as cleft lip, cleft palate, facial hypoplasia or any other cranial or velo-cranial problem. They believed caution should be taken if considering hydration via NG tube especially in those patients. One of them said, “So very easy to get NG in these cases (sick and dehydrated patients) unless there are oral problem like cleft palate, cleft lip or some mouth or airway issue that would make it [NG] difficult.” One of them said that, "any baby that would have hypoplasia of the face or any cranial or velo-cranial problems, I would caution against [NG].”

### Chapter 4.7.3 Pros and Cons of IV versus NG Hydration

When the participants were questioned about the ease of access either for NG tube or IV line placement, most of them considered that NG hydration is much easier and quicker to obtain, and also easy to maintain as compared to an IV line. They also stated that it would be much better to use NG hydration rather than needle poking the patients multiple times for IV placement, especially in sicker and dehydrated patients. One of the participants explained from personal experience and said:

> Well if you look at the baby we had last night, it was 17 attempts for an IV before they started NG feeds. Ease of access is a lot easier for a NG in a baby than IV. I

> would say NG is definitely lot easier, especially when they are little bit shut down, and they are dry.

Adding to this was another view from a participant. They said, "I think NG is easier to access, I guess it could still go down the wrong passage, but I do believe that it's much easier to keep in place once the access has been achieved." Another participant had the same opinion and said, "I think NG would be a lot easier and more successful than IVs. Especially if you have a baby who is already dehydrated or poorly perfused."

One participant also mentioned that although the ED and NICU nurses are more trained to do IV line placement, sometimes it is very hard to get an IV line placed in younger and sicker patients. Also, it increases the time to treating the patient in a timely manner if IV access is difficult and if multiple attempts are required before an IV line is obtained. On the other hand, an NG tube takes significantly less time and is easily maintained. This participant said:

> Speaking from emerg point of view, I think most nurses are skilled at getting IVs. However, we do have a population that especially the very young like one to three months that are very difficult to get an IV. Sometimes you see when they get in distress with bronchiolitis or dehydration, they are very hard to get in the IV. Most often the ones who had five to six pokes, they are the ones for whom to get an NICU nurse to come and get IV done. So, it takes a really long time and care is delayed, like sometimes it takes 1 or 2 hours to get an IV. Whereas if you put an NG in, then it goes in within 10 minutes, placement is confirmed, and you can check pH by aspirating some stomach contents and you are good to go.

Most of the participants were of the opinion that an NG tube causes much less discomfort and is tolerated well as compared to an IV line. One participant said, "NG although is uncomfortable is not as bad as several attempts at an IV, which is common with an infant." NG tube is less painful and less traumatic in the view of one of the participants as they explained that, "I think with NG success rate being so much higher, it would be less traumatic than with IV as because majority of dehydrated infants take more than one needle stick from my experience." Adding to this, another participant stated that, "I know for a lot of those little ones once it's in, they don't know of it. I don't think this is as painful as an IV stick."

Whereas the majority of the participants thought of an NG tube as causing less discomfort or pain and less traumatic, one of the participants' view was not in favor of this opinion. They explained from their personal experience that they would think IV to be more tolerable as compared to an NG tube as they stated:

> I guess if they are at certain age, we really don't know exactly what they are feeling. From personal experience having had those IVs and NGs, I would prefer an IV. So, as they get older, they may prefer IV access, but younger kids seem to tolerate it and potentially do better.

Perception of the ease of nursing appeared to be similar for NG or IV hydration. Monitoring of fluids through both methods is necessary somehow. For example, if the patient is on continuous NG feeds than it requires monitoring by the staff on duty. If the patient is having IV fluids it may be necessary to have blood work done and to watch for fluid overload. Supporting this, a participant said, "I don't think it's much difference

between either one, once it's established, putting an IV in it might be little bit more difficult than securing it. Nursing management would be very similar once it's established." Another participant described that, "I think it's probably equal except for a baby with continuous NG feed actually needs to be watched continuously. So, it does sort of change in dynamic of the level of observation, it's talking about who got continuous NG feeds."

With continuous NG feeding, close monitoring is required, and there could be fluid aspiration if it is not properly positioned. A participant pointed out:

> Really no impacts other than on this unit if there is something with NG going continuously there sometimes need to close [close observation]. So, somebody has to be in the room especially with an infant because if they dislodge it, it's not where it's supposed to be, you have a risk of aspiration.

Nutrition delivered to sick patients admitted with bronchiolitis is very important and dependent on what is given: breast milk or formula milk delivers more nutrients and is beneficial to the patient compared to just IV fluids. All of the participants considered that feeding of breast milk or formula milk through an NG tube is much better than fluids through an IV line. The nutrition offered through NG feeds was felt to be of benefit. As one participant stated:

> Well I think there are nothing better than the breast milk if that's what they are still consuming at that age, if they could have that it's a lot more nutrients in it than just D5W or normal saline. It will be pretty well superior to IV fluids assuming that they are not septic or critically dehydrated.

Breast milk or formula is nutritious as a participant said, “Well at least there is nutrition in formula or breast milk via NG whereas IV fluids is just IV fluid keeping them hydrated but not getting real nutrition with that." Fluids other than breast milk or formula could also be delivered through an NG tube as compared to IV, as one participant described:

> I think you can give anything, like while I was working in rural areas, we used to give Gatorade through NG. There is lots of other things that you can give like it’s just a route. You can give breast milk, in small babies, mom can do small frequent feeds. I think it’s [NG] wonderful.

When it comes to acceptability to the parents of NG hydration versus IV hydration, it was suggested that although an NG tube is easier to place and to take care for, it is seldom used at the Janeway. Moreover, it was pointed out that parents need to see more of it and have more information about NG tubes and feeds. It was felt that if NG tube hydration were used more often, parents and staff were given proper knowledge about it, and more staff were trained to do an NG tube placement, it would be a more acceptable method of hydration as compared to IV hydration. A participant described:

> I think parents will be accepting. More acceptable than five or six or seven times that you are poking their child. And every time you are poking a child, you are also breaking the skin so, it also increases the risk for infection.

Another concern about practicing NG feeding more often and increasing the parental knowledge about this was depicted by a participant, who said:

> For our setting, parents are less used to it for sure. I must say if you were through some issues in the ICU or something where you haven't seen before, you might

> get a real look for the parent, I guess when you suggest doing it. But I think if you walk them through it and tell them pros versus cons it might be more on board with it particularly if you have tried IV a couple of times and they have witnessed that and how poorly it can go sometimes. So, they might be initially confused but I think with proper explanation that will be ok.

Another described it this way: "I would say that parents would be more accepting of it. Especially if you can convince them or highlight the importance of just formula or breast milk going down rather than IV solutions." The parents don't see much of NG hydrations in the hospital as often as they see an IV line, in view of a participant, who said, "NG is something that they don't really see a lot and where it is unsightly, they may not like it."

### Chapter 4.7.4 Implementation of NG tube Hydration

How easy or difficult would it be to implement NG hydration at Janeway Children's Hospital, if it is thought to be an appropriate method of hydration, especially if the patient had multiple failed attempts at IV placement? It was a question of interest to find out from the participants' perspectives. The participants had mixed opinions about it. Some thought it to be very easily implemented in the wards as compared to ED because it is used more on the wards. As a participant explained:

> I think it will probably be easier at the floor as we are used to NG feeds. I think emerg will have much more difficulty with it, where its short term, children don't stay with us for a long period of time. I think it would be little bit hard.

Another stated, "It's simple for us. Where we are used to of putting an NG tube and used to of NG feeds it's a routine practice for us." Conversely, a different opinion was given by a participant who said:

> I think here at emerg, it would be fairly easy to implement. If the research proves that it's beneficial, I think most people would be aboard. I think the task itself is less difficult than an actual IV. Management I believe with NG is less difficult as well.

One participant felt that NG tube seemed to be much easier to put in compared to an IV line, although the participant described that they did not have any experience with it, as they stated:

> I don't have problems going with that, putting it in and giving it an attempt but like I said I have never done it before, so I don't really have a track record. But I can see how it would work and I can't see why it wouldn't.

While there seemed to be an overall response in favor of easy implementation of NG tube hydration as a preferable method of hydration in the wards or in ED, it is important to know that it (NG) is still not used as much as is IV hydration. In addition, there should be a written departmental protocol on management of hydration in patients admitted with bronchiolitis along with education for the staff, as a participant mentioned:

> Like any other change, is not always easy, it would probably require some formal clinical pathways to be written as well as some education for the nurses. Potential training for the nurses that are not familiar with it, but it's definitely would be doable.

Although most participants explained that NG tube is less troublesome and could easily be placed (while not practiced as often as IV hydration), a message was also generated to educate the parents, nurses and physicians about the benefits of NG hydration, especially when it is breast milk or formula versus IV fluids. One participant noted that NG feeds are widely used in several countries and other parts of Canada:

> I really like us to start using NG more. I would because it's done in the States, it's done in lots of other institutions in Canada, it's done in the UK, and it's done in Australia. We know it works based on all our data from several developing countries for nutrition and hydration. So, it's working, I hope that we use it.

### 4.8 Trustworthiness

In order to make sure that the results of the qualitative part of our study are accurate, I used various methods, namely, triangulation, peer debriefing and prolonged data gathering. With respect to triangulation, the interviewed participants were from different areas and professions. For peer debriefing, the data and the findings were discussed with the supervisor who has guided this research project. Finally, the data were gathered over the period of three months. I also used an audit trail by archiving all interview audios, interview transcripts, and documents relevant to this study.

# Chapter 5 Discussion

This study examined the practice patterns in NL in infants (less than one year old) hospitalized with a diagnosis of bronchiolitis, especially with respect to the management of hydration in these infants. The study also investigated the perspectives of parents (through survey) and HCPs (through survey and interviews) on methods of hydration and acceptance or preference of NG hydration as an alternative method to IV hydration, including in cases of difficult IV access, with multiple unsuccessful attempts to obtain an IV line. This section will summarize the findings of our study, strengths and limitations, future work, and conclusions of our study.

## Chapter 5.1 General Characteristics of the Cases and Diagnostic Interventions

A total of 101 infants less than one year of age at the time of admission were admitted to Janeway Children's Hospital with bronchiolitis during our two-year study period, based on our eligibility criteria. Of total 101 cases, 65.3 % were males and the majority (90.1%) were admitted through the ED. The mean age of the infants was 129 days. Male predominance (Florin et al., 2014; Ho et al., 2015; Schuh et al., 2017) and age distribution of the infants admitted with bronchiolitis is consistent with previously reported data (Ho et al., 2015; Schuh et al., 2017).

We found that diagnostic interventions were performed in a large proportion of hospitalized infants with bronchiolitis (viral testing using NP swab was performed on 93% of the cases and chest radiography was done for 73%), whereas CPS and most of the

other guidelines recommend against routine diagnostic testing in bronchiolitis and emphasize clinical diagnosis based on history of the symptoms and physical findings on examination (AAP, 2006; Friedman et al., 2014; Hodge and Chetcuti, 2000; Ralston et al., 2014). However, these were all admitted patients and NP swabs may have been done for cohorting purposes, which is acceptable (Friedman et al., 2014; SIGN, 2006). The literature also reports significant use of diagnostic tests such as chest radiography and viral testing in infants and young children admitted with bronchiolitis (Ho et al., 2015; Schuh et al., 2017). On the other hand, modest improvements in adherence to recommended practices (investigation and treatment) have been reported by Barr et al. in their surveys of pediatricians post-NICE guidelines implementation in the UK (Barr et al., 2018), and in the setting of a 'multifaceted educational bundle' associated with the Scottish clinical bronchiolitis guidelines (SIGN) (Murch et al., 2015). While our sample included only admitted patients, whose severity would be expected to be worse than the majority of bronchiolitis patients, the vast majority of patients were admitted to the ward, and severity alone does not seem to justify the high rates of viral and radiological investigation.

Bronchiolitis is a viral illness and RSV is the pathogen accounting for majority of the cases (Castro-Rodriguez et al., 2015; Florin et al., 2017; Panitch, 2003a); results from our study also showed that RSV was the most prevalent viral pathogen in these admitted patients, accounting for 68% of the cases with bronchiolitis, with the remainder of pathogens identified being HMPV, enterovirus, PIV and adenovirus.

**Chapter 5.2 Management of the Bronchiolitis Cases**

A number of available guidelines recommend supportive treatment for the management of bronchiolitis, such as maintaining oxygenation and restoring fluid loss or dehydration due to inability to feed or tolerate adequate feeds and recommend against use of pharmacological agents routinely (e.g. antibiotics and steroids). When we investigated the practice patterns in our cohort of patients, we found that approximately half (53.5%) of the cases were managed with supportive treatment of supplemental oxygen. However, our study showed that IV antibiotics were administered to half of the patients. Further examination of the data showed that 14% of the cases were <28 days old. Of these, 93% had IV fluid hydration and 46.2% had IV antibiotics therapy. This is an age group with special considerations, and the use of IV antibiotics could be a part of protocol for sepsis work up in those admitted infants aged <28 days old (Friedman et al., 2014). However, the high overall rate of IV antibiotic treatment is concerning.

It has been reported that in children with a typical presentation of bronchiolitis, the chest radiograph is of little significance and chest radiographs show findings consistent with the disease in the majority of cases (Schuh et al., 2007). When we investigated the chest radiograph findings for the cases who had IV antibiotics, we found that 27% of cases had a normal study, the majority (65.3%) had findings consistent with bronchiolitis (simple or complex), and a very small number (7.7%) had findings inconsistent with typical bronchiolitis. Although there may have been other reasons to treat with IV antibiotics in some cases, these findings suggest that children in our study were overtreated with IV antibiotics. It is noteworthy that the use of IV medications,

especially antibiotics, has been reported not to improve the clinical outcome of infants with bronchiolitis (Castro-Rodriguez et al., 2015).

Research shows that there is wide variation in management of bronchiolitis with respect to managing hydration in admitted infants. And to date there is no consensus on which method of hydration (IV versus NG hydration) is preferred in infants who are admitted with bronchiolitis, in whom a non-oral method of hydration is deemed to be necessary (Kennedy and Flanagan, 2005). Both methods are used, with NG hydration used widely in most parts of Europe, Australia and NZ (Babl et al., 2008; Brand and Vaessen-Verberne, 2000; Oakley et al., 2013; Oakley et al., 2016), with IV hydration commonly used in these patients in North America (Ralston et al., 2014). Our study showed that an IV line was placed in more than half of the study population and IV hydration was the most commonly practiced method of hydration in our cases (NG hydration 4% versus IV hydration 53.5%).

In this study, we also found through the chart review that IV access was not successful at first attempt in 1/3 of the cases and in 1/3 of the cases, the IV line was replaced. Parents might assume that obtaining IV access, especially in a pediatric centre, is more consistently successful on the first attempt. The proportion of cases where an IV line was not obtained on the first attempt and the proportion requiring IV cannula replacement are significant, and if parents were informed about these facts, they may choose NG hydration. It is interesting that the parent surveys reported much lower success rates for IV cannulation on first attempt and higher rates of replacement. This may be due to the small sample size or a non-representative sample of parents. However,

our chart review results showed that documentation of attempts at successfully securing an IV line did not appear to be rigorous, and it is possible that multiple needle pokes by a single provider could be recorded as a single attempt in the medical record. This could have influenced our results and points out the importance of proper documentation when it comes to the IV procedure record.

We did not do a comparative analysis between two groups (NG hydration versus IV hydration); however, we reported inpatient LOS and length of stay in ED. Median inpatient LOS as reported by our study was 49 hours, similar to previously reported data (Florin et al., 2014; Oakley et al., 2013; Kugelman et al., 2013).

**Chapter 5.3 Perspectives of Parents**

The method of hydration is important in treating young children admitted with bronchiolitis. Also, the nutritional value of fluids delivered either via NG tube or IV line is of significant importance. We found that that nutritional value of the fluids delivered to the sick infants hospitalized with bronchiolitis is perceived to be very important to parents (76.5%). Our study showed that in cases of difficult IV access, parents appeared to be accepting of NG hydration as an alternative method to IV hydration. In addition, our results showed that the proportions of parents of infants younger than 6 months old as compared to those of infants 6 months to 1 year old, accepting NG hydration as an alternative to IV fluids, were not statistically different ($p=0.64$). This finding is of limited significance, given our very small sample size.

Through parental comments from completed surveys, we were able to highlight parental mental stress and distress related to their infants' experiences of IV insertion,

reinsertion, and multiple unsuccessful attempts at an IV placement, as described by many parents.

## Chapter 5.4 HCPs Perspectives on Hydration (NG versus IV) of Infants with Bronchiolitis

From the pediatricians' surveys, half of the pediatricians (50%) would consider NG hydration over IV hydration in the case of multiple unsuccessful attempts at IV both in infants aged 2 months and older infants (11 months), and willingness to consider the NG option was greater if there was difficulty in establishing IV access. While the reasons for many not supporting NG hydration are unknown, participants may have been reluctant to embrace an unfamiliar treatment and may have been satisfied with the existing form of treatment.

The results of our study also showed that the nutritional value of fluids delivered to the infants admitted with bronchiolitis is perceived to be very important by pediatricians (more than 75%). We further examined the perspectives of HCPs on hydration of infant with bronchiolitis and collected data through interviews. Our study reported that most of the HCPs were in favor of using NG hydration, with some highlighting perceived drawbacks of IV hydration, namely, that IV is more invasive, may require multiple attempts, carries the risk of local tissue infiltration and requires monitoring of IV fluids and laboratory testing of blood. One participant mentioned the lack of experience in using NG hydration and showed expressed concern whether NG hydration is equally effective as IV hydration. A few also mentioned that IV hydration is used in most bronchiolitis cases at the Janeway Children's Hospital.

We also found that certain factors such as age, severity of illness and congenital malformations are some of the predictive factors in choosing the method of hydration, whether NG or IV, as indicated by HCPs. Most of the HCPs described NG hydration to be effective and easy to maintain in infants younger than one year old as compared to older infants, and that older infants can easily pull out an NG tube. However, since NG is not seen very often in these patients with bronchiolitis, parents are not used to seeing NG hydration in sick children with bronchiolitis. So, more knowledge needs to be given to parents and nurses before increasing practice. Previous literature also reported more reluctance in nurses and the parents for NG tube insertion (Valla et al., 2019), and lack of knowledge and awareness about NG hydration is an important factor for not using this method of hydration (Srinivasan et al., 2017). Half of the HCPs stated severe illness with respiratory distress was a factor against the use of NG hydration, mainly due to risk of aspiration and gastric distension, whereas half of the participants supported the use of NG hydration to hydrate these sick patients, considering IV access would be difficult to attain is such patients due to dehydration. In addition, certain congenital malformations such as cleft lip, cleft palate, facial hypoplasia and velo-cranial malformations would discourage use of NG hydration.

Previous literature showed concerns about the increased risk of pulmonary aspiration with the use of a NG tube (Khoshoo and Edell, 1999). Also, concerns existed about increased risk of compromising the respiratory functions due to partial obstruction of airways, in infants with bronchiolitis, with NG feeding (Greenspan et al., 1990; Stocks, 1980), with some studies reported increased work of breathing and increased airway

resistance (30-50%) with NG tube (Stocks, 1980). However, these concerns lack sufficient evidence and some studies also reported no increased incidence of aspiration or worsening of clinical condition or respiratory distress with NG tube feeding (Kugelman et al., 2013; Oakley et al., 2013; Oakley et al., 2016). On the other hand, severity of the respiratory symptoms is an important factor for choosing one method of hydration over the other (NG versus IV). The literature also shows that NG hydration is being used modestly in moderate bronchiolitis and in the recovery phase (Caballero et al., 2017; Da Dalt et al., 2013), and the severity of respiratory distress was a withholding or discontinuation factor for enteral (NG) feeding in sick infants with bronchiolitis (Valla et al., 2019). Of interest, the NICE guidelines recommend use of IV fluids in children with severe respiratory distress or impending respiratory failure (NICE, 2015).

Our interview participants also stated that an NG tube is easy to insert, easily maintained and causes less discomfort compared to an IV. Especially in sicker and dehydrated infants it could take multiple attempts to insert an IV line, and that could add to unnecessary delays in hydration treatment of these sick patients. Nursing care was described as similar with either method of hydration (such as fluid monitoring with IV versus watching feeds in continuous NG feeding). However, we found out that nutrition delivered through breast milk or formula via NG tube was considered superior and beneficial as compared to fluids through an IV line. The existing literature does highlight the importance of restoring physiological nutrition through expressed breast milk via NG tube, to treat dehydration, faster recovery and better clinical outcome in bronchiolitis (Kugelman et al., 2013; Weisgerber et al., 2013).

As NG hydration was not used commonly in infants with bronchiolitis in the institution studied, our participants brought to our attention the need to facilitate more awareness with respect to NG tube feeds to both parents and HCPs (pediatric physicians and nurses), and training of staff to insert an NG tube. They further elaborated that if parents are given adequate knowledge about the benefits of essential nutrition delivered with breast milk or formula through an NG tube, they would be more acceptive of NG hydration as opposed to seeing their child poked multiple times to attain an IV line. Lastly when we queried the implementation of NG hydration at the Janeway (if it was thought to be appropriate method of hydration especially in cases of failed multiple attempts at IV line placement), a few thought that NG hydration would be easier to implement on the floor (wards), whereas a few thought it could be easily implemented in the ED.

To summarize, through the HCP surveys and interviews, our study found that, from HCPs perspectives, NG hydration is an appropriate method of hydration in infants with bronchiolitis, but it is not used as often as IV hydration is (as also shown through our chart review data on use of NG hydration). NG hydration is perceived to be easier to attain and maintain, less invasive, and to provide better nutritional support compared to an IV line. However, certain factors, such as disease severity, age and congenital malformations, could lead to a preference of one method or the other, with NG considered to be more appropriate in younger patients and, by some, in more severe illness with dehydration. In addition, NG tube feeding could easily be implemented and would be more acceptable to the parents as compared to IV hydration if more awareness/knowledge (both to parents and staff) and training (to staff) is given on NG tube insertion and

maintenance. Lastly, there is need to change or readdress policies at an institutional level to facilitate implement the use of NG hydration if a change in hydration practices are desired. There is no previous data reported in the studied institution on HCPs perspectives, especially through interviews on hydration practices and preferred methods of hydration in infants with bronchiolitis.

## Chapter 5.5 Strengths and Limitations

This study has a number of strengths. This is the first study that examined hydration practices in infants with bronchiolitis in NL and addressed parental attitudes and HCPs' perspectives on methods of hydration. Our sample size was large enough to encompass cases admitted by a variety of admitting pediatricians and a good range of ages and illness severity.

Our study showed that currently at the Janeway, for the most part, NG hydration is not practiced in patients who are admitted with bronchiolitis, and it is likely that this option is seldom discussed with parents. On the other hand, it is practiced in many other countries and in some other regions of Canada.

Our study had several limitations. We limited the study period to only two years, as including more years' admissions for chart review and then surveying those parents could have led to more recall bias for the parents, as they might have forgotten many details about their child admission several years back. However, to minimize the chance of recall bias, our parental surveys for eligible admissions were sent out shortly after the end of the two-year period for chart reviews.

Also, our sample for parental survey was smaller than anticipated (only 54 eligible for parental survey versus 70 expected), and the response rate (31.5%) was lower than expected (50%), despite sending a reminder survey. This small sample led to a wide confidence interval for our estimate of the primary outcome. Another limitation is that our primary outcome was a proportion and we did not specify *a priori* how the proportion would be generated from the ordinal survey data for this question. However, we chose to dichotomize the data very conservatively (with only those responding 'extremely likely' or 'very likely' considered to be accepting).

Although the results from HCPs surveys and interviews nicely augment the parental perspectives, there is a possibility of bias in opinions because the HCPs who completed the surveys and interviews were not randomly chosen. For example, it is possible that the HCPs who supported NG hydration were more likely willing to be interviewed and therefore to present a particular perspective. Moreover, it is also difficult to draw an inference from the responses of pediatricians' surveys as to whether this could correlate to actual clinical practice or not. Also, from the parental surveys, bias in opinion and response could be expected, as is it possible that a disproportionate number of parents responded who had more unpleasant memories, were unsatisfied with the treatment, or had more stressful hospital experience (or vice versa).

### Chapter 5.6 Future Research and Knowledge Translation

More research is required in future to explore the practices in the management of bronchiolitis, with particular attention to modalities of rehydration offered, and to examine both at the institutional and stakeholder (nurses, pediatric physicians and

parents) levels, the nature of barriers that exist to offering NG hydration to infants with bronchiolitis. We know from this study that both parents and HCPs are accepting of NG tube feeding, and we know from the literature that QI initiatives are effective in facilitating the use of NG hydration over IV (Srinivasan et al., 2017). Therefore, future research should involve use of QI initiatives with educational elements.

Research has shown that NG hydration is as feasible and appropriate as IV hydration, and NG hydration is not reported to have resulted in worse clinical outcome as compared to IV in patients with bronchiolitis (Kugelman et al., 2013; Oakley et al 2013; Oakley et al., 2016; Sammartino et al., 2002). The very low percentage of NG hydration practice at Janeway as compared to IV hydration could be a strong argument to communicate the results of our study, in particular the parental responses, with administrative and clinical leads, as well as front-line providers, such as pediatricians, emergency physicians and nurses. Moreover, parental preference should be the deciding factor if both methods have comparable outcomes, and results from this study also show that parents' preferences for hydration of their sick children and concerns for adequate nutrition during this distressing illness are important factors in deciding treatment.

## Chapter 5.7 Conclusions

This study suggests that present practice at the Janeway with respect to methods of hydration of infants hospitalized with bronchiolitis, is likely more based on habit and medical culture than either best evidence or parental choice. Our data suggests that there are opportunities to expand parental choice and further bring investigation and

management practices in line with current evidence as expressed in clinical practice guidelines, through quality improvement initiatives.

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# Appendix A

Chart review data extraction form

**Practice Patterns and Parental Attitudes with respect to Hydration for Infants Admitted with Bronchiolitis, Newfoundland (NL), Canada.**

**Data Extraction form**

Screening ID: _____

**Inclusion Criteria:**

Age at the time of admission: less than one year: Y_____ N _____

Admitted to the Janeway Hospital: _____ Y_____ N

Diagnosis at discharge:

Either:

- Bronchiolitis_____ **OR;**
- Asthma (with +ve nasopharyngeal (NP) swab): _____ **OR;**
- Pneumonia (with wheeze + non-diagnostic Chest X-ray) _____

**Exclusion Criteria**:

Expired from Index Illness_____ Y _____ N

Expired from other Causes _____ Y _____ N

Intubation: _____Y _____N

---

Eligible _____ Y _____ N

**Study Enrolment ID #** _____

**Study Enrollment ID:** _____

1) Admission route via ED _____ direct to inpatient location _____

2) Patient Characteristics

Age (in months): _____

Sex: _____ Male _____ Female

Weight(kg): _____

Initial vital signs Triage Inpatient

Heart rate (beats/min) _____

Blood pressure (mm mercury) _____

Respiratory rate (breaths/min) _____

Temperature (Celsius) _____

Oxygen saturation (%) _____

Co-morbidities: _____ Y _____ N

Specify:

1. _____
2. _____
3. _____

3) Triage Code_____

4) Time of Triage (24 hr clock) _____ Date of Triage_____

5) Time of arrival to inpatient location (24 hr clock) _____ Date of arrival to inpatient location _____

5) Initial inpatient location Ward _____ PICU _____ NICU _____

6) Transfer at any time to PICU _____ NICU _____ Ward _____

7) Nasopharyngeal Swab: _____Y _____N

Results: _____

_____

8) Chest X-Ray: _____Y _____N

Result: _____

_____

9) Supplemental oxygen _____ Y _____ N

Details _____

_____

10) Nasogastric Feed _____ Y _____ N

a) Type of feed

Expressed breast milk _____ Y _____ N

Formula _____ Y _____ N

Other _____ Y _____ N (Specify) _____

11) IV line placed? _____ Y _____ N (If "No" go to Q12)

a) Initial type of fluids _____

_____

c) Complications (Local IV-line site) _____ Y _____ N

Details _____

d) IV fluid Bolus _____ Y _____ N Volume ordered (ml) _____ over _____ minutes

e) IV placement attempts _____1 _____2 _____ 3 _____ > 3 (specify) _____

f) IV replacement_____ Y _____N _____ # times

g) IV Medication _____ Y _____ N

a) Antibiotic 1 _____ Y _____ N Name: _____

Dose _____Interval (hours) _____# doses _____

b) Antibiotic 2_____ Y _____ N Name: _____

Dose _____Interval (hours) _____# doses _____

c) Antibiotic 3_____ Y _____ N Name: _____

Dose _____Interval (hours) _____# doses _____

d) Steroids _____ Y _____N Name: _____

Dose _____Interval (hours) _____ # doses_____

e) Other _____Y _____N Name: _____

Dose _____Interval (hours)_____# doses_____

h) Duration of IV placement (hours) _____

12) Length Of hospital stay (hours) _____

Research Personnel Name: _____

Signature: _____

Date: _____

# Appendix B

Ethics research ethics board approval letter

NEWFOUNDLAND AND LABRADOR
HREB
HEALTH RESEARCH ETHICS BOARD

**Ethics Office**
**Suite 200, Eastern Trust Building**
**95 Bonaventure Avenue**
**St. John's, NL**
**A1B 2X5**

January 09, 2018

Faculty of Medicine
Discipline of Medicine

Dear Dr. Saqib:

**Researcher Portal File # 20181280**
**Reference # 2017.276**

**RE: "Practice Patterns and Parental Attitudes with respect to Hydration for Infants Admitted with Bronchiolitis, Newfoundland(NL), Canada."**

This will acknowledge receipt of your correspondence.

This correspondence has been reviewed by the Chair under the direction of the Health Research Ethics Board (HREB). ***Full board approval*** of this research study is granted for one year effective **December 7, 2017**.

**This is your ethics approval only. Organizational approval may also be required.** It is your responsibility to seek the necessary organizational approval from the Regional Health Authority (RHA) or other organization as appropriate. You can refer to the HREA website for further guidance on organizational approvals.

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

- Application, approved
- Research proposal, approved
- Budget, approved
- Revised chart data abstraction form version 2017-12-18, approved
- Revised Research Protocol version 2017-12-17, approved
- Revisions requested from HREB - Survey for Parents version 2017-12-17,approved

MARK THE DATE

**This approval will lapse on December 7, 2018 .** It is your responsibility to ensure that the Ethics Renewal form is submitted prior to the renewal date; you may not receive a reminder. The Ethics Renewal form can be found on the Researcher Portal as an Event form.

*If you do not return the completed Ethics Renewal form prior to date of renewal:*

- ***You will no longer have ethics approval***
- *You will be required to stop research activity immediately*
- *You may not be permitted to restart the study until you reapply for and receive approval to undertake the study again*
- *Lapse in ethics approval **may result in interruption or termination of funding***

**You are solely responsible for providing a copy of this letter,** along with your approved HREB application form; **to Research Grant and Contract Services** should your research depend on funding administered through that office.

**Modifications of the protocol/consent are not permitted without prior approval from the HREB. Implementing changes without HREB approval may result in your ethics approval being revoked, meaning your research must stop. Request for modification to the protocol/consent must be outlined on an amendment form (available on the Researcher Portal website as an Event form) and submitted to the HREB for review.**

The HREB operates according to the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2), the Health Research Ethics Authority Act (HREA Act) and applicable laws and regulations.

**You are responsible** for the ethical conduct of this research, notwithstanding the approval of the HREB.

We wish you every success with your study.

Sincerely,

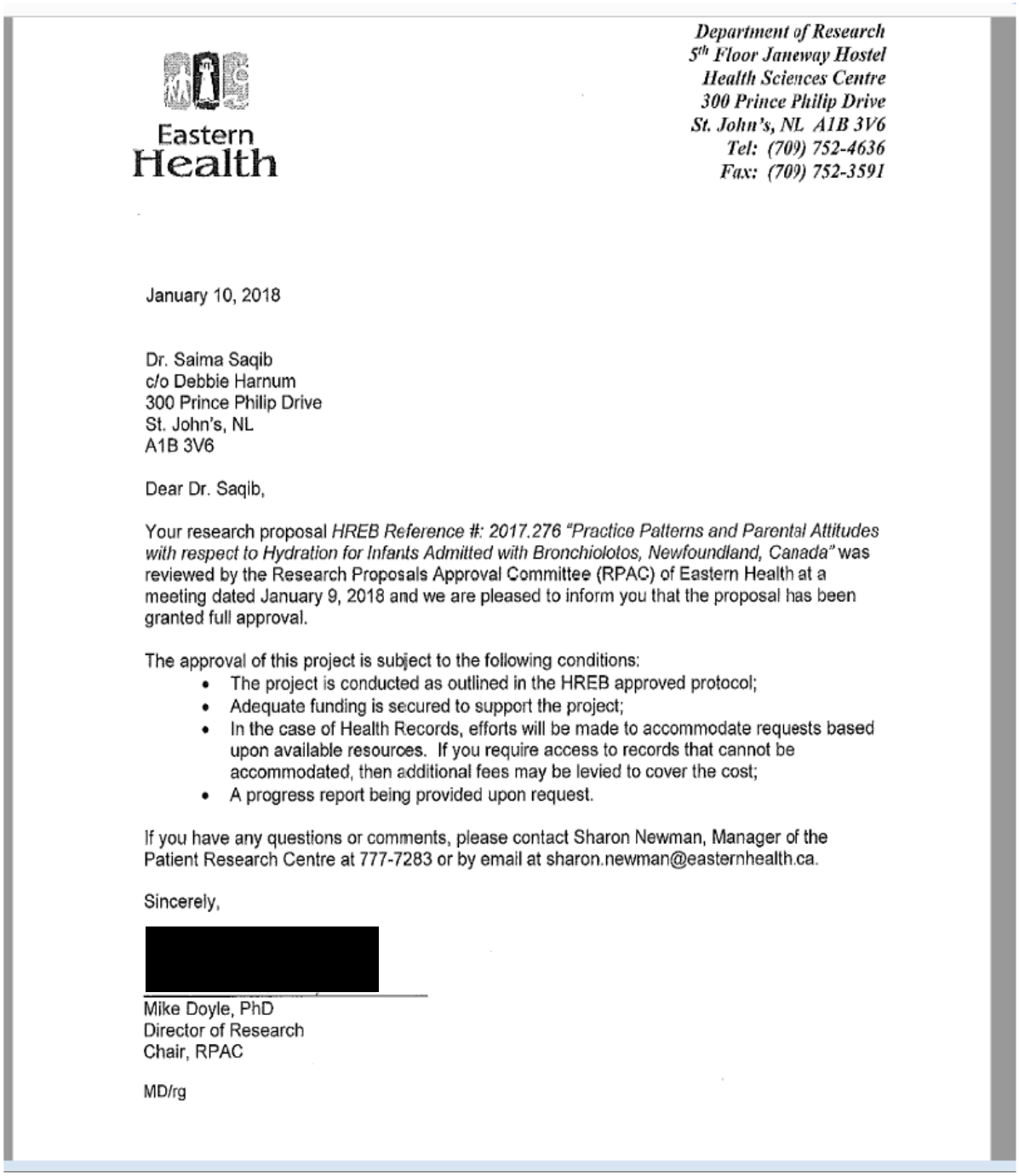
[redacted]

Ms. Patricia Grainger (Chair, Non-Clinical Trials Health Research Ethics Board)
Dr. Joy Maddigan (Vice-Chair, Non-Clinical Trials Health Research Ethics Board)

CC: G Mugford
R. Porter

# Appendix C

Research Proposals Approval Committee (RPAC) approval letter



Eastern Health

*Department of Research*
*5th Floor Janeway Hostel*
*Health Sciences Centre*
*300 Prince Philip Drive*
*St. John's, NL A1B 3V6*
*Tel: (709) 752-4636*
*Fax: (709) 752-3591*

January 10, 2018

Dr. Saima Saqib
c/o Debbie Harnum
300 Prince Philip Drive
St. John's, NL
A1B 3V6

Dear Dr. Saqib,

Your research proposal *HREB Reference #: 2017.276 "Practice Patterns and Parental Attitudes with respect to Hydration for Infants Admitted with Bronchiolotos, Newfoundland, Canada"* was reviewed by the Research Proposals Approval Committee (RPAC) of Eastern Health at a meeting dated January 9, 2018 and we are pleased to inform you that the proposal has been granted full approval.

The approval of this project is subject to the following conditions:

- The project is conducted as outlined in the HREB approved protocol;
- Adequate funding is secured to support the project;
- In the case of Health Records, efforts will be made to accommodate requests based upon available resources. If you require access to records that cannot be accommodated, then additional fees may be levied to cover the cost;
- A progress report being provided upon request.

If you have any questions or comments, please contact Sharon Newman, Manager of the Patient Research Centre at 777-7283 or by email at sharon.newman@easternhealth.ca.

Sincerely,

[redacted]

Mike Doyle, PhD
Director of Research
Chair, RPAC

MD/rg

# Appendix D

Parental survey

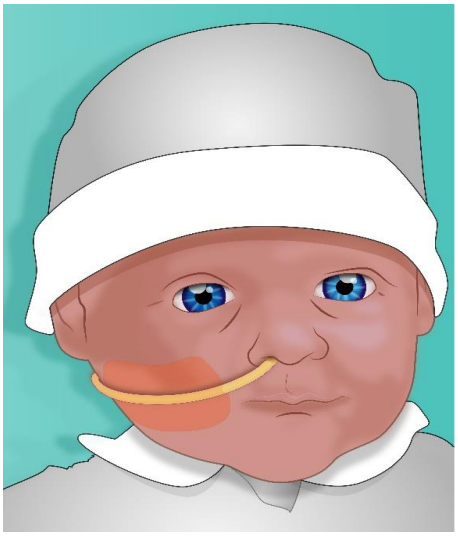
**Survey of Parents of Children Admitted with Bronchiolitis**

**Study Number**: _____

**Introduction:**

Thank you for taking time to participate in this survey. Bronchiolitis is a common illness usually affecting infants younger than 1 year of age. These infants have cold symptoms and difficulty breathing. Sometimes they are not able to drink sufficient fluids. In these cases they are commonly treated in North America with intravenous (IV) fluids; however, in other places, such as New Zealand and Europe, instead of inserting an IV, feeding is continued (either formula or breastmilk) through a very small tube inserted through the infant's nose into the stomach (a nasogastric or "NG" tube - see picture). Many current guidelines recommend nasogastric feeding as a first choice rather than an IV.

By completing this survey you confirm your consent to participate in this project. It will take approximately ten minutes to complete.



1. Our records indicate that your child had an intravenous inserted during an admission for a breathing problem sometime between May 2016 and April 2018. We are interested in your opinion as to the experience of IV access (if your child was admitted more than once, please reflect on the ***first*** admission for bronchiolitis where an IV was needed).

    a. Was IV access obtained on the first attempt? (circle one)
        - Yes
        - No
        - Don't Recall

a. At any time during your visit did the IV have to be reinserted? (circle one)
   - Yes
   - No
   - Don't Recall

b. Thinking about when your child first got the IV inserted for this admission, how would you describe your child's distress from the insertion of the IV? (circle one)
   - Extreme distress
   - High distress
   - Moderately distress
   - Minimal distress
   - No distress

2. If your pediatrician had offered you the option of nasogastric (NG) feeding INSTEAD of IV treatment, would you consider the option? (circle one)
   - Extremely likely
   - Very likely
   - Moderately likely
   - Somewhat likely
   - Not likely at all

3. If your child had more than one unsuccessful attempt at IV access, would you consider NG feeding as an alternative? (circle one)
   - Extremely likely
   - Very likely
   - Moderately likely
   - Somewhat likely
   - Not likely at all

(see next page)

4. In choosing a method for providing fluids to an infant who cannot feed for a few days due to a breathing problem, how would you rate the importance of each of the following?

   a. Nutrition delivered to the baby (breast milk or formula vs. IV fluids)
      - Very important
      - Important
      - Undecided
      - Unimportant
      - Very unimportant

   b. Discomfort of insertion of IV or NG tube
      - Very important
      - Important
      - Undecided
      - Unimportant
      - Very unimportant

   c. Discomfort due to the ongoing presence of an IV or NG tube
      - Very important
      - Important
      - Undecided
      - Unimportant
      - Very unimportant

   d. Success rate of first attempt (either IV or NG tube insertion)
      - Very important
      - Important
      - Undecided
      - Unimportant
      - Very unimportant

Do you have any other comments?

_____

_____

Thank you! Please return the completed survey in the enclosed self-addressed stamped envelope.

# Appendix E

Parental survey request letter

Children's and Women's Health Program
Janeway Site
300 Prince Philip Drive
St. John's, NL
Canada A1B 3V6
T: 709-777-4414
F: 709-777-4446
www.easternhealth.ca

**Research Study on Infants Admitted with Bronchiolitis**

Enclosed is a survey which is part of a research project being conducted by **Dr. Saima Saqib**, a Masters of Sciences candidate in the Discipline of Clinical Epidemiology and **Dr. Robert Porter**, an Emergency Physician at the Janeway Children's Hospital. The research is funded by the Janeway Foundation and the School of Graduate Studies at Memorial University. We are interested in the treatment of infants who have difficulty breathing who are admitted to hospital and treated with intravenous fluids.

You are invited to participate in this survey because your child has been admitted between May 2016 and April 2018 with breathing difficulty breathing and required intravenous fluids. This is a research project that aims to explore your attitudes towards intravenous fluid therapy in this condition and also your attitudes to nasogastric feeding, an alternative to intravenous therapy. Nasogastric feeding is a procedure where a very small tube (nasogastric tube) is passed through the infant's nose to the stomach to allow feeding to continue until the infant has improved and is able to drink. We are requesting that a parent or guardian who was present with the child during some of his or her admission complete the survey.

This results of this survey will be analysed as a group and you will not be identified individually. Your confidentiality is protected through the using of study numbers instead of names or other identifiers as well as locking up of files and password protection.

You are not obliged to participate in this survey. There is a risk that your participation in the survey may bring back unpleasant memories of your child's illness. If you think this will be upsetting to you, you may decide not to complete the survey. If you have concerns about unpleasant memories you experience as a result of completing the survey you may discuss with Dr. Robert Porter by email or phone as indicated below.

Otherwise, there is no expected harm to you as a participant, and you may not receive any direct benefit from participating. The only inconvenience is the time required to complete the attached survey questions. If you agree to participate in the project please complete the attached survey and return in the envelope provided. You do not give up any legal rights by

participating in the study. The time you take to complete the survey will hopefully allow us to improve the treatment of infants with bronchiolitis.

By completing this survey you confirm your consent to participate in this project.

**If you have any questions regarding this study, please call Dr. Robert Porter at 777-4611 or email rporter@mun.ca**

You can also talk to someone who is not involved with the project at all. They can tell you about your rights as a participant in this project. This person can be reached through: Ethics Office at 709-777-6974 or Email: info@hrea.ca.

[redacted]

Dr. Kevin Chan
Clinical Chief (Child), Children's and Women's Health
Eastern Health

# Appendix F

Parental survey reminder request letter

Eastern Health

Children's and Women's Health Program
Janeway Site
300 Prince Philip Drive
St. John's, NL
Canada A1B 3V6
T: 709-777-4414
F: 709-777-4446
www.easternhealth.ca

**Reminder Letter - Research Study on Infants Admitted with Bronchiolitis**

You were recently mailed a survey which is part of a research project being conducted by **Dr. Saima Saqib**, a Masters of Sciences candidate in the Discipline of Clinical Epidemiology and **Dr. Robert Porter**, an Emergency Physician at the Janeway Children's Hospital. The research is funded by the Janeway Foundation and the School of Graduate Studies at Memorial University. We are interested in the treatment of infants who have difficulty breathing who are admitted to hospital and treated with intravenous fluids.

*As we have not received a completed survey we are sending this letter and a copy of the survey for your consideration. If you have already completed the survey please accept our thanks.*

You are invited to participate in this survey because your child has been admitted between May 2016 and April 2018 with breathing difficulty breathing and required intravenous fluids. This is a research project that aims to explore your attitudes towards intravenous fluid therapy in this condition and also your attitudes to nasogastric feeding, an alternative to intravenous therapy. Nasogastric feeding is a procedure where a very small tube (nasogastric tube) is passed through the infant's nose to the stomach to allow feeding to continue until the infant has improved and is able to drink. We are requesting that a parent or guardian who was present with the child during some of his or her admission complete the survey.

This results of this survey will be analysed as a group and you will not be identified individually. Your confidentiality is protected through the using of study numbers instead of names or other identifiers as well as locking up of files and password protection.

**You are not obliged to participate in this survey.** There is a risk that your participation in the survey may bring back unpleasant memories of your child's illness. If you think this will be upsetting to you, you may decide not to complete the survey. If you have concerns about unpleasant memories you experience as a result of completing the survey you may discuss with Dr. Robert Porter by email or phone as indicated below.

Otherwise, there is no expected harm to you as a participant, and you may not receive any direct benefit from participating. The only inconvenience is the time required to complete the attached survey questions. If you agree to participate in the project please complete the attached survey and return in the envelope provided. You do not give up any legal rights by

participating in the study. The time you take to complete the survey will hopefully allow us to improve the treatment of infants with bronchiolitis.

By completing this survey you confirm your consent to participate in this project.

**If you have any questions regarding this study, please call Dr. Robert Porter at 777-4611 or email rporter@mun.ca**

You can also talk to someone who is not involved with the project at all. They can tell you about your rights as a participant in this project. This person can be reached through: Ethics Office at 709-777-6974 or Email: info@hrea.ca.

[redacted]

Dr. Kevin Chan
Clinical Chief (Child), Children's and Women's Health
Eastern Health

# Appendix G

Health care provider survey

**Survey of Pediatricians Caring for Infants Admitted with Bronchiolitis**

**Study Number**: _____

**Introduction:**

Bronchiolitis is a common illness affecting infants, frequently requiring hospitalization. In cases where these infants are unable to take oral fluids there are two options for maintaining hydration: intravenous (IV) fluids and nasogastric fluids – electrolyte solutions, breast milk or formula. A number of guidelines recommend nasogastric feeding as a first choice rather than intravenous fluids. The following questions revolve around your perceptions of these methods of hydration.

1. A 2-month old infant is admitted with wheeze, nasal congestion and mild respiratory distress. She is not feeding well and needs supplementary fluids. How likely would you be to consider NG feeds as an option as long as an IV line is not needed for another reason? (circle one)

    - Extremely likely
    - Very likely
    - Moderately likely
    - Somewhat likely
    - Not likely at all

2. If the infant above had 3 unsuccessful attempts at IV insertion, how likely would you be to consider NG feeds as an alternative to further attempts at IV access? (circle one)

    - Extremely likely
    - Very likely
    - Moderately likely
    - Somewhat likely
    - Not likely at all

3. If the infant presented in Question 2 (with 3 unsuccessful IV attempts) were an 11-month old, how likely would you be to consider nasogastric feeds as an alternative to further attempts at IV access? (circle one)

    - Extremely likely
    - Very likely
    - Moderately likely
    - Somewhat likely
    - Not likely at all

4. In choosing a method for providing fluids to an infant who cannot feed for a few days due to viral bronchiolitis, how would you rate the importance of the following factors?

    a. Nutritional value of fluid delivered to the baby (breast milk or formula vs. intravenous fluids)? (circle one)

        - Extremely important
        - Very important
        - Moderately important
        - Somewhat important
        - Not important at all

    b. Discomfort of insertion of IV or NG tube? (circle one)

        - Extremely important
        - Very important
        - Moderately important
        - Somewhat important
        - Not important at all

c. Discomfort due to ongoing presence of an IV or NG tube? (circle one)

- Extremely important
- Very important
- Moderately important
- Somewhat important
- Not important at all

d. Success rate of first attempt (either IV or NG tube insertion)? (circle one)

- Extremely important
- Very important
- Moderately important
- Somewhat important
- Not important at all

e. Familiarity with technique of insertion? (circle one)

- Extremely important
- Very important
- Moderately important
- Somewhat important
- Not important at all

f. Familiarity with logistics of delivering fluids/feeds? (circle one)

- Extremely important
- Very important
- Moderately important
- Somewhat important
- Not important at all

5. How would you rate the discomfort of ***insertion*** of an NG tube in an infant less than 3 months old compared to an IV line? (circle one)

    - NG much more uncomfortable
    - NG slightly more uncomfortable
    - About the same
    - IV slightly more uncomfortable
    - IV much more uncomfortable

6. How would you rate the discomfort of ***maintenance*** of an NG tube in an infant less than 3 months old compared to an IV line? (circle one)

    - NG much more uncomfortable
    - NG slightly more uncomfortable
    - About the same
    - IV slightly more uncomfortable
    - IV much more uncomfortable

Do you have any other comments?

_____
_____
_____
_____

Thank you for taking time to participate in this survey. Please return the completed survey in the enclosed self-addressed stamped envelope.

# Appendix H

Introduction letter and consent to take part in the pediatrician survey

## Consent to take part in Survey

**Title:** "Practice Patterns, Parental Attitudes and Health Care Providers' preferences with respect to Hydration for Infants Admitted with Bronchiolitis"

**Investigators**: Dr. Robert Porter, Saima Saqib (MSc candidate MUN)

**Sponsor**: Janeway Foundation

As a pediatrician involved with inpatient care of infants with bronchiolitis, we are inviting you to complete and submit the following questionnaire in order that we may find out more about your preferences, attitudes and concerns with respect to NG hydration of infants with bronchiolitis. The questionnaire should take no more than 10 minutes to complete.

Taking part in this study is voluntary. It is up to you to decide whether to be in the study or not. You can decide not to take part in the study. If you decide to take part, you are free to leave at any time.

The overall aims of the project are to 1) determine current practice patterns around hydration of infants admitted with bronchiolitis (through a chart review); 2) examine preferences of parents of infants admitted with bronchiolitis with respect to IV and NG hydration (through a mail survey); and 3) examine preferences of pediatricians who admit patients to the Janeway towards hydration of infants with bronchiolitis (this survey as well as interviews of a small sample of health care providers).

**In order to be eligible to complete this survey you must have admitted at least one infant with bronchiolitis to Janeway ward since May 1st, 2016.**

Before you decide, you need to understand what the study is for, what risks you might take and what benefits you might receive. This consent form explains the study.

Please read this carefully. Take as much time as you like. I f you do not understand or want explained better, please contact Dr. Robert Porter (contact information below).

**Overview of Study**

1. **Introduction/Background**
   This research study will focus on children less than 1 year old who are admitted to Janeway Children's Hospital with bronchiolitis. We would like to know about Health Care Professionals' (HCP) opinion and preferences about the methods of hydration offered to these admitted children. The project is being conducted by Saima Saqib, a candidate for Master of Science in Medicine (Clinical Epidemiology), co-supervised by Dr. Gerry Mugford and Dr. Robert Porter. We would be happy to provide any additional information or answer any questions you might have about the project.

2. **Purpose of study**
   The purpose of the study is to assess the hydration practices for infants with bronchiolitis at Janeway Children's Hospital and to determine the acceptability of nasogastric (NG) hydration for children admitted with bronchiolitis.

3. **Description of the study**
   We are asking you to participate by completing the enclosed survey. Your name will not be attached to any of your answers or comments and your name will not be attached to any study findings. At any time, if you would like to stop your participation you may do so with out any repercussions.

4. **Length of Time**
   Your involvement in the study will last about 10 minutes - the length of time taken to complete the survey.

5. **Possible risks and discomforts:**
   There are no risks to participating in the study apart from inconvenience of completing the survey.

6. **Benefits:**
   It is not known whether this study will benefit you.

7. **Liability statement:**
   **Completing and returning the survey gives us your consent to be in this study.** It tells us that you understand the information about the research study. When you complete and return the survey, you do not give up your legal rights. Researchers or agencies involved in this research study still have their legal and professional responsibilities.

8. **What about my privacy and confidentiality?**
   Protecting your privacy is an important part of this study. Every effort to protect your privacy will be made. However, it cannot be guaranteed. For example, we may be required by law to allow access to research records.
   When you sign this consent form you give us permission to
   - Collect information from you
   - Share information with people conducting the study
   - Share information with the people responsible for protecting your safety

**Access to records**

The members of the research team will see the study records that identify you by name. Other people may need to look at the study records that identify you by the name. They might include the research ethics board. You may ask to see the list of these people. They look at your records only when supervised by a member of the research team.

**Use of your study information**

The research team will collect and use only the information they need for this research study.

Your name and contact information will be kept secure by the research team in Newfoundland and Labrador. It will not be shared with others without your permission. Your name will not appear in any report or article published as a result of this study. Information collected for this study will be kept for five years.

If you decide to withdraw from the study, the information collected up to that time will continue to be used by the research team. The information collected up to that time will not be destroyed. This information will only be used for the purpose of the study.

**Your access to the records**

You may ask Dr. Porter, see the information that has been collected about you.

**9. Questions or problems**
**If you have any questions about taking part in this study, you can meet with the investigator who is in charge of the study at this institution. That person is:**

**Dr. Robert Porter**

**Telephone 709** [redacted]

**Email:** [redacted]

Other people involved in the study you may contact are:

Saima Saqib (Principal Investigator, MSc candidate)

Email: [redacted]

Phone: (709) [redacted]

Research Supervisors:

Dr. Gerry Mugford (Memorial University) (709) [redacted]

Dr. Robert Porter (Memorial University) (709) [redacted]

Or you can talk to someone who is not involved with the study at all but can advise you on your rights as a participant in a research study. This person can be reached through:

Ethics Office

Health Research Ethics Authority

709-777-6974 or by email at info@hrea.ca

# Appendix I

Introduction letter and consent to take part in the interview

**Consent to take Part in Interview**

**Title:** "Practice Patterns, Parental Attitudes and Health Care Providers' preferences with respect to Hydration for Infants Admitted with Bronchiolitis"

**Investigators**: Dr. Robert Porter, Saima Saqib (MSc candidate MUN)

**Sponsor**: Janeway Foundation

You have been invited to take part in a research study. Taking part in this study is voluntary. It is up to you to decide whether to be in the study or not. You can decide not to take part in the study. If you decide to take part, you are free to leave at any time.

Before you decide, you need to understand what the study is for, what risks you might take and what benefits you might receive. This consent form explains the study.

Please read this carefully. Take as much time as you like. I f you like, take it home to think about for a while. Mark anything you do not understand or want explained better. After you have read it, please ask questions about anything that is not clear.

The researchers will:

- Discuss the study with you
- Answer your questions
- Keep confidential any information which could identify you personally
- Be available during the study to deal with problems and answer questions

Overview of Study

1. **Introduction/Background**
   This research study will focus on children less than 1 year old who are admitted to Janeway Children's Hospital with bronchiolitis. We would like to know about Health Care Professionals' (HCP) opinion and preferences about the methods of hydration offered to these admitted children.

2. **Purpose of study**
   The purpose of the study is to assess the hydration practices for infants with bronchiolitis at Janeway Children's Hospital and to determine the acceptability of nasogastric (NG) hydration for children admitted with bronchiolitis.

3. **Description of the study**
   Participants will be asked to participate in a brief individual interview to share your perspectives on hydration methods in those admitted infants. Your name will not be attached to any of your answers or comments and your name will not be attached to any study findings. At any time, you would like to stop your participation you may do so with out any repercussions.

4. **Length of Time**
   Your involvement in the study will last about 20-30 minutes - the length of the interview by the researcher.

5. **Possible risks and discomforts:**
   There are no risks to participating in the study apart from inconvenience of answering questions.

6. **Benefits:**
   It is not known whether this study will benefit you.

7. **Liability statement:**
   Signing this form gives us your consent to be in this study. It tells us that you understand the information about the research study. When you sign in form, you do not give up your legal rights. Researchers or agencies involved in this research study still have their legal and professional responsibilities.

8. **What about my privacy and confidentiality?**
   Protecting your privacy is an important part of this study. Every effort to protect your privacy will be made. However, it cannot be guaranteed. For example, we may be required by law to allow access to research records.
   When you sign this consent form you give us permission to
   - Collect information from you
   - Share information with people conducting the study
   - Share information with the people responsible for protecting your safety

**Access to records**

The members of the research team will see the study records that identify you by name. Other people may need to look at the study records that identify you by the name. They might include the research ethics board. You may ask to see the list of these people. They look at your records only when supervised by a member of the research team.

**Use of your study information**

The research team will collect and use only the information they need for this research study.

Your name and contact information will be kept secure by the research team in Newfoundland and Labrador. It will not be shared with others without your permission. Your name will not appear in any report or article published as a result of this study. Information collected for this study will be kept for five years.

If you decide to withdraw from the study, the information collected up to that time will continue to be used by the research team. The information collected up to that time will not be destroyed. This information will only be used for the purpose of the study.

**Your access to the records**

You may ask Dr. Porter, see the information that has been collected about you.

9. **Questions or problems**

**If you have any questions about taking part in this study, you can meet with the investigator who is in charge of the study at this institution. That person is:**

**Dr. Robert Porter**

**Telephone 709** [redacted]

Or you can talk to someone who is not involved with the study at all but can advise you on your rights as a participant in a research study. This person can be reached through:

Ethics Office

Health Research Ethics Authority

709-777-6974 or by email at info@hrea.ca

**After signing this consent, you will be given a copy**.

**Signature Page**

**Study title**: Practice Patterns, Parental Attitudes and Health Care Provider's preferences with respect to Hydration for Infants Admitted with Bronchiolitis"

**Name of Principal Investigator**: Dr. Porter, Saima Saqib (MSc candidate, Clinical Epidemiology)

**To be filled out and signed by the participant**

Please check as appropriate

| | |
|---|---|
| I have read the consent | Yes { } No { } |
| I have had the opportunity to ask questions/to discuss this study | Yes { } No { } |
| I have received satisfactory answers to all my questions | Yes { } No { } |
| I have received enough information about this study | Yes { } No { } |
| I have spoken to the researchers and they have answered my questions | Yes { } No { } |
| I understand that I am free to withdraw from the study | Yes { } No { } |
| • At any time | |
| • Without having to give a reason | |
| • Without affecting my position in the Janeway hospital | |
| I understand that it is my choice to be in the study and I may not benefit | Yes { } No { } |
| I understand how my privacy is protected and my records kept confidential | Yes { } No { } |
| I agree to take part in this study | Yes { } No { } |

_____ _____ _____

Signature of the participant Name printed Year Month Day

**To be signed by the investigator or the person obtaining consent**

I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

_____ _____ _____

Signature of investigator Name printed Year Month Day

Telephone number: _____

# Appendix J

## Health care provider interview guide

**Practice Patterns and Parental Attitudes with respect to Hydration for Infants Admitted with Bronchiolitis**

Interview guide

Introduction

Evidence suggests that in infants hospitalized with bronchiolitis, nasogastric hydration has similar outcomes to intravenous hydration. Whereas a number of current guidelines recommend NG feeds or fluids first-line over intravenous fluids if an IV is not otherwise indicated, in North America intravenous hydration is much more widely used.

We are interested in your perspectives on hydration of infants (under 1 year of age) with bronchiolitis who are unable to take oral fluids, particularly with reference to the use of nasogastric fluids (electrolyte solutions, formula or breastmilk).

Question 1

All other things being equal, what do you think is the ideal method of hydration for an infant with bronchiolitis who cannot take oral fluids but who does not require IV access for another reason?

Question 2

Are there populations of infants with bronchiolitis for whom either NG or IV hydration is particularly suited? If no answer – age? clinical severity? Other?

Question 3

What are your thoughts on the pros and cons of IV versus NG hydration in terms of:

- Ease of access
- Discomfort to the patient
- Ease of nursing
- Nutrition/continuance of intake of breastmilk
- Acceptability to parents
- Anything else

Question 4

If you felt that NG hydration was appropriate (say a child with difficult IV access and multiple failed attempts), how easy or difficult would it be to implement this treatment on the floor?

Question 5

Is there anything else you would like to tell us on this topic?

Thank you.