The Relationship Between Feeding Method and Hospital Admission for Failure to Thrive in Infants Less than One Month of Age

By

Marybeth Tyler, R.N., N.N.P., I.B.C.L.C.

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APPROVED:

[redacted]

Pam Hellings, R.N., PhD., C.P.N.P., Associate Professor
Research Advisor

[redacted]

Carol Howe, R.N., DNSc., C.N.M., Professor
Committee Member

[redacted]

Beverly Hoeffer, R.N., DNSc.
Associate Dean for Academic Affairs

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ABSTRACT

Title: The Relationship Between Feeding Method and Hospital Admission for Failure to Thrive in Infants Less than One Month of Age

Author: Marybeth Tyler, R.N., N.N.P., I..B.C.L.C.

Approved: [redacted]

Pam Hellings, R.N., P.N.P., PhD., Associate Professor,
Primary Health Care, OHSU; MRP Advisor

The purpose of this study is to examine the relationship between feeding method (bottle or breast) and failure to thrive requiring hospitalization in a group of infants under one month of age. Clinical experience as a lactation specialist has led to the observation that the majority of these infants are not physiologically ill. Their problems appear to be related to conditions of inadequate milk intake and they respond quickly to receiving adequate calories. Knowledge of feeding method and outcomes may show that some hospitalizations and diagnostic evaluations are unnecessary. This information may provide additional rationale for comprehensive postpartum follow-up for new mothers and infants.

Charts were reviewed on seventy infants who met the criteria for inclusion in this study. The infants were divided into three groups based on method of feeding at hospital admission: exclusively breastfed infants, bottle fed infants and infants breast feeding with bottle supplementation. Data were collected on: admission and discharge diagnoses, admission and discharge weight, percentage of weight loss prior to admission, method of feeding during and after hospitalization, length of hospital stay, perinatal complications, frequency of laboratory and diagnostic tests, specialty consults, and therapies such as intravenous fluids, antibiotics and phototherapy.

The mean gestational age of the entire sample was 39 weeks and the mean birth weight was 3606 grams. The mean weight on readmission was 3251 grams, with a mean weight loss of 10%. The average length of hospital stay was 2.2 days. On admission, 44 infants were exclusively breastfeeding, 10 infants were bottle feeding (although 4 of these infants had initially been breastfed) and 16 infants were receiving both breast and supplemental feedings. The breast and "both" infants shared more similarities than either group compared with the bottle fed infants. Birth weight was greater, age at readmission was younger, length of stay was shorter, and degree of weight loss prior to admission was greater for the breast and "both". The bottle fed infants received more specialty consults and diagnostic procedures such as radiographic studies. While many diagnostic procedures such as blood culture and lumbar puncture were performed on the infants, there were only two positive cultures, both blood.

The results of this study support the original observation that for the most part, healthy but hungry breastfed infants are being admitted to the hospital. Other than breastfeeding difficulties, most of these infants have few problems other than hyperbilirubinemia, which may be exacerbated by the breastfeeding difficulties.

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CHAPTER ONE

Introduction

Clinical experience as a lactation specialist providing care for families at all stages of breastfeeding has provided some interesting observations regarding infants who are compromised enough to require hospitalization for failure to thrive or dehydration. In general, it seems that many of the breastfed infants who are rehospitalized are not physiologically ill. Their problems appear to be related to conditions of inadequate milk intake due either to decreased milk supply or poor breastfeeding technique. The infants lose weight, become dehydrated, may develop hyperbilirubinemia, or show sepsis-like symptoms. They respond quickly to receiving adequate calories through a combination of improved breastfeeding technique, stimulation of mother's milk supply, supplemental feeds, and support and education for the mother. Formula fed infants appear to have other diagnoses that are not as easily resolved by increased caloric intake. More data about these infants are required to examine the relationship between method of feeding and failure to thrive. What are the factors which lead to failure to thrive severe enough to necessitate hospitalization? Is it possible that formula fed infants may have underlying health problems which lead to an inability to consume adequate calories whereas most breastfeeding infants may otherwise be healthy and simply in need of breastfeeding assistance?

The purpose of this study is to examine the relationship between feeding method (bottle or breast) and failure to thrive requiring hospitalization in a group of infants under one month of age. Reviewing the records of these infants admitted for failure to thrive

may provide some additional understanding of the relationship between feeding issues and the health status of the infant for both breastfed and formula fed infants. Knowledge of feeding method and outcomes may show that some hospitalizations and diagnostic evaluations are unnecessary. This information may also provide additional rationale for comprehensive postpartum follow-up for new mothers and infants.

CHAPTER TWO

Review of the Literature

Breast milk is the ideal food for the human infant. Alexander, Fisher and Inch (1994); Dewey, Heinig, and Nommsen-Rivers (1995); Lawrence (1989); Minchin (1989); Neifert and Seacat (1985, 1986); Palmer (1993); Rentschler (1991); and Repucci (1995) are but a few of the authors writing extensively about the benefits of breast milk. These include: the biological specificity of human milk which changes and adapts as the infant grows, the immunological benefits of breast milk, the decreased risk of allergy, the decreased incidence of Sudden Infant Death Syndrome, and the decreased frequency and severity of many illnesses in the infant period. In addition, Walker (1993) has compiled information regarding the risks of formula feeding. These include: increased incidence of otitis media, increased incidence of lower respiratory tract infection, increased incidence of diarrheal illness, decreased bioavailability of nutrients in formula, and increased cost.

Breastfeeding is a learned skill for both mother and infant. If it is not going well, the infant may receive inadequate calories and fail to gain or even lose weight. This weight loss may be severe enough to require hospitalization.

Several researchers have examined the rehospitalization of breastfed infants. Pascale, Brittian, Lenfesty, and Jarrett-Pulliam (1996) reviewed the cases of 8 infants readmitted to the Intensive Care Nursery over a five month period. All infants had been discharged from the hospital as healthy newborns, but were readmitted within 48 hours of discharge with a diagnosis of either hyperbilirubinemia or possible sepsis. A primary diagnosis following hospitalization was mild dehydration related to inadequate intake.

Each infant responded well to increased caloric intake.

Thullen (1988) presented a case review of a two week old infant born at 36 weeks gestation admitted for rule-out sepsis. At the two week well baby check, the infant was noted to be more than 15% below birth weight. On admission, the serum sodium was 189 mEq/L. This infant required slow rehydration using intravenous fluids. Breastfeeding was assisted by maternal use of an electric breast pump to stimulate milk supply and use of a supplemental nurser. No other diagnoses were found. This infant was discharged, fully breastfeeding, after 15 days of hospitalization. He continued to breastfeed for 10 months. Follow-up at one year revealed normal growth and development.

Cooper, Atherton, Kahana, and Kotagal (1995) discussed a group of 5 infants with severe breastfeeding malnutrition and hypernatremia who were admitted to their tertiary care center over a 5 month period. The average weight loss on readmission was 23%, and the average initial sodium was 185 mmol/L. Three of these infants suffered significant complications. Two developed multiple cerebral infarctions and one infant required amputation of a leg due to an iliac artery thrombus. These sequelae were felt to be related to the severe dehydration and hypernatremia, not pre-existing pathology. Hospitalization in these infants ranged from 6-40 days. Follow-up neurological exams were normal on 4 of these infants. One infant demonstrated decreased tone on one side at 9 months of age. Two additional reports (Gorman, 1994; Helliker, 1994) discuss breastfed infants readmitted to the hospital who experienced a stroke, and dehydration-induced brain damage.

Lukefahr (1990) presented his review of 38 breastfed infants who experienced failure to thrive. His findings were that 26 of 28 infants less than one month of age had no underlying illness. However, 5 of the 10 infants between 1 and 6 months of age who did not thrive at the breast were experiencing other organic illnesses.

Hellings and Woo (1995) reviewed the charts of 73 infants less than one month of age readmitted to a tertiary children's hospital with the diagnosis of failure to thrive, poor feeding, and/or dehydration over a 10 year period. At admission, 35 infants were breastfeeding, 22 were bottle feeding, and 16 were receiving both breastfeeding and supplemental bottles. Thirty four percent (25) of the infants had spinal taps (all negative), almost all infants had blood chemistries done (most frequently positive—elevated bilirubin), and most infants had blood hematologies performed (23% positive in bottle fed infants, 9% positive in breastfed infants). The mean age at hospital admission was 14.7 days with a mean length of stay 6.6 days. Of the 35 babies who were breastfeeding at admission, only six were still breastfeeding exclusively at hospital discharge. Sixteen infants had switched to total bottle feeding and 13 were receiving both breast and bottle feedings. At discharge, 43% (31) of the infants who were breastfeeding at admission had additional non-feeding related diagnoses, including: social issues, drug use, upper respiratory infection, congenital hypotonia, polycythemia, and oomphalitis. In the bottle feeding group, 73% of the infants had discharge diagnoses related to non-feeding issues, including: social issues, impetigo, craniosynostosis, pyloric stenosis, chlamydia pneumonitis, heart murmur, oomphalitis, and upper respiratory infection . In summary, their findings supported their hypothesis that most of the breastfed infants were not

physiologically ill, but in need of caloric support and improved breastfeeding.

In addition to potential neurologic sequelae, early abandonment of breastfeeding may also be an outcome of these hospitalizations. Hellings and Woo (1995) found that of the 35 infants who were admitted to the hospital breastfeeding, only 17% (6) of these infants were breastfeeding at discharge. Because of the tremendous benefits of human milk for human infants, early cessation of breastfeeding may be viewed as a negative outcome. Dix (1991); Ducket, Henly, and Garvis (1993); Hill and Humenick (1989); Kearney, Cronenwatt, and Garrett (1990); Lawrence (1989); Neifert and Seacat (1985, 1986); O'Campo, Faden, Gielen, and Wang (1992); Rentschler (1991); and Walker and Watson (1989) all provide discussions of reasons why mothers may discontinue breastfeeding in the early weeks. Pertinent to this study are the impact of infant hospitalization and lack of information about the true importance of human milk for human infants.

With the exception of the Hellings and Woo study (1995), no other studies were found describing the neonatal hospitalization of bottle fed babies for the conditions of failure to thrive, dehydration, or poor feeding.

CHAPTER THREE

Methods

Data were collected via a retrospective chart review of the records of those infants less than one month of age who were admitted to a tertiary children's center. Diagnoses used to identify charts included: failure-to-thrive, poor feeding, slow weight gain, hyperbilirubinemia, hypernatremia, and rule-out sepsis. The Health Information Services department of a tertiary children's center pulled the charts of infants less than one month of age who met the diagnostic criteria. Charts continued to be identified until over 100 were available for review with the plan to have at least 40 infants in the bottle fed group and 40 infants in the breastfed group. Ultimately, 129 charts were reviewed with hospital admission dates from January 1, 1994 to December 31, 1996. Infants who had known underlying conditions prior to hospitalization such as congenital heart disease, surgical conditions, or congenital anomalies were eliminated from the study in addition to those with a hospital stay of less than 12 hours, gestational age less than 37 weeks, or a single diagnosis of hyperbilirubinemia.

Data were collected using the form developed by Hellings and Woo (1995) (Appendix A). Data were recorded on the following: infant age, gender, diagnoses at admission and discharge, birth weight, birth order, maternal and infant problems in the perinatal period, length of postpartum stay, method of feeding at admission, during hospitalization, and at discharge, admission and discharge weight, and length of hospital stay. Frequencies and results of laboratory tests such as lumbar puncture, blood chemistries, hematologies, blood cultures, and other tests; and diagnostic procedures such

as radiographic studies, ultrasounds, and electroencephalograms were recorded. Subspecialty consults and lactation consults were noted. Confidentiality was maintained by number coding the data collection sheets.

The data were analyzed with the CRUNCH statistical package. Frequency distributions, percentages and means were calculated. Cross tabulations were designed to examine the relationship between feeding method at hospital admission and the variables of interest, including: admission and discharge diagnosis, admission and discharge weight, weight loss prior to admission, method of feeding during hospitalization and at discharge, perinatal complications, frequency of laboratory and diagnostic procedures, and frequency of therapeutic interventions, such as antibiotics, intravenous therapy and phototherapy.

CHAPTER 4

Results

General Description of Sample

A total of 129 charts were reviewed of patients admitted to the pediatric ward of a tertiary children's center between January 1, 1994 and December 31, 1996. In all, 59 infants were eliminated for pre-existing conditions, prematurity, hospital stay of less than 12 hours, or hyperbilirubinemia as the only diagnosis. Seventy infants met the criteria for inclusion in this study.

The sample consisted of 31 male and 39 female infants. Thirty-two infants were first born, and 38 were subsequent children. The mean gestational age was 39 weeks and the mean birth weight was 3606 grams. The mean weight on readmission was 3251 grams, with a mean weight loss of 10%. The average length of hospital stay was 2.2 days. Sixty-three of the infants were from the Portland metropolitan area, 7 from outside. Complete newborn admission information was available on 17 of the charts, as these infants had been born at the study hospital or faxed newborn records were available for review. The newborn history on the remaining 53 infants was obtained from the history taken at readmission. The lack of data in the admission history accounts for the majority of missing information as far as birth weights, and documentation of maternal and/or infant complications in the antepartum, intrapartum, and immediate postpartum period. Table 1 summarizes the description of the total sample.

Table 1

Description of the Sample

Mean Gestational Age	39 weeks			
Mean Birth Weight	3606 grams			
Mean Admit Weight	3251 grams			
Mean Weight Loss	10%			
Mean Length of Stay	2.2 days			
Gender	Males	31	Females	39
Birth Order	First Child	32	Later	38
Admission Feedings	Breast 44	Bottle 10	Both 16	

The remainder of the discussion will occur with the infants divided into 3 groups based on method of feeding at hospital admission: breast fed infants, bottle fed infants, and those infants receiving both breast and supplemental feedings. Forty-three percent of the breastfed infants, 10% of the bottle fed and 75% of the "both" infants were first born children. On admission, 44 infants were exclusively breastfeeding, 10 infants were bottle feeding, and 16 infants were receiving both breast and bottle feedings. For the infants in the "both" group, supplementation began at birth for 4 infants , within 3-7 days of admission for 3 infants, within 12-24 hours of admission for 2 infants, less than 12 hours of admission for 2 infants, and was not documented in 4 charts. The history for one infant in the "both" group included bottle feeding for 7 days. At this time, when the infant was 4% under birth weight, the mother decided to begin exclusive breastfeeding. In the

following four days, the infant lost 300 grams (10% of the infant's birth weight). Bottle supplementation was started on the day prior to admission. At admission, the infant was 15% below birth weight. Four of the ten infants exclusively bottle fed at admission had initially been breastfed for a period of one day to one week.

Comparisons of Gestational Age and Weight between Breastfed, Bottle fed, and "Both" Infants

The mean birth weight of the breast and "both" infants was similar (3712 gm, 3588 gm) and greater than the mean birth weight of the bottle fed infants (3197 gm). The mean weight loss at readmission was also similar in the breast and "both" (10.7%, 10.4%) infants, and greater than the bottle fed infants (8%). All infants gained a similar amount of weight during hospitalization (184 gm, breast; 178 gm, bottle; 184 gm, "both"). The bottle fed infants were older at admission (13.4 days) than the breast fed (6.5 days) or "both" infants (7.2 days). Twenty-seven (61%) of the breastfed babies were admitted on day three, four, or five. Ten (63%) of the "both" infants were admitted during the same time period. However, only three (30%) of the bottle fed infants were admitted before five days of age. Length of stay was longer (3.5 days) for the bottle fed infants as compared to 1.9 days for the breastfed infants and 2.1 days for infants in the "both" group. Analysis of statistical significance and difference between the group means was not attempted due to the inequality in size of the groups and the small number of bottle fed infants. Table 2 summarizes these findings.

Table 2

Means for Gestational Age, Birth Weight, Admission and Discharge Weights, Percentage of Weight Loss for Breastfed, Bottle Fed, and Infants Receiving Both Types of Feedings

	Breast	Bottle	Both
Gestational Age	39.5 wks	38 wks	39.4 wks
Birth Weight	3712 gm	3197 gm	3588 gm
weight loss	377 gm	259 gm	373 gm
Admit Weight	3335 gm	2938 gm	3215 gm
Range	20-881 gm	43-737 gm	65-900 gm
% weight loss	10.7%	8%	10.4%
Range **	(1%-24%)	(1.5%-13%)	(2%-22.5%)
Discharge Weight	3519 gm	3116 gm	3399 gm
weight gain	184 gm	178 gm	184 gm
Age on Admit	6.5 days	13.4 days	7.2 days
Mode	3 days	4, 16 days	3 days
Range	1-28 days	4-29 days	2-24 days
Length of Stay	1.9 days	3.5 days	2.3 days

Values listed are means unless otherwise noted

**One infant in the breastfed group was above birth weight at admission

Admission and Discharge Diagnoses

Each infant had 1-4 diagnoses listed at admission. To be included for this study, one of the admission diagnoses had to be: failure to thrive, dehydration, poor feeding, or rule-out sepsis. Admission diagnoses were: failure to thrive (17), poor feeding (29), jaundice (38), mild dehydration (23), hypernatremic dehydration (8), rule-out sepsis (27),

lethargy (4), rule-out gastrointestinal problems (1), rule-out neurological problems (1), other (3). A common trio of diagnoses was rule-out sepsis, hyperbilirubinemia, and poor feeding.

Fifty percent (5) of the bottle fed infants were admitted with a diagnosis of failure to thrive, as compared to 16% (7) breast fed infants and 31% (5) in the "both" group. The rate of poor feeding as an admission diagnosis is similar in the breast and bottle group (36% breast, 30% bottle), but much greater in the "both" group (63%). The bottle feeding infants had the lowest incidence of hyperbilirubinemia on admission (30%), compared to the breastfed (61%) and the "both" infants (50%). Similar percentages of infants in all groups were admitted with mild dehydration: 34% breast, 30% bottle, and 31% "both". Hypernatremia was listed as a diagnosis for 13% of the breastfed infants, 10% of the bottle fed infants, and 6% of the "both" infants. Forty-three percent of the breastfed infants had rule-out sepsis as one of the admitting diagnosis, compared to 30% of the bottle fed infants and 31% of the "both" infants. Table 3 summarizes the frequencies of admission diagnoses for the three groups.

Table 3

Admission Diagnoses

	Breast	Bottle	Both	Total
Failure to Thrive	7	5	5	17
Poor Feeding	16	3	10	29
Hyperbilirubinemia	27	3	8	38
Mild Dehydration	15	3	5	23
Hypernatremia	6	1	1	8
R/O Sepsis	19	3	5	27
Lethargy	3	1		4
R/O GI		1 (diarrhea)		1
R/O Neuro		1		1
Other	1	2 (malabsorption)		3

The diagnosis at discharge changed for many infants. These changes included: poor breastfeeding, which was not listed as an admission diagnosis for any of the infants, true sepsis, probable viral illness, a greater degree of dehydration than realized at admission, documentation of seizures, malabsorption or formula intolerance, and social problems which were also not addressed at admission. Discharge diagnoses included: failure to thrive (14), poor feeding (22), poor breastfeeding (14), jaundice (33), mild dehydration (4), hypernatremic dehydration (18), bacterial sepsis, e.coli (2), suspected viral sepsis (7), social issues (12), and other diagnosis (9). Eleven percent of the breast

fed infants, 50% of the bottle fed, and 31% of the "both" infants had failure to thrive listed as one of

their discharge diagnosis. Sixteen percent of the breastfed, 50% of the bottle fed, and 31% of the "both" infants had poor feeding as a diagnosis. Poor breastfeeding was acknowledged as a discharge diagnosis for 30% of the breastfeeding infants and 10% of the bottle fed infants. Hyperbilirubinemia was listed for 52% of the breastfed, 30% of the bottle fed, and 44% of the "both" infants. The breast and "both" infants were similar in percentage of mild dehydration noted at discharge, 7% breastfed, and 6% "both". There were no bottle fed infants with this discharge diagnosis. Hypernatremia was a discharge diagnosis for 34% of the breastfed infants, 10% of the bottle fed infants, and 12% of the "both" infants. Sepsis was a diagnosis for 14% of the breastfed infants (5% bacterial [e.coli], 9% viral), 20% (all viral) of the bottle fed infants, and 6% (all viral) of the "both" infants. Social concerns were listed for 9% of the breastfed, 20% of the bottle fed, and 37% of the "both" infants. Table 4 summarizes the frequencies of discharge diagnoses.

Table 4

Discharge Diagnoses

	Breast	Bottle	Both	Total
Failure to Thrive	5	4	5	14
Poor Feeding	7	4	5	22
Poor Breastfeeding	13	1	0	14
Hyperbilirubinemia	23	3	7	33
Mild Dehydration	3	0	1	4
Hypernatremia	15	1	2	18
Sepsis	6 (2 e.coli) (4 viral)	2 (viral)	1 (viral)	9
Social	4	2	6	12
Other	4 (2 UTI)	4	1	9

Maternal and Infant Problems in the Perinatal Period

Information was collected regarding maternal and infant problems noted in the chart. There was a great deal of "missing information" in this section, as the readmission history often did not mention complications surrounding the pregnancy, and/or labor and delivery. However, 39 of 70 charts noted at least one maternal complication, and 38 of 70 charts noted at least one infant complication. Mothers and/or infants had from 1-3 complications noted. Maternal complications included: preterm labor (7), toxemia (7), chronic hypertension (4), diabetes (6), and other (35). Complications included in the other

category were: Group B streptococcus (+), prolonged rupture of membranes (>24 hours), history of herpes, and maternal fever in labor. Fifty percent of the mothers in the breastfed and bottle fed group, and 75% of the "both" group had one or more maternal complications noted.

Infant complications included: meconium staining (9), poor feeding (25), early jaundice (6), small for gestational age (1), large for gestational age (5) and other (13). Complications in the other category included: vacuum extraction, cephalohematoma, mention of traumatic delivery, and a work-up for sepsis. Forty-eight percent of the breastfed infants, 80% of the bottle fed, and 56% of the "both" infants had at least one complication noted in the chart.

It is interesting to note that 21 infants had poor feeding mentioned as a part of their newborn hospital stay: 16 (36%) breastfed, 3 (30%) bottle fed, and 2 (13%) in the "both" group. Of these, only 4 of 16 infants in the breastfed group, and both of the infants in the "both" group had documentation of lactation assistance in the postpartum period. Histories on 2 infants in the breastfed group indicated that an extra day was spent in the hospital after birth due to feeding related issues.

Laboratory Results and Procedures Performed

Data were collected on the various laboratory tests and procedures performed on these infants. A total of 19 infants (43%) had a lumbar puncture, 15 (34%) breastfed, 2 (20%) bottle fed, and 2 (13%) in the "both" group. A sample of cerebrospinal fluid was obtained for only 16 of the infants. Many infants were noted to have more than one attempt to obtain a sample. No specimens were positive.

Blood cultures were drawn on 37 (53%) of the total sample. Twenty-four (55%) breastfed, 6 (60%) bottle fed, and 7 (44%) in the "both" group were cultured. Two specimens were positive (both from the breastfed group), with e. coli as the identified organism in both cases. Blood chemistries were obtained on 67 infants, 96% of the sample. Thirty-seven (53%) of these samples were positive, defined for the purposes of this study as: serum bilirubin $\geq$ 20 mg/dL, serum sodium $\geq$ 145 mEq/L, elevated liver function tests (1 infant) and low serum potassium (1 infant). Twenty-five (57%) of the breastfed, 5 (50%) bottle fed, and 7 (44%) of the "both" infants had positive specimens.

Sixty-one infants (87%) had hematologic studies drawn. Seven samples (10%) were positive due to either an abnormal white cell differential or a low platelet count. Four (9%) of the breastfed infants and 3 (30%) of the bottle fed infants had positive specimens. Two of the positive CBC results in the breastfed group were from the infants with the positive blood cultures.

Other procedures were performed on the infants, most commonly radiographic studies. A total of 15 babies had from one to three studies done. A total of ten chest x-rays, three head ultrasounds and five CT scans of the head were done. Seven "other" tests were performed. These included renal or abdominal ultrasound and one electroencephalogram (EEG). Nine percent (4) of the breastfed and 6% (1) of the "both" infants had chest x-rays, as compared to 50% (5) of the bottle fed infants. Five percent (2) of the breastfed infants and no "both" infants had head ultrasounds, compared to 10% (1) of the bottle fed infants. Seven percent (3) of breastfed and no "both" infants had a CT scan, compared to 20% (2) of bottle fed infants. Nine percent (4) of breastfed and no "both" infants had other tests. Thirty percent (3) of the bottle fed infants had other

studies. Of all of these diagnostic tests, only the EEG was positive, on a known drug affected infant. Two renal ultrasounds showed transient renal pathology related to the severity of dehydration experienced by the infant. A summary of tests and results follows in Table 5.

Table 5

Summary of Laboratory Tests and Diagnostic Studies Performed during Hospitalization

	Breast	Bottle	Both	Total
Lumbar Puncture	15	2	2	19
Positive Result	0	0	0	0
Blood Cultures	24	6	7	37
Positive Result	2 (e.coli)	0	0	2
Blood Chemistries	44 (all)	10 (all)	13	67
Positive Result*	25	5	7	37
Hematologies	40	9	12	61
Positive Result*	4	3		7
Diagnostic Studies				
Chest X-Ray	4	5	1	10
Positive Result	0	0	0	
Head Ultrasound	2	1	0	3
Positive Result	0	0	0	
CT Scan of Head	3	2	0	5
Positive Result	0	0		
Other**	4	3		7
Positive Result	2 (Renal US)	1 (EEG)		

* Tests counted positive for: Bilirubin $\geq$ 20 mg/dL, Na+ $\geq$ 145mEq/L, elevated LFT's, Low K+

* Tests counted positive for abnormal CBC, low platelets

** Includes EEG, Renal ultrasound, Abdominal Ultrasound

Thirty-one infants were admitted with a diagnosis of dehydration. For this study, mild dehydration was defined as a serum sodium level ≥ 145 mEq/L and hypernatremic dehydration was defined as a serum sodium level ≥ 150 mEq/L. Thirty-four percent (8) of the breastfed infants, 10% (1) of the bottle fed, and 13% (2) of the "both" infants had documented hypernatremia. The range of sodium levels for those in the hypernatremic dehydration group was 150 mEq/L-174 mEq/L (Mean 155).

Of note are the infants admitted with the diagnosis of jaundice. Hyperbilirubinemia requiring treatment is frequently defined in the literature as a bilirubin ≥ 20 mg/dL after 72 hours of age (AAP, 1994). Only 19 of 38 infants (50%) admitted with the diagnosis of hyperbilirubinemia had a serum bilirubin level greater than 20 mg/dL.

Other Laboratory Tests and Consults During Hospitalization

Other diagnostic tests were performed as part of the hospital work-up. The most common were: urine culture (26), type and screen (20), Coombs (17), viral work-up (11), and blood gas (10). Of these tests, 1 urine culture was documented positive with e.coli. None of the viral work-ups yielded a positive viral culture. However, 7 infants were discharged with a diagnosis of probable viral illness.

Additional consults were ordered on 18 infants. Nine (14%) of the breastfed infants, 4 (40%) of the bottle fed, and 5 (31%) of the "both" infants had consults. Fifteen infants had 1 consult, and 3 infants had 2 consults (1 breastfed and 2 bottle fed). The most common consults were Pediatric Infectious Disease, Speech Therapy for assistance with feeding difficulties, and Social Services.

Lactation consultations were completed for 31 (44%) of the patients. The lactation services department saw 20 (45%) of the breastfed babies, 2 (20%) of the bottle fed, and 9 (56%) of the "both" infants. Consults ordered on 4 patients were not done due to unavailability of services on the weekend. Half of the mothers and infants received no help beyond basic nursing care with feeding issues.

Prescribed Therapies

Various therapies prescribed for these infants included intravenous fluids (44), antibiotics (29), and phototherapy, both in the hospital (31) and at home either before or after hospitalization (11). Twenty percent (31) of the breastfed, 50% of both the bottle fed (5), and "both" (8) infants had intravenous therapy in the hospital. Three additional breastfed infants had multiple unsuccessful attempts at placing a peripheral intravenous line. Rather than placing a central line, the infants were rehydrated orally. Forty-five percent (20) of breastfed, 40% (4) of bottle fed, and 31% (5) of "both" infants received antibiotics during hospitalization. Forty-eight percent (21) of breastfed, 20% (2) of bottle fed, and 50% (8) of "both" infants received phototherapy in the hospital. Eighteen percent (8) of breastfed, no bottle fed, and 19% (3) of "both" infants received home phototherapy. Table 6 summarizes these findings.

Table 6

Therapies Ordered

	Breast	Bottle	Both	Total
IV Therapy	31	5	8	44
Antibiotics	20	4	5	29
Phototherapy	21	2	8	31
Home Phototherapy	8	0	3	11

Feeding Method on Admission, During and After Hospitalization

Sixteen babies were exclusively breastfed during hospitalization, 15 from the breastfed on admission group and one from the "both" group who had received supplementation prior to admission. Four (9%) of the infants breastfeeding at admission were exclusively bottle fed during hospitalization. Twenty-five (57%) breastfed infants received both breast and bottle feedings during hospitalization. One mother in the bottle fed group desired to resume lactation during hospitalization, and this infant was both breast and bottle feeding at discharge. Another mother in the bottle feeding group began using the electric breast pump and planned to bottle feed her infant pumped breast milk, supplementing with formula as necessary. The remaining 8 bottle fed infants continued with formula feedings. Four (25%) infants in the "both" group were exclusively bottle fed during hospitalization and 11 (69%) continued with breast and bottle feedings.

Twenty-four (55%) of the breastfed on admission infants were exclusively breastfeeding at discharge. Six (14%) infants in the breastfed group had been switched to

total bottle feedings and 14 (32%) were breastfeeding and supplementing. Two of the 16 infants (13%) receiving "both" feedings on admission were exclusively breastfeeding at discharge, 6 (37%) had been switched to total bottle feeds, and 8 (50%) were continuing to receive both types of feeds. Table 7 contains a summary of feedings at admission, during hospitalization, and at discharge.

Table 7

Feeding Method at Admission, During Hospitalization, and at Discharge

	Feeding Method at Admission			
	Breast	Bottle	Both	Total
	44	10	16	70
Hospital Feeding Method				
Breast	15	0	1	16
Bottle	4	9	4	17
Both	25	1	11	37
Discharge Feeding Method				
Breast	24	0	2	26
Bottle	6	8	6	21
Both	14	2	8	23

Summary

In summary, the results describing the three groups of infants show many similarities as well as some important differences. The breast and "both" infants were younger at readmission and experienced a greater degree of weight loss than the bottle fed infants. The majority of the breastfed and "both" infants had no positive results with any of the diagnostic work-ups performed. They responded quickly to increased caloric

intake and were hospitalized an average of 2 days. The bottle fed infants were older at admission and hospitalized 3.5 days. They experienced a greater frequency of diagnostic tests and consults than either the breast or "both" group. It appears that many of the hospitalizations in this sample related primarily to feeding issues. It is possible that some hospitalizations could have been prevented by early assessment of the potential for problems, early follow-up and management of breastfeeding problems encountered by mothers in the early days postpartum.

CHAPTER 5

Discussion

Discussion of Results

The purpose of this study was to examine the relationship between feeding method (bottle or breast) and failure to thrive or dehydration requiring hospitalization in a group of infants under one month of age. The results regarding both the breastfed and "both" infants support the original observations that the majority of these infants are hungry, not ill. As in the study by Hellings and Woo (1995), the breast and "both" infants appear to be more like one another than either group compared with bottle fed infants in the following characteristics: birth weight (greater for breast and "both"), age at readmission (younger for breast and "both"), length of stay (shorter for breast and "both"), and degree of weight loss prior to admission (greater for breast and "both"). Statistical significance of differences cannot be established due to the small sample size and inequality in sizes of the three groups of infants.

Forty-three percent (19) of the infants in the breastfed group, 75% (12) of those in the "both" group, and 10% (1) of the bottle fed infants were first born. It would have been easy to hypothesize that a greater percentage of breastfed infants needing hospitalization would have been first-born—due to lack of maternal knowledge regarding breastfeeding and normal newborn care. However, nothing is known of the previous breastfeeding experience(s) of the mother. It is possible that this hospitalized infant could be her first breastfed infant, or that she had difficulties breastfeeding a previous infant. Others have shown that both primiparous women and multiparous women share a similar

degree of knowledge deficit in all areas during the postpartum period. Brown and Johnson (1998) conducted a pilot study regarding the benefits of postpartum home visits for low-risk mothers and infants. Sixty-six percent of their study population were multiparous women. One of their surprise findings was an equal level of knowledge deficit regarding self care, infant care and feeding issues in the postpartum period between primiparous and multiparous women. Ninety-seven percent of the mothers in their study reported a knowledge deficit in these areas.

Comparisons of Gestational Age and Weights between Breastfed, Bottle fed, and "Both" Infants

The degree of weight loss experienced by the breast and "both" infants indicates a greater caloric deficit than the bottle fed infants. Seventeen infants (39%) in the breastfed group had lost >10% of their birth weight by the time of admission. Two of these infants had experienced a >20% weight loss (21%, 24%). Five of 16 infants (31%) in the "both" group lost >10% of their birth weight. One of these infants had lost 22.5% of birth weight. The greatest amount of weight loss in the bottle fed group was 13%. This was also the only bottle fed infant to lose >10% of birth weight. This difference might be explained by better caloric and volume intake in the bottle fed infants.

Admission and Discharge Diagnoses

It is difficult to draw conclusions about similarities and differences between the 3 groups of infants based on admission and discharge diagnoses. It is interesting to note that 41% of the breastfed infants, 30% of the bottle fed infants and 63% of the "both" infants had poor feeding listed as an admission diagnosis. It is possible that the higher percentage of infants in the "both" group reflects contact with a medical professional who

recommended supplementation and/or increased family awareness that things were not going well. Both poor feeding and poor breastfeeding were listed as discharge diagnoses. Thirty-six percent of the breastfed infants and 40% of the bottle fed infants were discharged with a diagnosis of poor feeding. Thirty percent of the breastfed infants and 10% of the bottle fed infants had a discharge diagnosis acknowledging poor breastfeeding.

The degree to which elevated bilirubin levels compromise an infant's ability to feed well is open to debate. Gartner and Auerbach (1987) discuss hyperbilirubinemia as a result of poor breastfeeding, not a cause of poor breastfeeding in many cases. Eighty-six percent (38) of the sample had hyperbilirubinemia listed as an admission diagnosis and 75% (33) listed hyperbilirubinemia as a discharge diagnosis. Of these, only 27% (19) had bilirubin levels $\geq$ 20 mg/dL. Comparing the groups, 52% (23) of the breastfed infants had a discharge diagnosis of hyperbilirubinemia but only 30% (13) had a bilirubin level greater than 20 mg/dL. Thirty percent (3) of the bottle fed infants, and 44% (7) of the "both" infants were discharged with a diagnosis of hyperbilirubinemia, but only 20% (2) of the bottle fed and 25% (4) of the "both" infants had a level greater than 20 mg/dL. One could reasonably expect a higher rate of hyperbilirubinemia in breastfed infants for whom adequate caloric intake, and thus stooling, was not occurring. The "both" infants may have had a decreased incidence of hyperbilirubinemia due to the introduction of supplemental feedings. The bottle fed infants had the lowest frequency of hyperbilirubinemia, but were also admitted to the hospital an average of 6 days later than the breast or the "both" group—past the normal physiological peak in bilirubin level.

Thirty three percent (23) of the sample were admitted with a diagnosis of mild dehydration, with a fairly similar distribution among the 3 groups (34% breast, 30%

bottle, 31% "both"). At discharge, 7% of the breastfed infants, no bottle fed infants, and 6% of the "both" infants still had a diagnosis of mild dehydration. Eleven percent (8) of the sample were admitted with a diagnosis of hypernatremic dehydration. Fourteen percent (6) of the breastfed infants were admitted with a diagnosis of hypernatremic dehydration. However, this number increased to 34% (15) for the discharge diagnosis after laboratory determination of a serum sodium > 150 mEq/L. One infant (10%) in the bottle fed group was admitted and discharged with the diagnosis of hypernatremic dehydration. One infant (6%) in the "both" group was admitted with hypernatremic dehydration and two infants (12%) were discharged with this diagnosis. It makes sense that the breastfed infants experienced a greater degree of hypernatremic dehydration than either the bottle fed or both infants, since presumably the latter two groups had been offered a greater amount of fluid prior to admission—even if only short term for the "both" group.

Maternal and Infant Problems in the Perinatal Period

Half of the mothers in the breastfeeding group had some sort of antepartum or intrapartum complication recorded in the history. Half of the breastfed infants were noted to have one or more risk factors associated with the birth or in the immediate postpartum period. Half of the mothers and 80% of the babies in the bottle feeding group and 75% of the mothers and half of the infants in the "both" group had documentation of a complication in the records. The most commonly mentioned infant problem in the breast and bottle group (30% in both groups) was poor feeding. Yet, only 5 of 25 infants who had mention of poor feeding after birth had documented assistance with feeding in the

postpartum period. It is likely that support, assistance and follow-up regarding feeding issues could have prevented some of these hospitalizations.

Did the higher rate of infant complications in the bottle fed group compared to the breast and "both" group contribute to a decision to bottle feed? Did the mother change her mind about feeding method once her infant had documented complications? Did the higher level of maternal complications in the "both" group explain a decision to begin supplementation early? One can only speculate about the meaning of these similarities and differences between the 3 groups of infants.

Laboratory Results and Procedures Performed

These primarily well infants experienced multiple invasive procedures during hospitalization. Nineteen spinal taps were performed. Results were negative on the 16 successfully obtained samples. Thirty-seven infants had venipuncture for blood culture. There were 2 positive samples (2.9%) with e.coli as the isolated organism. The 2 positive cultures were from infants in the breastfed group. Both infants were discharged 1 day after birth and readmitted the next day. Neither admission note mentions risk factors for sepsis, such as prolonged rupture of membranes or maternal elevation of temperature in labor. Other than age at readmission, the only common factor for the infants was a history of chronic hypertension in both mothers. Other concerns in the postpartum period which could have indicated illness in these infants are not apparent from the records.

Ninety-six percent of the total sample had either venipuncture or heel stick phlebotomy for hematologic and/or chemical analysis. Thirty-seven (53%) of the chemistries were abnormal (mostly elevated serum sodium or bilirubin) and 7 CBC's (10%) were abnormal. The slightly higher rate of positive blood chemistries in the

breastfed group (57% compared to 50% [bottle] and 44% [both]) may be explained by a slightly higher degree of dehydration and hyperbilirubinemia secondary to poor feeding. The low degree of positive CBC's in the breastfed group and absence of positive CBC's in the "both" group support the position that most of these infants were not ill.

A total of 25 radiographic studies were performed. Ten of these were done on the bottle fed babies, 1 on a "both" infant, and 14 in the breastfed group. In the breastfed group, 4 infants had renal ultrasound—done because of the degree of dehydration experienced by the infant. This level of dehydration is preventable, if the mother and infant receive adequate feeding support and information.

Other Laboratory Tests and Consults during Hospitalization

Thirty percent of the breastfed infants, 50% of the bottle fed infants, and 20% of the "both" infants had urine cultures. Of these, only 1 culture was positive in a breastfed infant who was 18 days of age at admission. Interestingly, this infant was not blood culture positive. Irrespective of the urine culture, this baby warranted attention long before the hospital admission. The infant weighed 4054 grams at birth and had lost 354 grams (8%) at the two week check-up. The mother was instructed to bring the infant back for a weight check in one week. At that time, the weight was down to 3280 grams (19% weight loss) and the infant was admitted to the hospital with a diagnosis of failure to thrive. It is not clear if the infant was more susceptible to infection because of its compromised nutritional status. Is possible that the infant was not feeding well because of the urinary tract infection.

Twenty percent of the breastfed infants, 40 % of the bottle fed, and 31% of the "both" infants had specialty consults. The higher percentage of bottle fed infants receiving

specialty consults may indicate potential problems beyond simple feeding issues. However, whether any of these consults resulted in non-feeding related diagnoses is not clear.

Prescribed Therapies

Thirty-one of 44 (70%) breastfed infants had intravenous therapy while in the hospital. Half of the bottle and "both" group received intravenous therapy. It is possible to hypothesize that the breastfed infants were more dehydrated and in need of fluids. This does not appear to be so, based on mean weight loss and serum sodium levels. Twenty-nine infants (66%) in the entire sample received antibiotics, yet only two infants were blood culture positive and only 7 CBC's were abnormal.

Half of the breastfed and "both" infants, and 20% of the bottle fed infants received phototherapy in the hospital. Yet only 30% of the breast fed, 25% of the "both", and 20% of the bottle fed infants had bilirubin levels greater than 20 mg/dL at 72 hours of age--the accepted standard for treatment. These figures would cast doubt on the need for treatment in many cases. Eighteen percent of breastfed and "both" infants also received home phototherapy. With appropriate breastfeeding support, these infants may have been able to be managed at home. The costs associated with hospitalization, intravenous therapy, and antibiotic therapy are not insignificant. If these hospitalizations are avoidable, there would be savings in health care dollars as well as decreased family disruption.

Feeding Method on Admission, During and After Hospitalization

Overall, 63% of the sample were exclusively breastfeeding (although not totally successfully) at hospital admission, yet only 37% were doing so at discharge. The

duration of breastfeeding after hospitalization for these infants cannot be determined from this study. It is not known how many of the 23 infants in the "both at discharge" group were able to transition to total breastfeeding, how many switched to total bottle feeding and how many continued breastfeeding with supplementation.

Disturbing to this investigator is the fact that only 31 patients (44%) were seen by the lactation services department. Less than 50% (20) of the infants exclusively breastfeeding at admission were seen by a lactation consultant during hospitalization. Twenty percent of the bottle fed infants and 56% of the "both" infants were seen by lactation services. Four consults were ordered but not done due to lack of coverage on the weekends. Intervention by a lactation specialist during hospitalization may improve the duration of breastfeeding and/or provide support for the mother to make an informed decision to discontinue breastfeeding.

In summary, the results of this study describe hospitalizations for many well infants who were primarily having difficulty with feedings. The infants in the "both" group share many similarities with the breastfed infants as far as age and percentage of weight loss at readmission. It is interesting to note that they had the greatest frequency of poor feeding mentioned as an admission diagnosis. They had a higher degree of maternal complications than the other two groups. They had the lowest frequency of venipuncture for blood culture, the lowest frequency of positive chemistry and hematology results, and the lowest antibiotic usage. It is possible the etiology of their difficulties was recognized as a feeding difficulty rather than failure to thrive or suspected sepsis—since many of these infants' families had been in contact with a health care provider in the 1-2 days prior to admission.

The bottle fed infants had the greatest frequency of failure to thrive as an admission diagnosis, while the breastfed infants had the lowest frequency.

The results of this study are similar to the findings of Hellings and Woo (1995). This study showed 43% of the infants had a lumbar puncture, compared with 34% in the Hellings and Woo study. No samples were culture positive. Fifty-seven of the breastfed infants in this study had positive chemistry studies, compared to 56% in the Hellings and Woo study. Hematologic studies also showed similar findings, 9% positive in the breast fed group in both studies, 30% positive in the bottle fed group for this study, and 23% positive in the Hellings and Woo study. Fifty percent of the bottle fed infants in this study had positive chemistries, compared to 41% in the Hellings and Woo group. There was a lower overall frequency of positive blood cultures in this sample (2 breastfed infants) compared to 2 breastfed and 9 bottle fed infants in the Hellings and Woo sample.

Implications for Nursing Practice

The mothers and infants in this study speak loudly to the need for more comprehensive care regarding feeding issues in the early postpartum period. Feeding an infant, whether by breast or bottle, is a learned art. Many mothers do not receive the information and support they need to nourish their infants adequately. Good support for a breastfeeding mother begins, at the very latest, during her prenatal care. Feeding information needs to be thoroughly discussed. Mothers need to be provided with information regarding not only the benefits of breastfeeding but the risks of formula feeding so that they can make an informed feeding choice. A decision to formula feed needs further exploration from a knowledgeable health care professional. A history and physical examination for "breastfeeding success" needs to be done in the third trimester of

pregnancy. Risk factors for lactose intolerance and inadequate milk supply need to be addressed at this time and communicated to the infant's care provider.

Some hospitalizations in this study likely could have been prevented by early assessment and management of the potential for feeding difficulties. For example, one breastfeeding mother had a history of Hodgkin's disease and radiation to the chest 5 years prior to the birth of this baby. This was certainly a risk factor for inadequate milk supply. Prenatal counseling, and early infant follow-up could have prevented weight loss severe enough to case this infant's hospitalization. Another infant, admitted at 29 days of age, 300 grams under birth weight, was breastfed for 1 day, then switched to formula feedings. Feeding difficulties (diarrhea, mucousy stools, weight loss) continued despite formula changes. It is unlikely that a health care professional was consulted when the mother decided to discontinue breastfeeding. There is no evidence that the possibility of relactation was ever discussed with the mother when the infant clearly was not tolerating the different formulas, or that a family history taken regarding a history of food allergies, specifically milk intolerance.

Prenatal care providers need to emphasize the benefits of attending prenatal breastfeeding and parenting classes, and encourage inclusion of the father or other support persons. The success of breastfeeding depends not only on the mother and her infant, but on the support systems which enfold her (Dix, 1991; O'Campo, Faden, Gielen, and Wang, 1992). Nurses on the mother-baby unit must continue to take an active part in assisting mothers and babies with feeding issues and have an adequate knowledge base to make appropriate referrals for lactation services. Hospital management teams need to look at the benefits of providing lactation services for all mothers. All new mothers might benefit

from a follow-up phone call in the first 24 hours after hospital discharge and a mother-baby visit in the first week after birth. Health care providers and third party payors must look at the economics of hospitalizing one infant verses providing preventive follow-up care to a large number of mothers and infants.

Education of all levels of health professionals must continue, on topics including: the benefits of breastfeeding, methods of assisting a breastfeeding mother and infant, the risks of formula feeding, and ways to support a mother who is unable or unwilling to breastfeed despite the best of knowledge and support.

Limitations of This Study

The sample size is small. Comparisons are difficult to establish between the groups due to the inequality in size of the groups. Statistical analyses are essentially meaningless. Conclusions about hospitalized bottle fed infants are difficult to establish since there were only 10 bottle fed infants in the sample, and 4 of these began as breastfed infants. This study shows that 26 infants were exclusively breastfeeding at hospital discharge but cannot address the duration of breastfeeding for these families nor the adequacy of follow-up with feeding related issues. The discontinuation of breastfeeding is to be viewed as a negative outcome for many of the mothers and infants. In addition, this study did not measure the degree of family disruption caused by hospitalization of an infant, or factors associated with the development of a vulnerable child syndrome.

Suggestions for Future Research

The results of this study need to be combined with those collected by Hellings and Woo (1995) to look at a total sample size of 143 infants from two different pediatric tertiary care centers. To understand fully the causes and effects of failure to thrive and/or

prevented by early contact with a health care provider knowledgeable in the area of breastfeeding.

The monetary and psychological costs of unnecessary hospitalizations and the potential for early discontinuation of breastfeeding—all undesirable outcomes--may be preventable. It is well documented that breastfed babies save health care dollars, both short term and long term (Riordan, 1997, Walker, 1993). The money spent on these hospitalizations would have been better utilized providing early follow-up programs for mothers and infants. Dollars spent on prevention of disease and promotion of wellness behaviors go much further than those spent on treating illness.

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Appendix A

Data Collection Form

FEEDING AND HOSPITALIZATION DATA COLLECTION SHEET

1. Study Number _____
2. Year of Admission_____
3. Age of infant (in days)_____
4. Sex of infant
   1 Male 2 Female
5. Other infant diagnosis at admission_____
   _____
6. Birth History
   1 From chart 2 Admission history
7. Birth Weight (grams)_____
8. Birth Order
   1 1st 2 Later
9. Length of postpartum stay (days)_____
10. Infant health problems
    1 Yes 2 No 3 Missing
11. Maternal health problems
    1 Yes 2 No 3 Missing
12. Evidence of feeding education during postpartum
    1 Yes 2 None documented
13. Home location
    1 Portland metro 2 Outside metro
14. Method of feeding at admission
    1 Breast 2 Bottle 3 Both
15. Weight at admission (grams)_____
16. Length of hospitalization (days)_____
17. Spinal tap 1 Yes 2 No
18. Results 1 Positive 2 Negative
19. Blood chemistries 1 Yes 2 No
20. Results: 1 Positive 2 Negative
21. Peak Bilirubin_____ 22. Age_____
23. Peak Sodium_____
24. Blood Hematology 1 Yes 2 No
25. Results: 1 Positive 2 Negative
26. Cultures 1 Yes 2 No
27. Results: 1 Positive 2 Negative
28. X-rays 1 Yes 2 No
    List_____
29. Consult with specialists
    1 Yes 2 No
30. How many_____
31. Other tests_____
32. Feeding method during hospitalization
    1 Breast 2 Bottle 3 Both
33. Feeding education/support provided during hospitalization
    1 Yes 2 None documented
34. Feeding method at discharge
    1 Breast 2 Bottle 3 Both
35. Weight at discharge (grams)_____
36. Discharge diagnoses_____
    _____

Comments_____

_____

_____

_____