The Premature Infant

ITS MEDICAL AND NURSING CARE

By JULIUS H. HESS, M.D.
AND
EVELYN C. LUNDEEN, R.N.

A Book of Vast Interest to Every Doctor and Nurse

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This book is dedicated to
The Infants' Aid Society of Chicago
through whose loyalty and devotion

THE HORTENSE SCHOEN JOSEPH PREMATURE STATION

OF

MICHAEL REESE HOSPITAL

was established and is being maintained
as a Memorial to the
Founder and First President
of their Society

Preface

In the past ten years, the birth rate in the State of Illinois, the state with which we are most familiar, has dropped from 20.5 per 1,000 population in 1930 to 15.6 in 1940. This is a decrease of 23.9 per cent. In Chicago, however, the decline has been from 17.2 in 1930 to 15.0 in 1940, a reduction of 12.8 per cent. Such facts are significant and should be given our most serious consideration. They emphasize the importance of preserving infant life and of giving all possible assistance toward the development of healthy minds and bodies.

During this same period, among each 1,000 live births, the mortality rate among all newborn infants in the State of Illinois has been reduced 37.3 per cent; from 56 in 1930 to 35.1 in 1940. In Chicago the decrease has been from 53.4 in 1930 to 28.8 in 1940, a reduction of 46 per cent.

Statistics indicate that lives have been saved largely among infants past one month of age. These results have been chiefly due to minimizing infections among young infants, and more especially the infections of the respiratory and gastro-intestinal tracts. Far less has been accomplished in reducing infant mortality in the first day, week and month of life. Furthermore, approximately one-half of all the deaths in the first month of life in the State of Illinois are still being reported as due to premature birth. Moreover, it is in these first weeks of life that metabolic disturbances, which are the forerunners of secondary anemias, rickets and tetany, are most active in the premature infant. Therefore, further reduction of infant mortality, and of the equally important morbidity, must be sought in these first periods in the life of a newborn, and more especially of the prematurely born.

The development and initiation of a program to meet the needs of premature infants is the first step to be observed. Twenty-eight of the 48 states, as well as the District of Columbia and the Territory of Hawaii, have more or less complete plans in operation for improving the care of premature infants. Some of these emphasize the development of urban centers, while others have concentrated on rural areas.

Any program, whether it is city or state-wide or limited only to the requirements for care in the home, must provide the minimum facilities to meet the needs of the infant. There must be adequate provision for transportation of the infant without exposure, if it is to be moved from its home. Nursing service by trained personnel is essential, and oxygen and other types of emergency therapy must be available. Further, provision should be made to supply breast milk, at least for very small infants. Instruction of mothers in the promotion of breast-milk secretion and in aseptic nursing care of the infant is important. Such a service should also supply a simple type of heated bed for the early use of the infant, if it is to be cared for in the home, and when indicated, similar beds for the use of graduates from hospitals after return to the home.

Most striking is the reduction of cases of congenital syphilis seen among premature infants at the Sarah Morris Hospital * Station. There has been a decline from an average of 8.27 per cent of all infants admitted during the first 12 years that the Station was in operation, to less than 1 per cent during 1940. In all probability, this is due to the rigid enforcement of the recent marriage laws in Illinois and to the practice of making serologic tests of pregnant women, followed by the institution of treatment of infected mothers during the later months of pregnancy.

In 1922 Dr. Hess published a book which included the first comprehensive survey of the problems of prematurity and methods of care. In the 20 years that have passed since then the authors have continually been alert to study effects of new technics and methods and have utilized the new advances that would aid in bringing down the mortality and morbidity rates of their charges. We therefore present in the following pages something of the practical experience gained from work in the Station co-ordinated with what medical science has to offer us today. Since it is our conviction that untiring, unremitting care has no substitute in the care of the premature infant, we have deemed it essential to give equal prominence to the role of the nurse.

We are indebted to Lea and Febiger, publishers, for permission to use material from the book "Premature and Congenitally Diseased Infants," written by Dr. Julius H. Hess.

We also gratefully acknowledge our appreciation to Mrs. Anna Mantel Fishbein for her able assistance in editing the manuscript and to our secretary, Miss Mary Anne Norin, for her untiring patience and constructive interest in the preparation of this book.

THE AUTHORS

Chicago, Illinois

* The Sarah Morris is the Children's Hospital of the Michael Reese Hospital in Chicago.

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What Constitutes Prematurity in the Infant

At the Annual Meeting of the American Academy of Pediatrics held in New York City on May 19, 1935, the following resolution was passed defining prematurity:

> For statistical purposes and comparison of results of care, a uniform standard for diagnosis of prematurity is important. A premature infant is one who weighs 2,500 grams or less at birth (not on admission) regardless of the period of gestation. All liveborn premature infants should be included, evidence of life being heart beating or breathing.

According to this interpretation, premature infants may be classified for practical clinical purposes to include any infant, of single or multiple birth, born prematurely, at term, or even past term, whose weight at birth is below 2,500 grams (5½ pounds). The inference is that the infant is not completely prepared for full, normal, independent, extra-uterine life. There may be, however, only a relative body weakness, in the absence of inherited constitutional debility and malformations. Careful consideration must be given in each individual case to the precipitating causes in the parents and in the infant as well, which might have led to premature delivery or to pathologic intra-uterine development.

It is well established that the younger and smaller the fetus, on leaving the uterus, the greater are the difficulties to be overcome in carrying out required body functions necessary to life. The subsequent lower vitality is obvious.

CLASSIFICATION OF PREMATURE INFANTS

For statistical study and comparison of reports, premature infants may be grouped as follows:

I. According to birth weight—living and dead.
   1. Under 750 grams.
   2. 750 to 1,000 grams.
   3. 1,001 to 1,250 grams.
   4. 1,251 to 1,500 grams.
   5. 1,501 to 2,000 grams.
   6. 2,001 to 2,500 grams.

II. Age at time of death of various weight groups.

III. Age at time of admission of infants received from outside hospitals and homes.

IV. According to their physical development.
   1. Premature infants without pathologic changes. Those normal for their fetal age.
   2. Premature infants with pathologic changes due to:
      a. Constitutional disease and chronic infections in the parents.
      b. Maternal factors influencing the fetal nutrition, such as overwork, undernourishment and acute illnesses during pregnancy. Any of the acute infectious diseases may be responsible for the termination of pregnancy before the end of the term. Pneumonia, influenza, typhoid fever, malaria, diphtheria, scarlet fever, measles, smallpox, Asiatic cholera and bubonic plague may have a deleterious effect on the continuance of pregnancy. Premature labor is quite common in the presence of pneumonia and influenza.
      c. Local conditions in the mother, such as contracted pelvis, premature separation of the placenta, difficult presentations, uterine fibroids resulting in improper nutrition, and asphyxia due to various causes, such as pressure of the cord around the neck. Local conditions, such as diseases of the decidua or gonorrheal infection of the endometrium and malpositions of the uterus, frequently result in premature labor, often before the fetus is viable. Anomalous positions of the fetus in the uterus may be responsible for the premature expulsion of the uterine contents.
      d. Multiple pregnancies, which are a common cause of premature labor.
      e. Constitutional defects and congenital malformations in the fetus.
      f. Infants born to parents late in life.

3. Full-term but immature infants with pathologic changes due to the same causes as those enumerated under 2.

ETIOLOGY

Premature birth depends on many causes, which may be divided into those resulting in the expulsion of a healthy premature infant, and those which have a damaging effect on the product of conception. In the first group may be included various injuries, falls, heavy lifting, overwork or other physical exhaustion, sudden emotional disturbances and premature rupture of the membranes, either accidental or intentional. These conditions do not necessarily affect the nutrition of the ovum, yet some may be followed by impaired nutrition of the fetus. Pelvic or spinal deformity in the mother, placenta praevia, premature detachment of the placenta, etc., may also result in improper nutrition and premature expulsion of the fetus.

Conditions which require operative procedure, although not involving the uterine cavity, frequently result in premature labor either through shock or trauma. Furthermore, infection may be an added danger in the presence of cholecystitis, cholelithiasis, appendicitis, ileus and renal operations.

All disorders of the second category react in varying degrees on the fetus. For instance, the milder, acute infections may produce only temporary weakness, while others, as a result of their long-continued action on the nutrition and development of the fetus, may cause an impaired physical condition.

Syphilis is one of the most significant causes of prematurity. Among the 3,540 premature infants received in the Premature Infant Station of the Sarah Morris Hospital up to January 1, 1940, 180, or 5.1 per cent, were found to be syphilitic on examination. In every case that is received at the Station, the mother, if living, is subjected to one or more Wassermann or Kahn tests. Should the diagnosis be doubtful, an endeavor is made to secure the blood of the father for examination. Many of these mothers have been seen in prenatal clinics, and whenever possible the history of their serologic reactions is obtained, together with the kind and amount of prenatal therapy received. This history is important to the infant should the mother's Wassermann or Kahn test be negative at the time of delivery. With such a record, the possibility of a latent or low-grade infection in the infant will not be overlooked in the Hospital Station, or later in the out-patient clinic. Every infant in whose mother the serologic test for syphilis has been found positive, either before or after delivery, is referred, with its complete history, to the out-patient clinic. This is important because some infants of both treated and untreated mothers do not show clinical evidence of syphilis. Nevertheless, for their own protection they must be considered as potential syphilitics. We do not place great importance on the blood findings of the infant itself. Whenever there is any doubt as to the activity of syphilis in the infant, x-rays are taken of the long bones. Forty-one of the 180 syphilitic infants died during their stay in the hospital. (For further consideration, see Chap. 26, Syphilis.)

Pulmonary Tuberculosis. Although pulmonary tuberculosis is the cause of premature labor less frequently than syphilis, the children, even at full term, are often small and weak. Tuberculosis of organs and tissues, other than the lungs, influences the fetus in proportion to the nutritional effect on the mother. Moreover, if the disease involves the vertebral column or hip joints, it may be necessary, because of resulting deformities, to induce premature labor. Congenital tuberculosis is quite rare but does occur. Premature infants are especially susceptible to contact infection and must therefore be kept away from cases of tuberculosis.

Chronic nephritis is one of the most frequent causes of spontaneous premature labor. The offspring of these mothers are often puny, due either to the systemic effect of the disease on the mother, or to the impaired nutrition of the fetus caused by placental hemorrhages and infarcts. Nephritis in the mother is another common indication for the induction of premature labor.

Cardiac Disorders. Premature labor is not unusual in women with cardiac disorders, in the presence of broken compensation. The infants are often imperfectly nourished as a result of the poor aeration of the mother's blood.

Exophthalmic goiter occasionally is the cause of premature emptying of the uterus. If chronic dyspnea exists as a result of a laryngeal or tracheal stenosis, the development of the fetus will necessarily be retarded.

Faulty nutrition of the fetus is a serious condition which results in immaturity. It may result from overwork or from lack of sufficient food, as well as from wasting diseases and blood dyscrasias (pernicious anemia and leukemia). In addition, any acute or chronic intoxication from bismuth, phosphorus, arsenic, mercury or lead, may cause either an early termination of pregnancy or so serious a lowering of nutrition of the fetus that the vitality at birth may be greatly impaired. Infants born to parents late in life are often born prematurely, perhaps because of the factor of undernourishment. This also seems true of premature infants born to women who have had numerous pregnancies at short intervals.

Multiple pregnancy is the most common single cause of premature expulsion of the fetus.

Congenital malformation in the fetus may result in premature birth.

Diabetes. In the presence of diabetes, prematurity is not infrequent. Infants of diabetic mothers may show glycosuria temporarily, with an early tendency to develop hypoglycemia, due to excessive secretion of insulin by the infant's pancreas.

Finally, habitual miscarriage without evident cause, resulting in the interruption of successive pregnancies, frequently at about the same stage, is not rare.

2

Physiologic Development

CLINICAL FEATURES

The appearance and characteristics of the healthy premature child vary with the fetal age at the time of birth. With a lengthening of the period of gestation, the distinctive characteristics of the fetus become less and less distinctive, until it becomes impossible to differentiate the slightly premature from the full-term infant. All the distinguishing features of the premature may also be found in the congenitally diseased full-term infant. Just as there are innumerable degrees of prematurity, so also are there all stages of development between the extremes of functional and anatomic inferiority on the one hand and the normal constitution on the other. Both the premature and the debilitated infant may exhibit the following features in varying degrees.

1. The body is usually small and puny, though in some instances the infant may be of considerable size and yet have an imperfect development of its internal organs.

2. The weight is slight, varying from amounts approximating 700 grams (1½ pounds) to 2,500 grams (5½ pounds) in the viable. The latter figure may be exceeded in infants nearing maturity, and by some of the full-term weaklings, but will serve as a fair maximum.

3. The skin is soft and usually of a vivid red color. The epidermis is thin and the blood vessels are easily seen.

4. The skin frequently hangs in folds. The adipose tissue is scant, the features are angular and the face looks old.

5. Lanugo is abundant, especially on the extensor surfaces of the extremities.

6. The skull is round or ovoid, in contradistinction to the dolichocephalic skull which is typical of the full-term newborn. The fontanelles are large and the sutures prominent.

7. Many small comedones are visible on the nose. The ears are soft and small, and hug the skull.

8. The nails have scarcely reached the ends of the fingers even in the larger infants, while in the smaller ones, they may be poorly developed.
9. The cry is feeble, monotonous and whining.

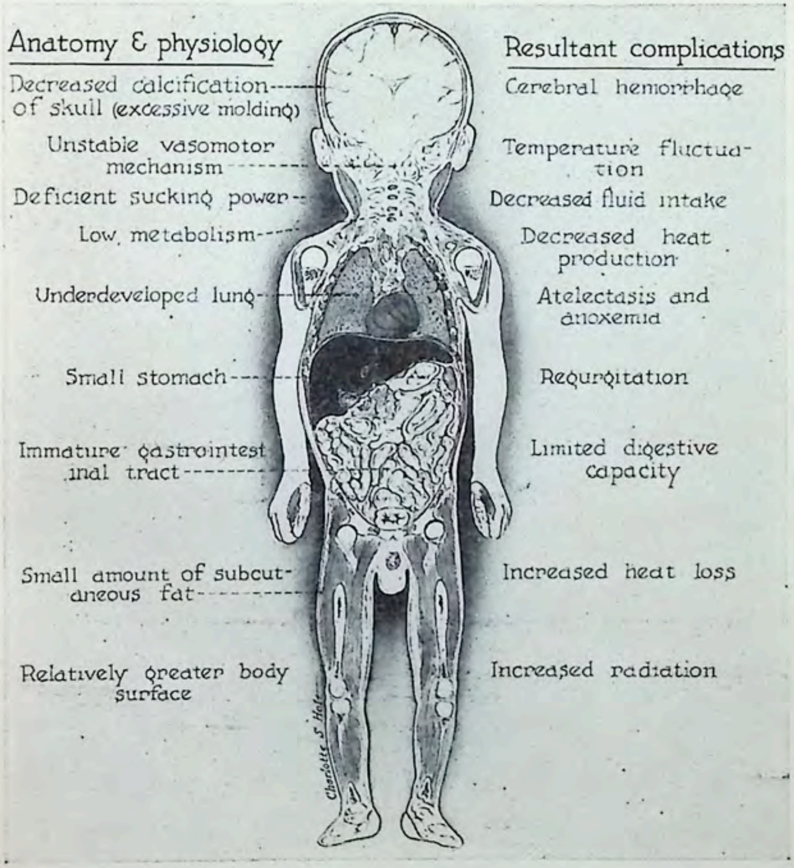


FIG. 1. Anatomic and physiologic development of seven-month fetus.

10. The infant lies in a deep sleep, and must be aroused for its feedings. Efforts at suction are weak or absent. All movements are slow, functions are sluggish and the child shows a remarkable degree of muscular inertia.

11. The temperature has a decided tendency to remain below normal and is inclined to be irregular in character.
12. The urine is usually scanty.
13. Early and intense jaundice is common.

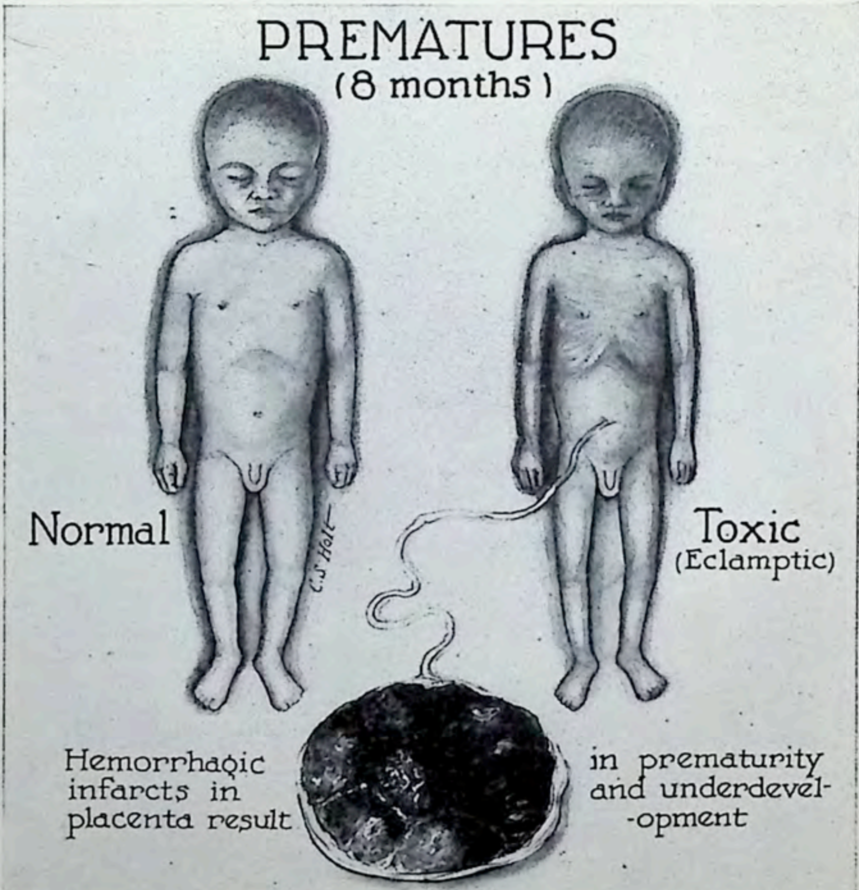


Fig. 2. Comparative development of infants born to normal mother and a toxic mother.

These are the principal appearances which may be observed on superficial examination. It must be remembered that any of these symptoms may vary in different individuals of the same age, depending on the cause of prematurity, and on the state of health of both the mother and the child. With increasing age, the characteristics become less conspicuous.

The determination of the exact age of the infant prematurely born offers considerable difficulty. The information furnished by the mother regarding her last menstrual period, or the time when life was first felt is insufficient to approximate accurately the date of confinement, so that errors in calculation of a month or more are not rare. In institutions for foundlings, as a rule, all data is absent and other means for determining the infant's fetal age must be consulted. Furthermore, weight is of little value, since an infant weighing 1,500 grams may be a premature seven-month baby of a healthy woman, while one of the same or lesser weight may be an eight-month offspring of a nephritic or syphilitic mother. Body measurements also vary considerably with the individual. The degree of development of the osseous system is invaluable in determining the anatomic development. Indirectly, the condition of the bones serves as a guide to judge physiologic development, although it does not give exact data regarding age.

TABLE I

PHYSICAL CHARACTERISTICS OF THE FETUS

	20-24 WEEKS	24-28 WEEKS	28-32 WEEKS	32-36 WEEKS	36-40 WEEKS
Weight Average	650 to 1,000 Gm.	1,000 to 1,200 Gm.	1,200 to 1,600 Gm.	1,600 to 2,500 Gm.	2,500 to 3,500 Gm.
Length	28-34 cm.	35-38 cm.	39-43 cm.	46-48 cm.	48-52½ cm.
Head Circumference	19-24 cm.	21-27 cm.	26-30 cm.	29-33 cm.	33-37 cm.
Chest Circumference	16-20 cm.	18-23 cm.	21-27 cm.	25-32 cm.	32-35 cm.
Skin	Wrinkled	Wrinkled Dull Red	Slight Filling out Dark Red	Filling out	Smooth Paler
Lanugo	Plus	Plus	Less	Less	Little
Hair on Head .			0.5 cm.	1.0 cm.	
Subcutaneous Fat	Very Little	Very Little	Plus	Plus	Rapid Increase
Nails	Soft	Soft	Firmer	Hardening	Well-formed
Testicles	Unde-scended	Often at External Ring		May be in Scrotum	Usually in Scrotum
Labia	Labia minora extend beyond labia majora				

The history of syphilis, tuberculosis, trauma, or other causes operating in the mother and responsible for the early emptying of the uterus, is of special significance to the welfare of those infants born but a few weeks before the full, natural term. Records of these diseases are more important to the premature infant than a determination of the approximate term of pregnancy or a consideration of the size of the infant.

BODY TEMPERATURE

During intra-uterine life, the child receives biologically the substances necessary for its maintenance, and for the development and regeneration of its cells. The maternal blood stream brings to the level of the placenta the oxygen and other elements needed for its nutrition. The passing of these foods into the antenatal circulation does not require any effort on the part of the fetus other than the cardiac contractions. From birth on, however, the child is an independent being and must fight that it may live.

Increased metabolism, dependent on the digestive and respiratory functions, is necessary to enable the infant to combat external physical agents, principally cold.

Hypothermia. Heat regulation is one of the least developed functions of the premature infant. As might be expected, the body temperature shows considerable fluctuation with a tendency to hypothermia. This is due to several factors.

1. Faulty Heat Regulation Due to Lack of Development on the Part of the Nervous System. It is possible to perceive that in a premature infant in which the brain is still developing, and in which the separation into white and gray matter has not been completed, the nervous system is not sufficiently mature to function normally.

2. Loss of Heat Through Radiation. The extent of the heat loss from the body of an animal by conduction, radiation and evaporation from the skin and the surface of the lungs is determined by the extent of the surface and by the thickness of the insulating subcutaneous fatty layer. The heat loss is in greater part proportional to the extent of the surface of the body. The body surface of a premature infant is relatively greater than that of a full-weight newborn. Wrinkled skin and absence of the fat deposits in the skin are also characteristic of the premature baby. These physical conditions make it difficult for the premature infant to retain its own heat and predispose to the readiness with which the subnormal temperature can occur.

3. Insufficient Oxygen Combustion Due to a Poorly Developed Respiratory Center. This often causes asphyxia.

4. A Slower Circulation Due to Weak Cardiac Action. Inadequate oxygenation is a consequence.

5. Insufficient Heat Production Due to Lack of Food or Inadequate Metabolism. This cause of hypothermia is of minor importance in the premature infant that is fed a sufficient quantity of breast milk and that shows ability to assimilate it. Since the sucking centers are too poorly developed to enable the infant to obtain ample nourishment, most of these infants cannot be trusted to their own resources in obtaining food.

A careful consideration of all of the factors tending to hypothermia makes it evident that we cannot depend on an equalization of the heat loss from the body surface by the internal production of heat. Therefore, in order to maintain a uniform temperature, it is necessary to assist the infant by giving it an artificial environment of good air, adequately heated to maintain a normal body temperature.

The heat-producing power in the premature baby is so meager that the body temperature falls below normal quickly. Therefore, instead of the normal 98.6° F. of the full-term infant, the temperature will fall to 96° F. or less, unless special effort is made to keep the baby warm. Such low temperatures are undesirable and can be avoided if the infant is put into an incubator or heated bed, with a surrounding temperature sufficient to maintain its body temperature. If the infant maintains a temperature between 97° and 98° F. during its first days, it will frequently make satisfactory progress.

Hyperthermia. Because of the instability of the heat-regulating center, premature infants react very quickly to overheating. For this reason the bed should be inspected as a possible cause of high temperature in the infant. If the surrounding temperature is the cause of the hyperthermia, cooling the bed will result in a quick response, and the infant's temperature will drop rapidly.

RESPIRATORY TRACT

One of the most conspicuous features of the premature and of the congenitally weak infant is the poor respiratory effort. In response to the need for oxygen, the premature infant inspires at birth, but its muscular power is weak and its efforts are insufficient to raise the thoracic wall and thus expand the pulmonic cavity. As a result, though the large bronchi are filled with air, many of the small bronchioles are not dilated, and a large portion of the lung remains in a fetal state and may require even weeks for its complete expansion.

Attacks of cyanosis, during which respiration ceases entirely, accompany the deficient oxygenation of the blood. Such an apneic interval may endure for as long as one minute and then breathing is resumed. These attacks are not at all infrequent during the first fortnight, and often appear without warning. In those instances in which recovery occurs, the attacks become less frequent and less severe, but when unrelieved, they are of grave significance and often result fatally.

Clinically, the weakened respirations are manifested by a monotonous, feeble, whining cry, and by grunting expirations with comparative immobility of the thorax. In addition, the respirations are superficial and often irregular, and become abdominal in type. While a child born at the sixth month may breathe for hours, it is not until the seventh month of gestation that the respiratory function may be considered as well established. Although respiratory exchange may not occur, the heart may beat several hours after birth.

The physical observations of the chest of the premature infant are uncertain. On inspection and palpation, the thorax is deficient in mobility; on percussion the sounds over the bases of the lungs are lower than over the balance of the chest, and on auscultation, the vesicular murmur is hardly perceptible. At autopsy, these signs are confirmed, and the lower lobes of the lungs, particularly, are found to be atelectatic. At times the major portion of the lung is involved, making gaseous interchange difficult.

Complete establishment of respiration may be prevented not only by the weakness of the respiratory movements but by the aspiration of liquor amnii or mucus during the last moments of delivery. Mechanically, the liquid will prevent the entrance of air into the pulmonary alveoli.

THE DIGESTIVE TRACT

The muscles of the buccal region, tongue and soft palate are weak. The stomach of the premature infant, before its first feeding, as seen at autopsy, is in an almost vertical position and tubular in form. In the premature infant which has been fed, the fundus is fairly well developed and, as a result, the stomach has assumed a more oblique position. This is corroborated by x-ray examination.

The cardiac end of the stomach is found well to the left and, generally, at about the level of the tenth dorsal vertebra. The cardiac sphincter is usually poorly developed. This partly accounts for the ease with which the premature infant regurgitates its food. The pylorus lies somewhat higher than that of the full-term newborn infant, in whom it is found about midway between the ensiform cartilage and the umbilicus. Before feeding, it is almost always found to the left of the median line. The pyloric musculature is usually well developed, even in the newborn premature child.

Although many authors have at autopsy and in the living measured the stomach of the full-term infant as to its capacity, their figures vary considerably. A careful study of full-term infants, measured during life and post mortem, demonstrates that the physiologic capacity of the stomach exceeds its anatomic capacity during life, because of the rapid passage through the pylorus of some of the milk, mainly whey, while the infant is nursing. This can be demonstrated by use of the fluoro-

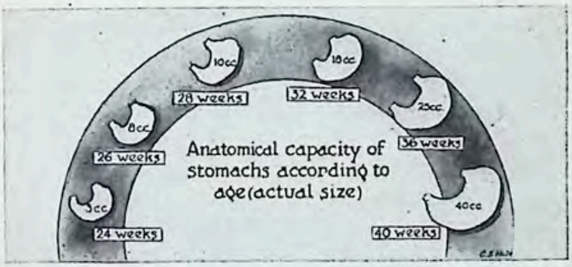


FIG. 3. Gastric capacity. Actual capacity varies with: a. Kind of milk. Stomach empties in 1½-2 hours, breast milk; 3 hours, artificial feeding. b. Method of feeding. Some milk leaves stomach during feeding. Slow feeding, maximum emptying (breast and dropper); rapid feeding, minimum emptying (bottle and catheter).

scope. Therefore, the gastric capacity, as measured post mortem, does not give the exact functional capacity.

When the premature infant is on a diet of breast milk; its stomach is generally found to be empty at the end of one and one-half to two hours. When the infant is artificially fed, the emptying time of the stomach is considerably longer, depending on the nature of the food administered.

NERVOUS SYSTEM

The development of the cerebrospinal nervous system is relatively less complete than that of the autonomic system. This is most manifest in the muscular inertia of the infant. Many premature infants lie in a state of stupor or somnolence from which they must be aroused to be fed. External stimulation may result only in a weak cry and slight movements of the body. The movements are slower than those of the full-term infant, and the child tends to relapse into a deep sleep as soon as the stimulus is removed. Also depending to some extent on the incomplete development of the nervous centers are the weak respiratory functions and the feeble efforts at sucking.

The nasal and pharyngeal reflexes are particularly weak in children born before term. Abdominal reflexes are seldom present in the premature—in fact, they are rarely seen in the newborn infant.

Many neurologists believe that prematurity predisposes to idiocy, imbecility and epilepsy. It appears, however, that in such cases, it is not the premature birth that is responsible, but rather that the same factor which may have led to the retarded mental development may also have caused the premature expulsion of the fetus.

CARDIOVASCULAR SYSTEM

Heart. As compared with other organs, the heart is relatively well developed. That the heart should be strong is not surprising, since, from the first months of pregnancy, the precocious development of this organ is found to be in complete accord with the importance of its function. The high position of the diaphragm and the shape of the thorax cause the long axis of the heart to lie in a more nearly transverse position. Because of this position, the apex beat is found in the fourth interspace, 0.5 to 1.0 cm. outside the mammillary line.

The pulse rate of the premature newborn is exceedingly variable, ranging from 90 to 200 per minute, with an average of about 120 or more. This variability is probably due to a lack of development of the cardiac inhibitory centers.

Usually the heart is only secondarily involved in asphyxial attacks, the tones becoming weak and slow during the cyanotic spells. The heart action often persists for hours after the respiration ceases. However, myocardial asthenia in the premature infant may also result in cyanosis, and is frequently accompanied by edema. General circulatory difficulties may also, as stated, be among the causative factors of subnormal temperature in these infants.

Blood Vessels. The vascular walls of the premature infant are weaker than those of the infant at term. Because of this condition, premature children are subject to hemorrhage following relatively slight trauma. The intracranial vessels are similarly affected, which accounts for the frequency of intracranial hemorrhage in the premature infant. Intracranial hemorrhages, if massive or secondary to brain injury, are usually followed by early death. In many instances, they are interpreted as respiratory deaths, because of the influence of pressure on the respiratory center.

Blood. The prothrombin clotting time of the blood is of great importance in its relationship to hemorrhage. It has been found that the prothrombin clotting time of the premature infant on the first day of life is slightly longer than that of most full-term infants, but by the sixth to the tenth day of life, this differential is not present in the majority of infants. (See Chap. 18, Hemorrhage.) An abnormal prolongation of prothrombin clotting time signifies a state of vitamin K deficiency and replacement therapy is indicated.

The cell content of the blood of the premature infant does not differ greatly from that of the newborn infant, although it does possess certain special characteristics. In the premature child, the erythrocytes are slightly less in number than in the full term, and diminish readily, especially under the influence of infections, jaundice and edema. Moreover, macrocytes, microcytes and poikilocytosis may be prominent findings in the presence of low erythrocyte and hemoglobin values. Nucleated erythrocytes are characteristic of the blood of the premature infant, and the farther the child is from term the more numerous are these nucleated cells. In the mature infant, nucleated cells are found only during the first few days of life, while in the premature they are noted as late as one month after birth. The reticulated red blood cells are highest in number at birth and in the first few weeks of life.

The leukocytes are less numerous or only slightly increased. Instead of 12,000 to 13,000 leukocytes, as found in the normal full-term newborn infant, there are, on the average, 8,000 per cubic millimeter in the premature. The differential count shows a high percentage of mononuclears and abnormal elements, such as mast cells (basophiles) and myelocytes.

In the normal full-term infant, the hemoglobin content gradually decreases, and at the end of the fourth week amounts to about 85 per cent or less (by Sahli's hemoglobinometer), whereas in the prematurely born infant, its value at this time is 50 to 60 per cent. Therefore, in prematurely born infants there is a distinct and early hemoglobin impoverishment of the blood, which has been found to reach its maximum about the third or fourth month. Although the hemoglobin content shows a pronounced deviation from the normal, the number of erythrocytes is only little below the normal. Consequently, the hemoglobin content of the individual blood corpuscle is considerably less than normal. This accounts for the constant and early development of anemia in premature babies during the first three months of life. The cause of this hemoglobin deficiency seems to be an insufficient iron content in the blood of the premature infant. This is easily understood when we recall that Hugouneng has proved that the quantity of iron stored by the fetus in the last third of pregnancy is twice as large as that during the first two-thirds. (See Chap. 24, Anemia.)

THYMUS AND THYROID GLANDS

The thymus and thyroid present the highest degree of development of any of the glandular structures. In fetal life, these organs contribute to the formation of blood and, during the first few weeks of life, have a phagocytic action.

SPECIAL SENSES

Occasionally some well-marked vestiges of the pupillary membrane can be seen over the eyes of the youngest prematures. The cornea is inclined to be somewhat thicker, the anterior chamber less deep and iris less pigmented than in the full-term infant. Strong light impressions are followed by reflex closure of the lids, but sudden movements are not followed by such closure, as this reflex is a conditioned one.

The eye movements of the premature infant are incoordinated, motion being generally in a horizontal direction, occasionally outward but more often definitely inward. This tendency to convergence may persist until the second month. The light reflex is present before birth and the pupil, when exposed to a strong light, contracts, only to dilate again in two or three seconds.

SKIN AND ADNEXA

The skin is thin, soft and usually of a vivid red appearance. Occasionally, it has a peculiar cyanotic hue, and the transparent dermis allows the circulatory network to be clearly distinguished. The skin is partly or completely covered with lanugo hairs, especially between the shoulder blades, but frequently also on the face and extensor surfaces of the extremities. Flaccidity of the auricle and the nasi is due to poorly developed cartilage. The skin is studded with small white or yellow nodules, due to retention of sebaceous secretion.

Icterus is usually more pronounced in prematurity than at term, and erythema is slower to disappear. If hypothermia develops, the redness of the skin usually fades.

The absence of subcutaneous fat betrays itself by an angular appearance of the face, the chin is pointed, and the head is small and narrow. The wrinkles of the skin impart an oldish appearance to the face, which is particularly noticeable after a few days, when the loss of weight has been significant, so that the skin often hangs in folds over the muscles and bones. Frequently, the skin appears glossy as if on tension, and this is seen especially in small prematures in the presence of sclerema and scleredema. Patches of skin may be absent, usually over the heels.

The hairs on the scalp are short. The nails are often poorly developed and do not reach the end of the fingers or toes, and the nose is covered with small white comedones. The navel is closer to the symphysis than at term.

MAMMARY GLANDS

The mammary glands are almost always poorly developed in premature infants. Usually, they are not palpable in the younger prematures. If fluid is present, as it may be in the older premature infants, it usually appears about the eighth day, is most abundant up to the fifteenth day and may last until the third month. It is equally common in either sex.

3

Growth and Development

The average, normal full-term infant who receives a well-balanced diet and his quota of good care, and who is not handicapped by illness, can be expected to follow a fairly definite pattern of growth, as measured by both height and weight. With the premature infant, there enter many factors which may interfere with its expected progress, such as prenatal conditions which were active in causing expulsion of the fetus, trauma suffered at birth, and many postnatal factors. Among the latter, the facilities offered for the infant's physical protection and its nutrition play important roles. It will therefore be readily understood that, to a certain extent, the growth and development of the premature infant is an individual one, largely inherent in the infant's equipment to meet its own physiologic requirements and the vicissitudes encountered in its new environment.

Handicapped as they may be at birth, many premature infants are able to overcome their difficulties in the first year of life, although others may require several years to acquire normal stature.

WEIGHT

Birth weight is the major factor in determining the growth curve during early childhood. Infants with a birth weight between 1,500 and 2,000 grams usually approximate the average for the full-term infant by their third to the sixth year, while those between 1,000 and 1,500 grams may require from five to eight years or longer.

Loss of body weight during the first days of life occurs so consistently in full-term infants that moderate losses must be considered physiologic. This is also true of premature infants, although in most instances the loss is relatively greater. By comparison, premature infants lose more than normal babies and also regain their birth weight more slowly. The smaller the infant, the longer is the time required for regaining its birth weight. The nearer the premature baby is to full-term, the less is the comparative loss of weight as expressed in percentages.

TABLE II

AVERAGE INITIAL LOSS OF WEIGHT IN BREAST-FED INFANTS

BIRTH WEIGHT IN GRAMS	GRAMS LOST
From 1,000 to 1,500	70 to 120
From 1,500 to 2,000	150 to 175
From 2,000 to 2,500	150 to 200

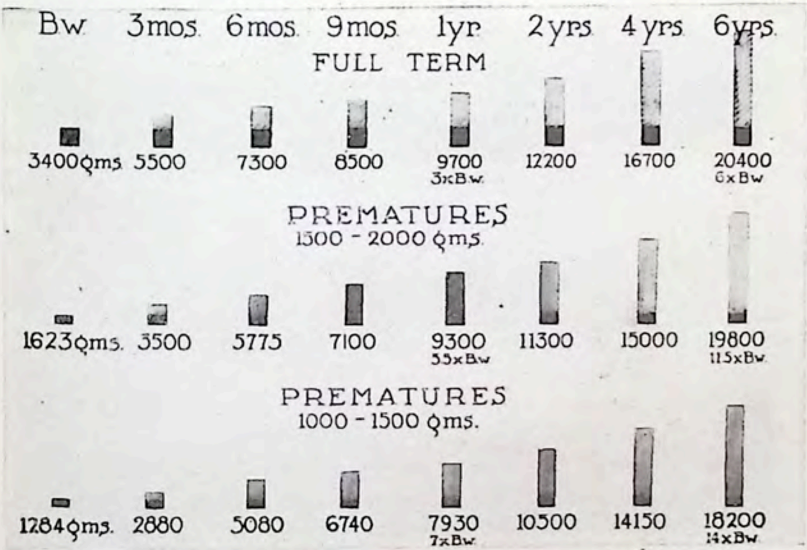


FIG. 4. Weight progress of full-term infants compared with prematures.

Most premature infants regain their birth weight by the eighteenth to the twenty-first day. After reaching their lowest weight, most premature infants have a daily gain that averages from five to 20 grams (one-sixth to two-thirds ounce). Infants under 1,500 grams may be considered as growing satisfactorily on an average daily increase of from five to ten grams (one-sixth to one-third ounce). The babies weighing from 1,500 to 2,000 grams usually double their birth weight in from 60 to 75 days. The larger premature infants double their birth weight in 75 to 90 days.

Table III

AVERAGE DAY ON WHICH BIRTH WEIGHT WAS REGAINED

BIRTH WEIGHT IN GRAMS	DAYS
From 1,000 to 1,500	18.6
From 1,500 to 2,000	14.4
From 2,000 to 2,500	11.8
From 2,500 to 3,000	12.0

Table IV

AVERAGE LENGTH OF STAY IN STATION ACCORDING TO WEIGHT

BIRTH WEIGHT IN GRAMS	DAYS IN HOSPITAL
Under 1,000	83.0
1,000 to 1,500	45.7
1,500 to 2,000	30.5
2,000 to 2,500	19.9
2,500 to 3,000	16.8

HEAD CIRCUMFERENCE

Rapid growth of the brain as compared with that of the skeleton leads to a relative enlargement of the head as compared with the trunk. The wide separation of the sutures allows the early expansion which is termed megacephalus or pseudohydrocephalus. This cranial expansion results in the characteristic facial features of the premature as evidenced by wide separation and increased prominence of the eyes. The eyes are often directed downward, the cornea being partly covered by the lower lid, and the upper part of the sclera showing prominently. The smaller the infant at birth, the more likely are these features to be exaggerated.

Although the head may give the appearance of enlargement, it is often, by actual measurement, still under that of the expected normal size for a full-term infant, when the premature baby reaches what would have been its chronologic age of 40 weeks of intra-uterine life.

Our study of 250 infants did not indicate persistence of a relatively large head circumference as a result of the megacephalus seen in the first weeks or months of life. A true hydrocephalus may be seen secondary to meningeal hemorrhage and this is usually persistent. Occasionally, microcephalus results from lack of development of the brain or early ossification of the sutures together with closure of the fontanelles.

COMPARATIVE MEASUREMENTS

Curves showing growth in weight, length, head and chest measurements in the late fetal weeks and first weeks after birth were plotted by Reiche.[1]

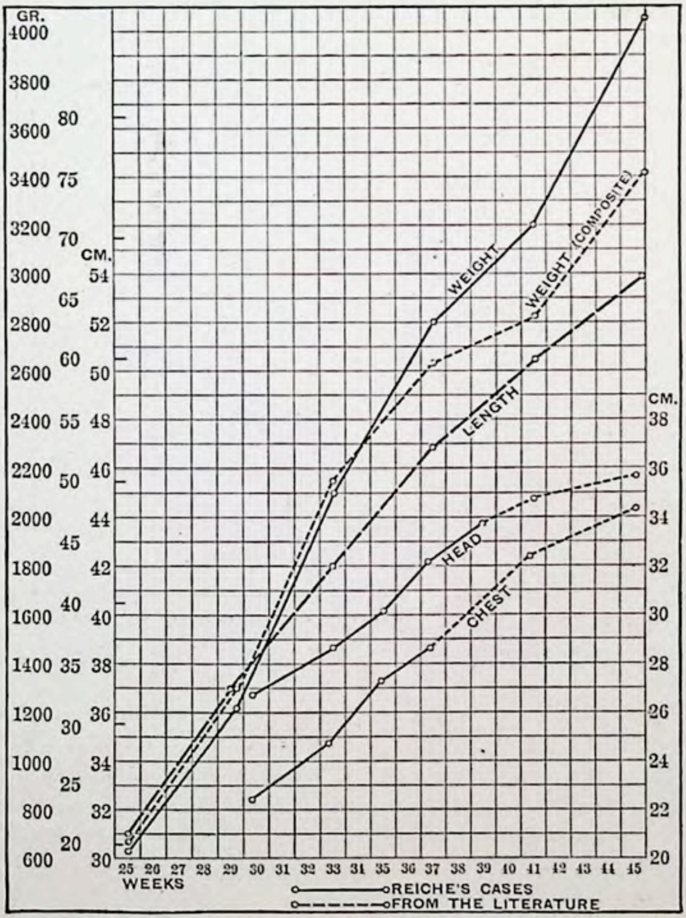


Fig. 5. Curves showing growth in weight, length, head and chest measurements in the late fetal weeks and first weeks after birth.

These curves show a gradual and steady increase of the measurements of chest and head and amount of weight, up to the time of maturity when they average 50.5 cm. in length, 32.9 to 33.8 cm. in chest circumference, 34.5 cm. in head circumference and 3,200 gm. in weight.

We see an abrupt rise in the curve of chest circumference in the eighth to the tenth month, the curve flattening somewhat soon after birth. This increase in the circumference of the chest in the last fetal months is considerably higher than that of a full-term child during the first months after birth.

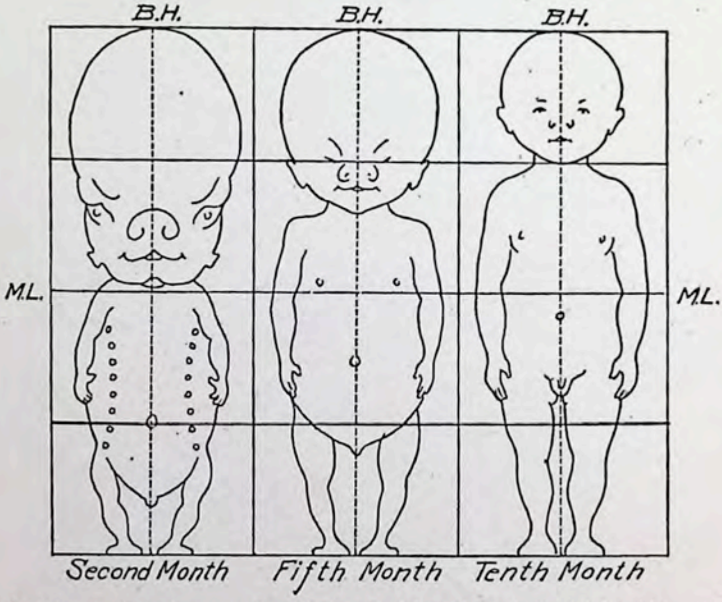


FIG. 6. Changes in body proportions during fetal life: B.H., body height; M.L., midline.

In the curve of the growth of the skull, the flattening out of the curve appears even somewhat earlier. The ratio, however, between the growth of the skull in the last three fetal months and that in the first six months of life is the same as in the circumference of the chest. Also the circumference of the head grows absolutely and relatively considerably more in the last fetal months than in the first six months of life.

In the second month, the head approximates one-half the length of the entire body, and the legs are very short. By the fifth month, the head approximates one-third, and at full-term it has become one-fourth of the body length.

4

Minimum Requirements for Nurseries for Full-term Infants and Premature Infant Stations

Today the trend is toward inspection of nurseries by state and city health departments and the establishment of minimum requirements. In the development of any state or city program for the premature infant, it is first necessary to make a survey of the care given to the full-term infant. Unless the standards for the management of the full-term infant are of the highest, in all probability the premature infant will not be given the essential individual attention. Hospitals should be alert and abreast of the times, meet and maintain at least the minimum requirements.

THE NURSERY FOR FULL-TERM INFANTS

The evaluation of any nursery is determined by three major factors, its physical equipment, its nursing personnel and its nursing technic. The considerations that must be evaluated, as well as the minimum requirements to be met by each one of these integral factors of the nursery, are outlined.

Physical Equipment

Evaluation.

1. Size of nursery and spacing of bassinets.
2. Common bathing table or individual bassinet care.
3. Temperature control.
4. Humidity control.
5. Formula room.
6. Isolation facilities.
7. Running water.
   a. Location.
   b. Type of faucets.

8. Containers for linen and diapers.
9. Sterilization facilities for bottles, nipples, etc.
10. Individual thermometers.
11. Bath basins or oil bottles.
12. Oxygen.
13. Refrigerator.

Minimum Requirements.

1. At least six inches between each bassinet.
2. Running water easily accessible to nursery proper, with faucets that can be controlled by either foot, knee or elbow.
3. Isolation room.
4. Closed containers for diapers.
5. Individual thermometers.
6. Individual bath basins or oil bottles.
7. Separate formula room.
8. Oxygen in the nursery.

State health departments are urging individual outfits and complete individual units. Although these are desirable, the nurse must remember that if proper technic between babies is not carried out, the individual unit is of little or no value.

Nursing Personnel

Evaluation.

1. Supervision.
2. Graduate or undergraduate assistance.
3. Number of nurses during day, evening and night.
4. Is there always a nurse in the nursery?
5. Does the nurse assigned to the nursery take care of other patients at the same time?
6. Are students given necessary instruction and supervision?

Minimum Requirements.

1. Supervision either by nursery supervisor or obstetric supervisor.
2. A nurse in the nursery at all times during the day, evening and night. A sick patient should not be left alone. Adult patients are at least supplied with a bell, so that the nurse can be summoned. Leaving babies alone in the nursery is dangerous, since they may become cyanotic or asphyxiated and death may result.
3. At all times, during the 24 hours of the day, there should be at least one nurse for every eight normal infants.
4. Student nurses should be permitted to care for the full-term infant

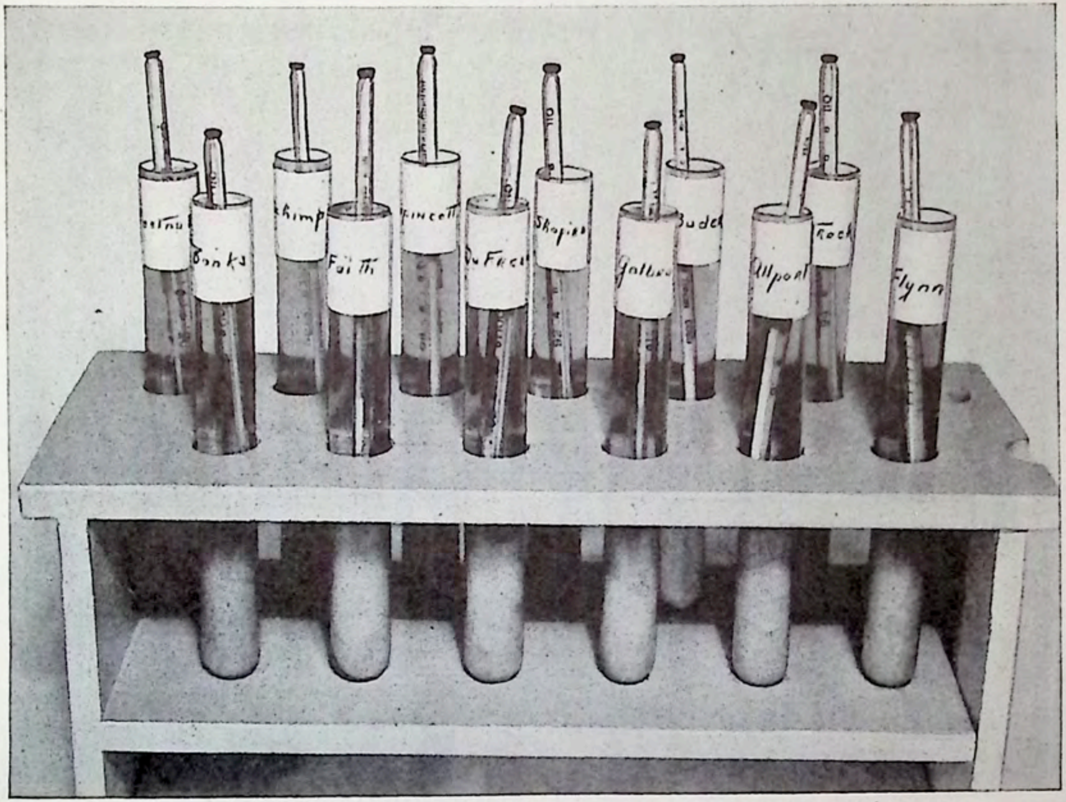


Fig. 7. Thermometer rack. The solution should be changed daily, the test tube changed once a week.

only after they have been given bedside demonstrations. They should have adequate supervision at all times.

Nursing Technic

Evaluation.

1. Hand washing.
2. Wearing of gowns and masks. Changes of uniform.
3. Methods used in taking baby to breast.
4. Bath technic.
5. Changing babies.
6. Temperature technic.
7. Preparation of feedings.
8. Handling of sterile equipment (nipples, bottles, gauze, etc.)
9. Weighing babies.
10. Cleanliness of nursery.

Minimum Requirements.

1. Thorough hand washing between the handling of babies, after the diapering of an infant and before feeding any baby.
2. Proper draping of scale and common bathing table to prevent cross infections.
3. Diapering the baby in its bassinet.
4. Carrying the baby to breast, in place of the carrier, when possible.
5. Protecting the baby from coming in contact with the mother's bed.
6. Handling all linen and equipment so that there is no danger of cross-infections.
7. Formula room.
   a. Formulas to be prepared under aseptic conditions or to be autoclaved.
   b. Stock solutions for formulas should not be permitted.
   c. Adequate refrigeration of the feedings.
   d. All nipples on bottles to be kept covered, and this covering not to be removed until the feeding is at the bedside of the baby.
   e. Eliminate propping of bottles.

The full-term infant with pathologic changes progresses better when given the same kind of care as is given to the premature baby. Heat and minimum handling, as well as oxygen and mother's milk are often important factors in aiding the recovery of the sick full-term baby. A nurse's experience with premature infants, therefore, makes her more adept in caring for the sick full-term baby. It is often advisable to put such a sick infant in the nursery for premature infants.

THE PREMATURE INFANT STATION

The significant factors in the care of the premature infant are:

1. Nursing personnel.
2. Aseptic nursing technic.
3. Maintenance of body heat.
4. Careful and minimum handling.
5. Oxygen.
6. Breast milk.
7. Careful feeding regulation.
8. Follow-up care.

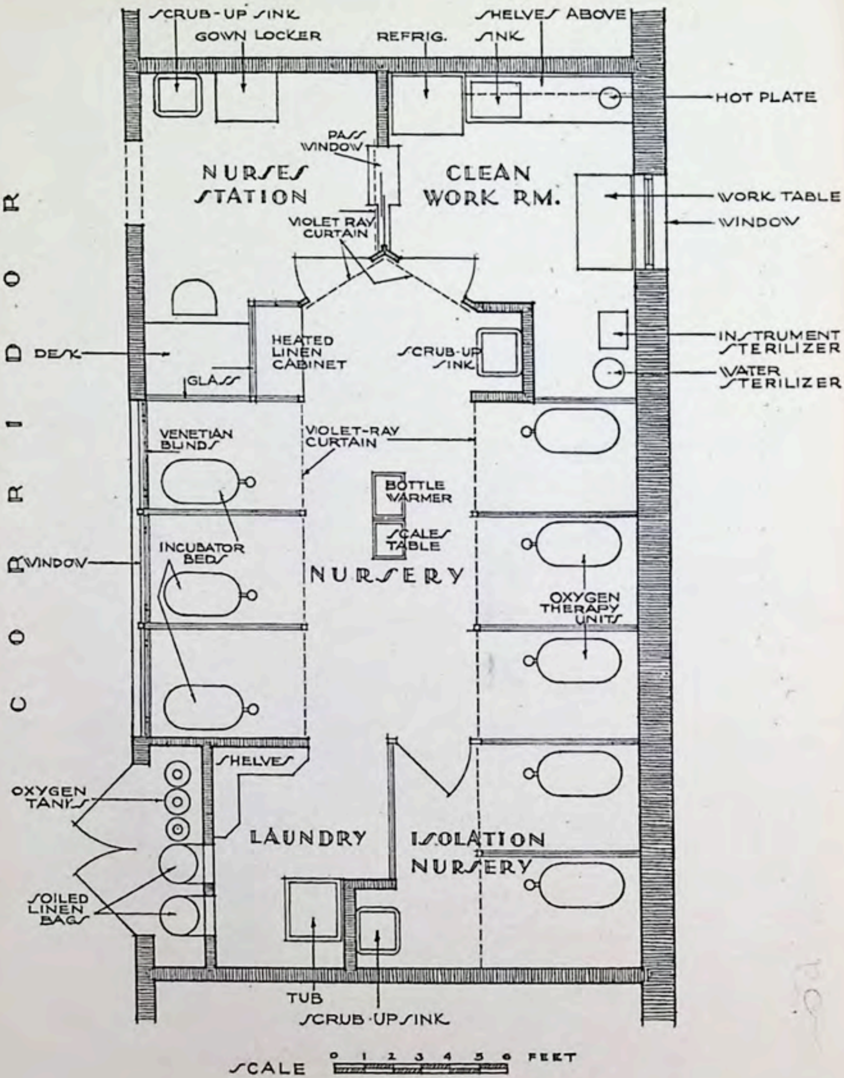
To carry out these principles, the nursery for premature infants must fulfill, in a more punctilious fashion, the minimum requirements outlined for the nursery for full-term infants, and in addition, meet those needs that are peculiar to the premature infant.

Essentials in the successful management of a premature infant station include:

1. A permanent, well-trained personnel. The premature-infant nursery should never be without one or more persons especially trained in the care of premature babies.
2. Some type of heated bed or incubator.
3. Oxygen set-up for emergency and routine use.
4. Supervision by a physician, preferably a pediatrician.
5. Moderation, in both the medical and nursing care. Minimum handling, minimum feedings and minimum experimentation are all essential, if morbidity is to be kept at a minimum.
6. Establishment of a dependable source of breast milk.
7. Feedings should be regulated by the physician, resident physician and nurse in charge of the station, and not by constantly shifting interns or nurses.

Equipment. The premature infant station should have the following equipment:

1. Individually heated beds for small infants.
2. Bassinets for graduates.
3. Heated beds for home use (loaned to graduates for temporary use).
4. Oxygen therapy units.
5. Oxygen.
6. Electric heater for emergencies.
7. Heated dressing table.
8. Sink with slab.



AN EIGHT BED PREMATURE STATION
DESIGNED BY SCHMIDT GARDEN & ERIKSON ·· ARCHITECTS
CHICAGO

FIG. 8. *An Air-Conditioned Premature Station*—The plan presented for an eight-bed premature station was designed by Schmidt, Garden and Erikson, hospital architects of Chicago.

The plan is in itself quite complete and covers the essential requirements for infants requiring oxygen therapy, larger and older infants needing chiefly external heat, and those for whom isolation care is indicated. Individual cubicles are provided and each cubicle contains a heated bed or oxygen chamber.

Variations will be necessary depending upon the location assigned to the station and the number of infants to be cared for. Basically, however, every station should provide:

1. A vestibule between the corridor and the infants' unit
2. The infants' ward
3. A clean workroom
4. Oxygen unit
5. An isolation section for suspected or infected cases.

The vestibule can be, as it is in this case, a nurses' station in which her records are made and kept and a place where doctors may scrub and put on gowns before entering the nursery.

The infants' ward should be liberal in size and, if possible, cubicled, as is this one. Conveniently located scrub sinks, a bottle warmer, a portable scales table, and a heated cabinet for linens are essentials of the ward proper, and it is desirable to provide an observation window between the ward and the corridor so that interested persons may see the babies, especially those about to be discharged. This window should have a Venetian blind or other means of being closed at will. These plans assure that each baby will have its own complement of utensils and supplies.

A workroom separated from the ward, as shown here, is desirable but not essential. The equipment should include a refrigerator large enough for the feedings (which have been prepared under sterile conditions elsewhere and delivered to the workroom by way of the nurses' station, so that the infants' ward itself is not transversed), as well as a sink with a drain board, a hot plate and a water and instrument sterilizer.

Foot-controlled openings just above the laundry bags permit of their removal without their being carried through the clean nursery. Adjacent to these bags, and also accessible from the corridor, is located the battery of oxygen tanks. This battery is so arranged that as one tank is emptied, another one is automatically opened for use, thus insuring a constant supply of oxygen to the pipes leading to the oxygen-using incubators. A simple alarm should be hooked up to the oxygen tanks so that when the next to the last tank is emptied, the nurse in charge can arrange to have the empty tank or tanks replaced. A case or shelves for miscellaneous supplies and a laundry tub or deep sink (well separated from the sink in the "clean" workroom) are also desirable. In this plan, they are located in the area marked "Laundry."

The walls, floors and other details should conform to the best standards of hospital detail. Sound-absorbing material in the ceiling is desirable, but is not as important here as in nurseries for full-term infants.

Complete air-conditioning, which includes cleansing, heating, cooling, humidification and dehumidification, is necessary for any unit such as this, in which, except for the workroom, there are no windows. As a matter of fact, air-conditioning is necessary even in those rooms that have windows. Generally speaking, windows must be kept closed to avoid drafts and, in the winter time, the radiation from the cold panes of glass to any nearby baby cannot be lightly dismissed. The cooling and dehumidification are also desirable for the comfort of the personnel who must otherwise work under extremely trying conditions at times. To insure an even distribution of the air, the conditioning system should be installed in such a way that each cubicle and other subdivision of the unit has its own supply and exhaust. The necessary machinery can be located at any convenient place in the hospital, but for accurate control of individual areas within the station, local units must be placed in or near the nursery, possibly suspended from the ceiling over the nurses' station or workroom.

The cubicles might be entirely enclosed, making a separate room for each infant, but the plan shown contemplates the installation of ultra-violet (2,537 Angstrom units) to form a "light" partition or curtain at the entrance to the cubicle. The light tubes should be located about seven feet above the floor. Experiments now being conducted seem to indicate that ultra-violet light barriers may be effective in preventing the passage of air-borne bacteria. The plan also suggests light curtains at other points, as indicated.

9. Supply closets.
10. Individual bath basins and rectal thermometers.
11. Diaper containers (closed).
12. Linen hampers.
13. Standard nursery equipment and linens.
14. Scale. A gram scale is preferable.
15. High and low temperature registering thermometer.
16. Hygrometer, wet and dry bulb type.
17. Screens.
18. Electric refrigerator.
19. Transportation ambulance for premature infants.
20. Ultraviolet-ray lamp.
21. Electric breast-pump.

Rooms. Usually the premature baby is cared for in the nursery on the maternity floor. It is, however, desirable to have a small room adjacent to the nursery proper set aside for the care of such infants. A separate room would provide the necessary isolation and make possible a higher room temperature. A nurse experienced in the care of the premature infant should be on duty at all times.

If the premature infant station is to be a complete, independent unit, it is suggested that special rooms be designated for the following needs:

1. An anteroom in which doctors and nurses may scrub, put on clean gowns and caps, and, when regulations demand, don masks and gloves before entering the nursery.

2. One room for the smaller premature infant. In this unit a sufficient number of beds should be equipped for oxygen therapy to meet both ordinary and emergency requirements.

3. A special room for the care of infants being prepared to graduate. These infants should weigh from four to five pounds. Most of the babies at the Sarah Morris Hospital are sent home when they weigh five pounds.

4. An isolation room equipped with individual cubicles.

5. A formula room.

6. A demonstration room with the equipment usually found in homes. The mother of a premature baby should be permitted to make visits to the hospital before the baby is discharged, so that she will learn how to care for the infant. These visits supplement the instruction that she has received in her home from the visiting nurse.

7. A room in which visiting mothers and wet-nurses can express their milk. This should be under the supervision of the nurse in charge of the premature wards.

8. A central supply room for oxygen.
9. Space to be used as an office and chart room.
10. A utility room.
11. Adequate space for linens and other necessary nursery equipment.

5

Incubators

The earliest use of incubators is indicated in descriptions of their employment for the hatching of eggs of fowls in Alexandria. It is possible that the Egyptians may have applied this method to the human newborn also, although actual mention of it has not been found. Hippocrates, in his writings of 460 B.C., asserted that "No fetus coming into the world before the seventh month of pregnancy can be saved." Notwithstanding, the literature of our day records a considerable number of exceptions to such conclusions as that infants born before the end of the 28th week are not viable.

Prior to the advent, about sixty years ago, of the modern incubator, the mortality rate among prematurely born infants was exceedingly high. Nevertheless, history records the premature birth of many persons who were outstanding and left their mark on the world. Among these have been: Sir Isaac Newton (1642-1727), François Marie Voltaire (1694-1778), Jean Jacques Rousseau (1712-1778), Napoleon Bonaparte (1769-1821), Georges Cuvier (1769-1832), Alphonse de Lamartine (1790-1869), Victor Marie Hugo (1802-1885), Charles Robert Darwin (1809-1882) and Ernest Renan (1823-1892).

The fact that these infants survived, even though the equipment for their care must have been of a primitive character, is additional proof that the most modern incubator does not replace good nursing and feeding care.

In 1880, Tarnier had an infant incubator constructed similar to the chicken incubator. This unit, built for him by Odile Martin, director of the Paris Zoo, was of such size that it could hold several children. It was installed in the Maternity Hospital of Paris in 1881. This is the first closed incubator of record which may be qualified as modern, since the perfected apparatus of our day differs from it only in detail. This event dates the principal work undertaken on incubator construction, and since then the most varied modifications have followed each other almost without interruption to our day.

The first important work on the results obtained by the use of incubators is an account by Auvard in 1883. In this interesting report, the author gives the first statistics on the use of the incubator in the Maternity Hospital of Paris, under the scientific direction of Tarnier.

To this class of incubators, which are all modifications of the original Lion closed type of bed, belong the models of Couney, DeLee and others. These models differ but slightly in principle, the chief variation being in the manner of heating and distributing the air and supplying moisture. The unit may be heated by gas or oil stoves placed at the side of the incubator, which heats the air as it enters, or a system of electric bulbs within the apparatus may supply the heat. In recent years, this type of incubator has lost its early popularity. Much of this deserved disfavor is due to inability to ventilate the incubators in the ward and the necessity of having a trained person in attendance.

During the past 25 years many different types of incubators or heated beds have been developed. Some of them depart quite radically from the earlier models and include special features for heating, ventilation and humidity control and the supplying of regulated oxygen mixtures. A few are as rudimentary as some of the earlier models, nevertheless, they are capable of furnishing external protection to the infant when the more specialized types of heated beds are not available.

It is impossible to describe all of the serviceable beds now on the market, therefore, we will limit ourselves to the description of a good model of each type that presents individual features.

THE HESS HEATED BED

The Hess Heated Bed (Fig. 9) combines the features of an open heated bed for the more mature premature infants, with those of an oxygen chamber for smaller and weaker infants (Figs. 10, 11). This bed is designed to maintain, with a minimum of attention and regulation, a constant temperature with a safe maximum, as well as allow for easy observation and handling of the infant. When used as an oxygen chamber, the pressure from the oxygen tank insures a constant flow of room air through the bed.

The Hess Heated Bed consists of an inner chamber into which the bed is set. This inner chamber is surrounded, except on top, by a one-inch water jacket. This jacket is covered with an insulating material over which is fitted a polished and nickel-plated copper jacket, making in all three walls of copper, with water between the first and second walls, and insulation between the second and third.

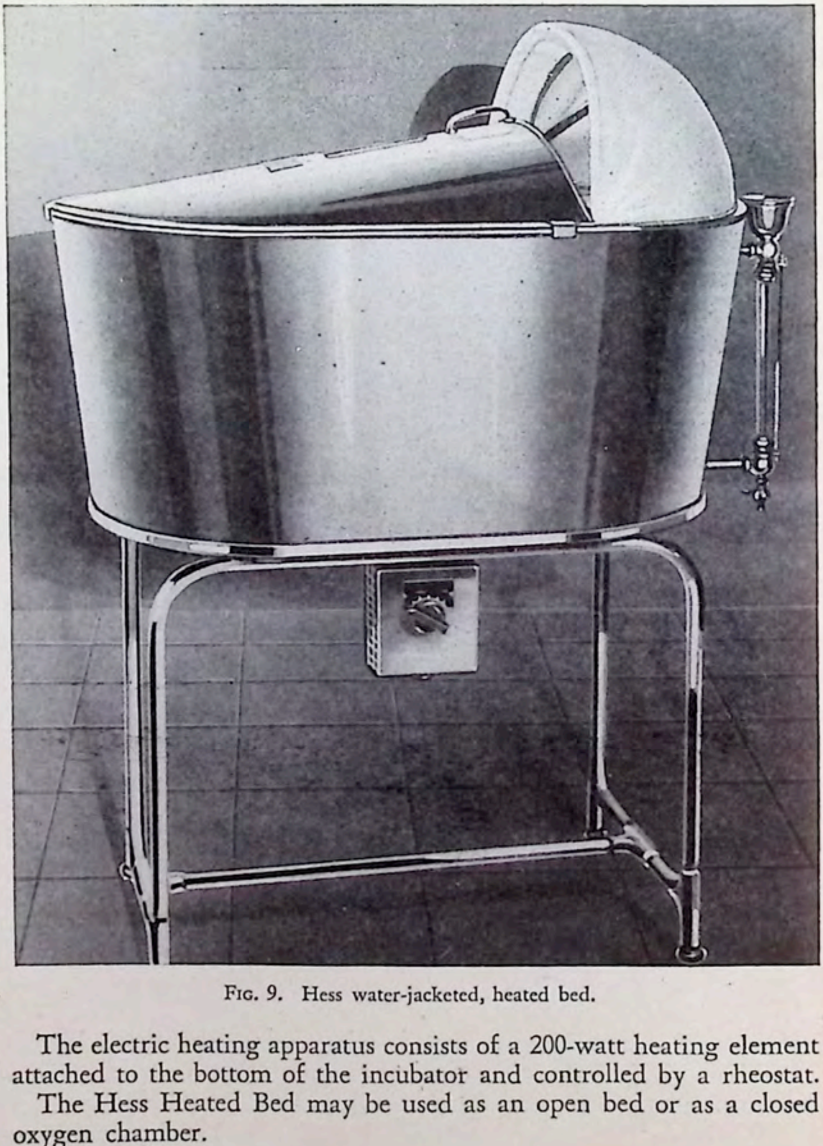


Fig. 9. Hess water-jacketed, heated bed.

The electric heating apparatus consists of a 200-watt heating element attached to the bottom of the incubator and controlled by a rheostat.

The Hess Heated Bed may be used as an open bed or as a closed oxygen chamber.

As Open Bed

As an open bed the top of the incubator is fitted with a cover containing a thermometer which registers the temperature within the bed. This cover, 21 inches long, leaves a space of nine inches, which serves as an air inlet and also gives opportunity for observation. An adjustable frame is fitted over this space, and a removable linen cover forms a hood, which aids in shielding the infant from outside air currents and helps to control temperature. This heated bed can also be used for the reception of newborn infants in the delivery room.

As Closed Bed

When oxygen therapy is indicated, the oxygen unit replaces the cover and canopy and forms an oxygen chamber of a size that can conveniently accommodate infants up to about six months of age. The unit was designed primarily for premature and young infants in the obstetric nursery and infant wards and stations. It meets the special indications for oxygen therapy in asphyxia after resuscitation in the newborn, cyanosis from various causes and the pulmonary infections.

The oxygen unit is equipped as follows:

1. The flow meter has four openings and allows the use of a mixture of oxygen and air varying from 38 to 80 per cent (as may be required) with a flow of oxygen of two liters per minute. The mixture is varied by rotating the cylinder of the meter. (An instruction plate is attached to the unit.)
2. Glass and metal hinged door for feeding purposes.
3. Thermometer window with thermometer in the bed.
4. Metal hinged door for purposes of body care of the infant.
5. Ventilator with large and small exit openings.
6. Opening for obtaining samples of oxygen mixture for testing purposes.
7. Ice tank for use within the chamber for cooling purposes.

The ordinary large commercial tank of oxygen contains approximately 6,000 liters of oxygen and should last about 48 hours using two liters per minute. The cylinder should be equipped with a pressure gauge and an oxygen regulator which will accurately indicate a flow of two to four liters per minute. A two-stage regulator designed for oxygen therapy is recommended. The outlet on the regulator should be connected with the flow meter on the oxygen unit with rubber hose.

Maintenance of Oxygen Concentration in the Bed. Two liters of oxygen per minute will maintain an oxygen concentration within the

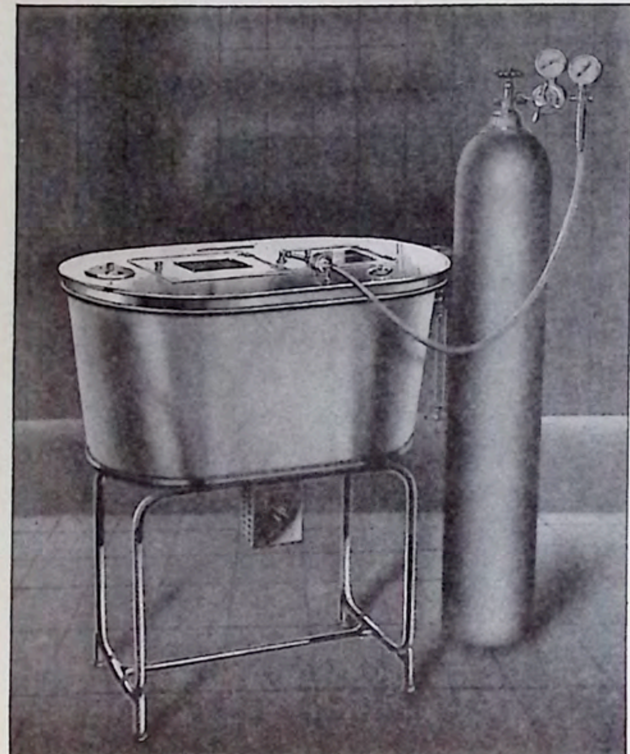


Fig. 10. Hess heated bed with oxygen unit.

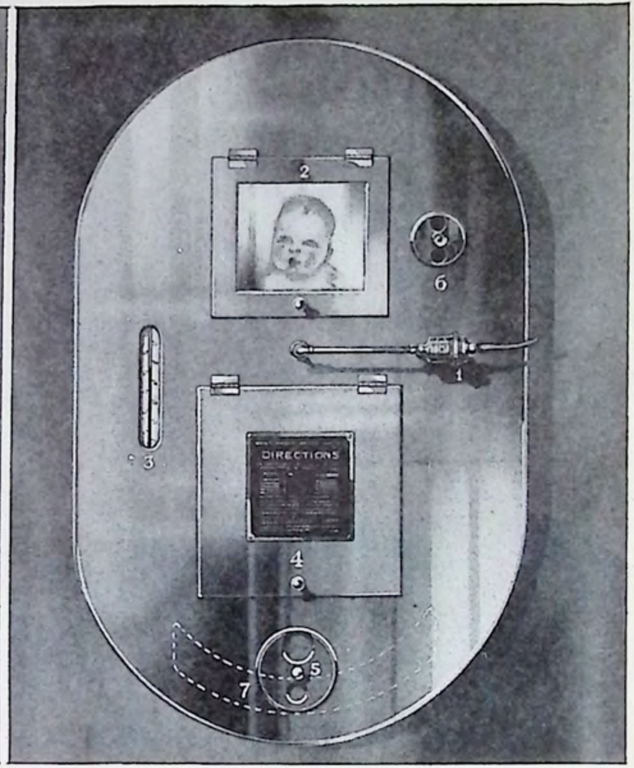


Fig. 11. Oxygen unit.

bed varying from 38 to 80 per cent, depending upon the amount of air which is allowed to mix with the oxygen as it passes through the flow meter. Once established, the percentage of oxygen remains constant with a two-liter flow, with either of the vents open, if the pressure in the oxygen cylinder is maintained.

The smaller vent openings are used only with the small premature infants or with the newborn; the larger openings should be used on all other cases. The latter provide for more rapid dispersion of heat when large infants or fever patients are in the bed.

During the feeding or dressing, when one of the doors is open, the oxygen percentage will drop from 5 to 15 per cent, depending upon the length of time the door is open. After closing the door, the percentage will return to normal within five to ten minutes.

During the first 20 minutes when preparing the bed for use, four liters of oxygen per minute may be needed temporarily. This also may be true for cases with marked respiratory embarrassment, if the feeding or dressing door has been left open for a prolonged period of time.

Care of Oxygen Lid. Whenever there is difficulty in maintaining the oxygen pressure at the level desired, it is quite possibly due to the fact that the air flow meter is dirty and needs to be cleaned.

For inspection and cleansing, the flow meter can easily be taken off the top of the bed by removing the three small screws which hold it in place. The very small opening is then cleansed with a Wassermann needle stylet. A pipe cleaner is used to clean the long metal stem and the stem underneath the lid, to which the short rubber tubing is connected. If the bed is in constant use, it is recommended that this cleansing be carried out every three or four weeks.

After the bed has been used for an infant, the short rubber tubing leading into the bed is washed and boiled. Soap and water are used to cleanse the inside of the lid and bed, after which both the inside and the outside of the bed are cleansed with alcohol.

Oxygen Mixtures. With the room and bed temperature at 80° F. and the bed empty, two liters of oxygen per minute flow will result in the following oxygen content within the bed in 30 minutes:

FLOW METER AT	PER CENT OF OXYGEN WITHIN BED
0	70 to 80
1	50 to 55
2	40 to 45
3	38 to 42

A 38 to 42 per cent oxygen-air mixture answers most indications for increased oxygen. This about doubles the per cent of oxygen in the air under ordinary living conditions. When emergency stimulation for a short period of time is indicated, a higher oxygen percentage mixture may be needed for purposes of resuscitation.

The nurse should check both the oxygen tank and the air-flow meter every time she feeds the infant. If it is necessary to fill the bed with oxygen rapidly, the air-flow meter can be kept at "0" or "1" for a short while. The tubing leading from the lid to the infant should be kept close to the infant's face. Care should be taken that it is not *under* the feeding bib or blanket.

After a constant oxygen concentration in the chamber has been attained, one of the vents (preferably the larger) should be kept open at all times. There will be no appreciable lowering of the oxygen content. Increasing the flow of oxygen to three or four liters per minute only increases the maximum percentage in the chamber from 2 to 4 per cent. With an increased flow, the maximum content will be reached 10 to 20 minutes sooner. This measure is desirable in case of an emergency.

Relative Humidity. The ice tank can be filled with water or ice to increase the relative humidity within the bed.

When the bed is empty, cooling the bed with crushed ice effects rapid changes in the relative humidity, as shown by the following figures obtained in a test situation:

HOURS	TEMPERATURE	HUMIDITY
0	80	29
½	79	37
1	77	45
1½	75	51
2	74	50
2½	73	50
3	73	50

Lowering the Temperature of the Bed. During the hot days of summer, and when an infant has a high temperature (this applies more especially to the larger infant), it may be necessary to lower the temperature within the bed. As has been shown in the foregoing table, this can be accomplished within a few hours by placing crushed ice in the tank provided for that purpose. When the bed is used for large babies, the tank is drained out and filled with cold or ice water.

The tank will require refilling about once every three hours. At times, in the presence of pneumonia with a high temperature in an older infant, it may be necessary to add some coarse salt to the ice and refill the tank at as often as two-hour intervals.

Carbon-Dioxide Accumulation. When the bed is being used as an oxygen unit, because of the constant flow of the air-oxygen mixture, the amount of carbon dioxide that can accumulate is very small. In experiments conducted with premature, full-term newborn and older infants and those ill with pneumonia, the carbon-dioxide percentage of the chamber never exceeded 1 per cent. The carbon dioxide usually reaches a definite level by the end of the first hour and then remains fairly constant throughout the period the infant is in the chamber.

When the bed is not being used as an oxygen chamber, one or both of the large doors in the lid should be kept open, or the oxygen unit should be removed.

CAUTION: Do not use any open flame near the bed at any time, as the high concentration of oxygen greatly increases the inflammability of the bedding.

PROCEDURE TO CHANGE OXYGEN TANKS

Requirements.

Full oxygen tank.	Long wrench.
Three-prong wrench.	Dust cloth.

Procedure:

1. When the tank in use is almost empty, dust new tank and bring it into nursery.
2. Change tank when both indicators register zero.
3. With the three-prong wrench, open the full tank for one second and permit just enough oxygen to escape to clean out the passageway.
4. Loosen gauge on empty tank with straight wrench and remove, supporting gauge so that it does not fall.
5. Screw gauge on full tank.
6. If air-pressure gauge is used, see that handle of controlling pressure is loose before oxygen is turned on, or safety valve will be destroyed.
7. In water gauges, the water must register zero.
8. After gauge is fastened, turn on oxygen and adjust control lever.
9. An oxygen flow of 2 liters per minute is usually sufficient.

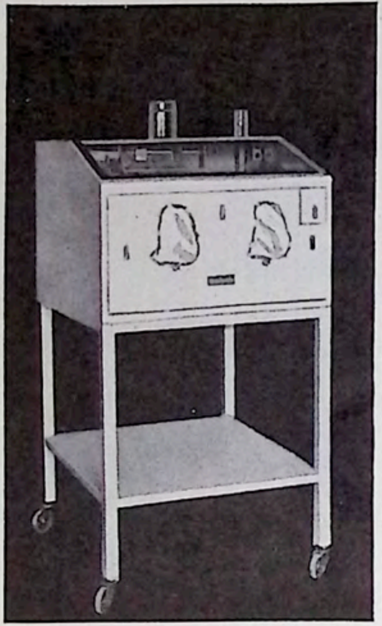


FIG. 12. Chapple bed, closed.

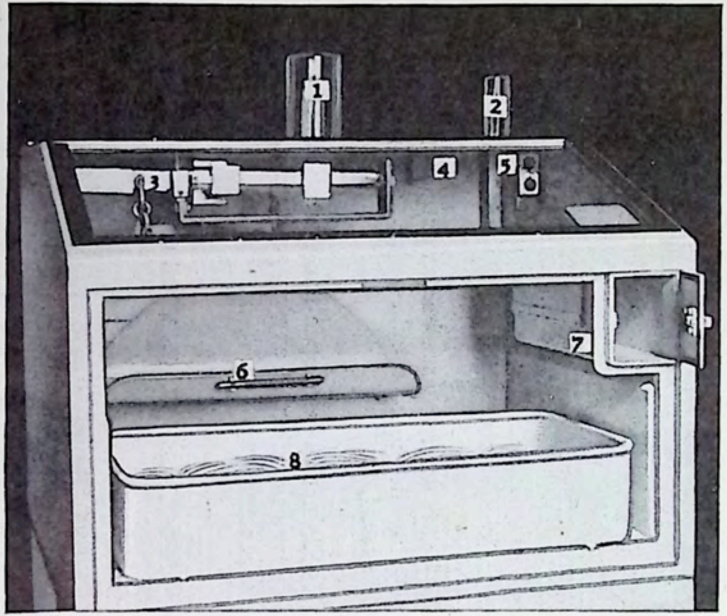


FIG. 13. Chapple bed, interior view.

CHAPPLE INCUBATOR

The Chapple Incubator (Figs. 12 and 13) combines the features of constant temperature, ventilation and humidity control. The incubator compartment contains a bed, stethoscope and a scale, and is electrically lighted. For the purpose of administering care, sleeves and an airlock are provided so that the infant can be attended without opening the bed. A cooling unit and an intake for the administration of oxygen are also provided.

Among other closed types of incubators are the Castle and the Davidson.

STATE INCUBATORS

Massachusetts, Nebraska, Iowa, Illinois and several other states have constructed simple and cheap incubators for state-wide distribution.

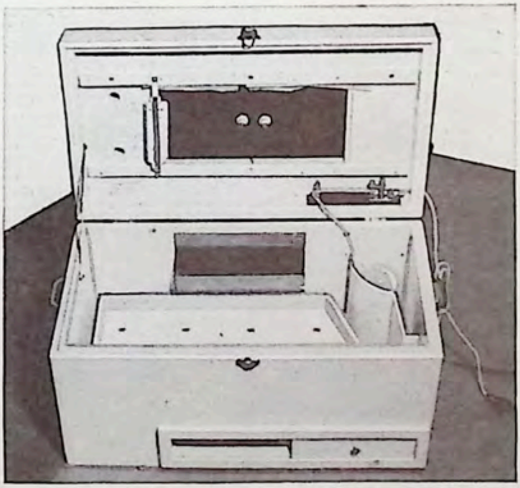


Fig. 14. Type of bed distributed by Nebraska and Iowa.

On application, these are furnished free of charge for use in hospitals and homes. Details of the construction of any state incubator can be obtained by applying to the particular state department of health.

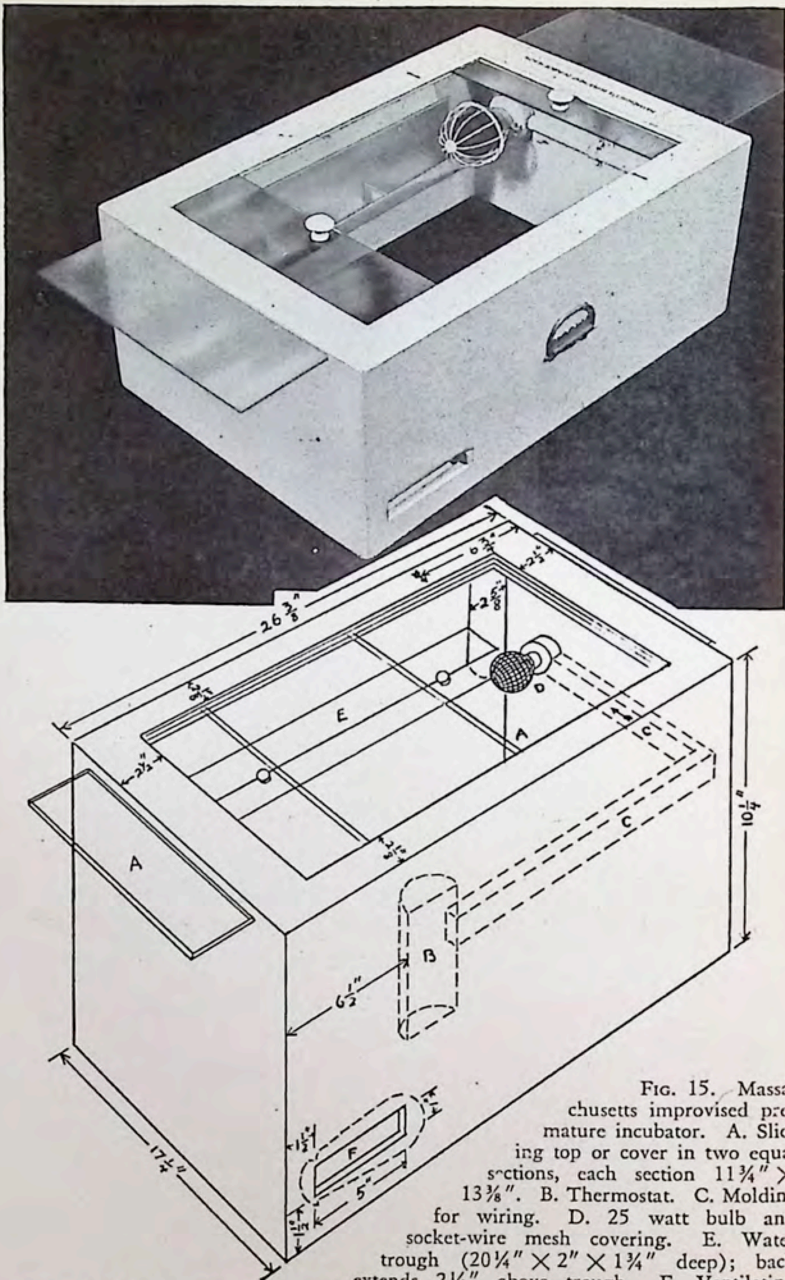
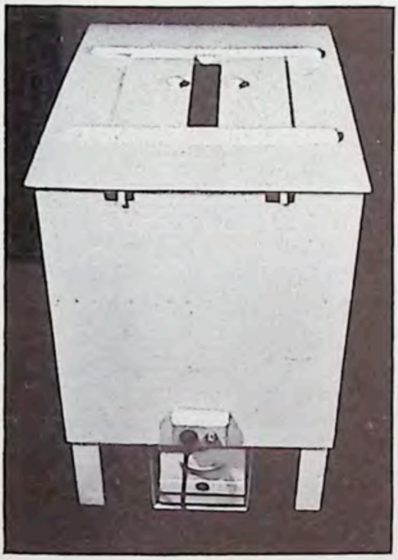


Fig. 15. Massachusetts improvised premature incubator. A. Sliding top or cover in two equal sections, each section 11¾" × 13⅜". B. Thermostat. C. Molding for wiring. D. 25 watt bulb and socket-wire mesh covering. E. Water trough (20¼" × 2" × 1¾" deep); back extends 2¼" above trough. F. Ventilating openings (5" × 1") with metal shell covers inside. (Courtesy, Massachusetts State Department of Public Health, Division of Child Hygiene.)

MINNEAPOLIS GENERAL HOSPITAL BED

The Minneapolis General Hospital Bed consists of a white, enameled wooden box, supported on four legs with roller casters. (See Figs. 16 and 17.) The top is hinged and may be raised so that the bassinet may be placed within the bed. The electric heating units are regulated by thermostatic control. The humidity within the bed may be increased by adjusting the humidifier which is placed under the bed; moisture enters through an opening in the floor of the bed.



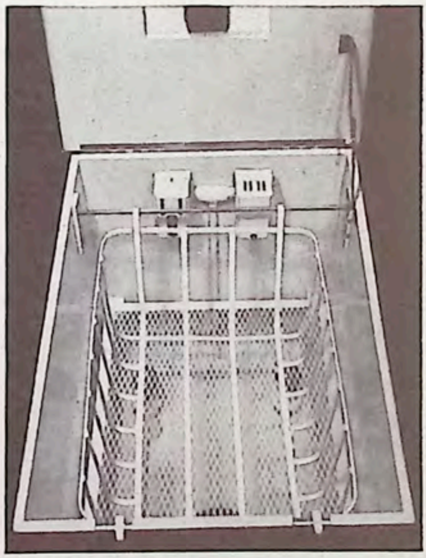


Fig. 16. Minneapolis General Hospital bed, closed.
Fig. 17. Minneapolis General Hospital bed, open.

THE HESS ISOLATION UNIT

The Hess Isolation Unit (Fig. 18) is planned primarily for nursery equipment. It is so constructed that it furnishes complete isolation for the infant, with a cabinet for the individual infant's necessary articles and an adjustable bathing and dressing table. The unit includes an individual detachable heating hood which can be removed at will. This unit was developed to furnish infants with extra warmth when indicated.

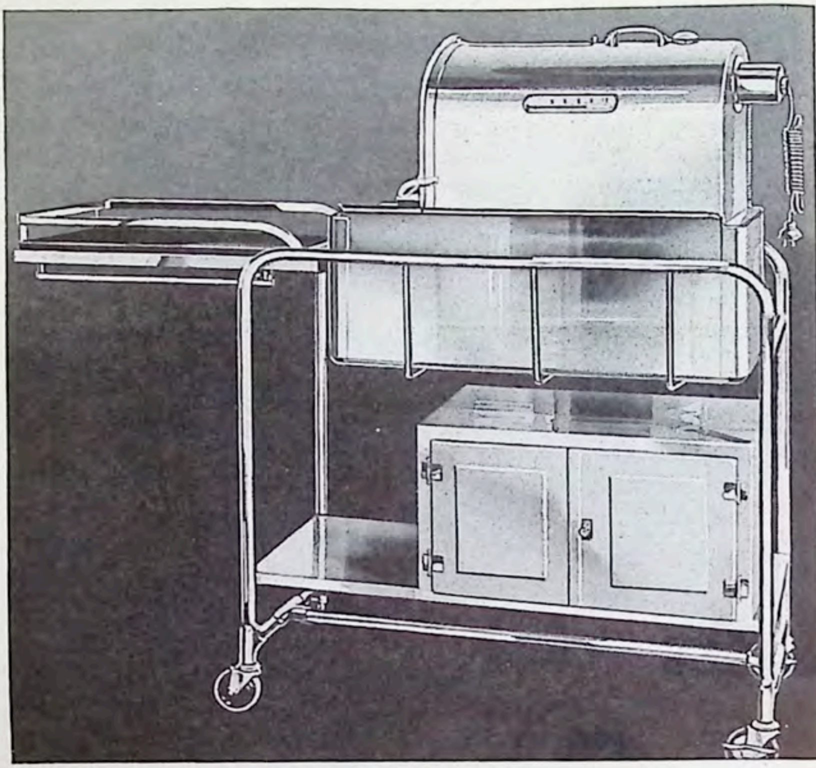


FIG. 18. The Hess nursery isolation unit.

ST. JOSEPH'S HOSPITAL OF MILWAUKEE BED

The bed used at the St. Joseph's Hospital of Milwaukee is so constructed that the head of the infant is outside the heated compartment (Fig. 19). A tent is supplied with the bed, and when oxygen is administered, the tent is attached to the front of the bed. The bed, as originally constructed,* is heated by a 25-watt Mazda lamp which is protected by a wire screen. There is automatic thermostatic control of temperature, and within the main unit there is a humidifier constructed of spongy rubber and encased in a metal cylinder. On the outside of the cabinet, a dual indicator registers the temperature and

* Modifications of this bed are being marketed, one by the A. S. Aloe Company under the name of the St. Joseph's Thermostatic Infant Incubator, and another by Burnadette LeRoy under the name of the Accli-Bator.

relative humidity in the body compartment of the bed. Except when the oxygen tent is in use, the infant breathes the room air.

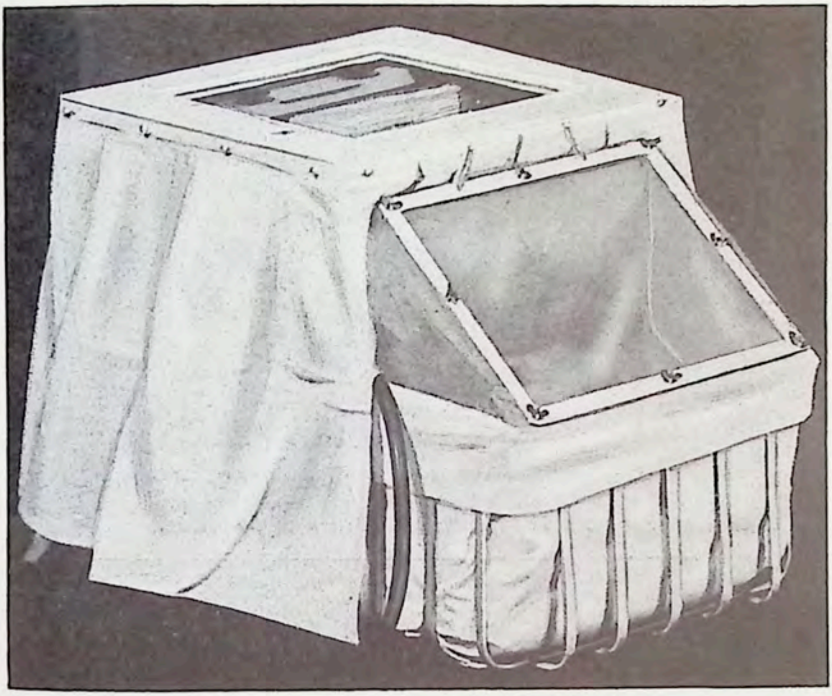


Fig. 19. St. Joseph's Hospital of Milwaukee bed.

SELECTION OF AN INCUBATOR

The nurse is often consulted when incubators are purchased for hospitals, and in the home the responsibility for improvising an incubator is frequently hers. Therefore, she should know the essential features of a satisfactory incubator.

To be satisfactory, an incubator must be safe to use, simple to regulate, and must assure easy observation and handling of the baby, with proper asepsis.

The heating unit of an incubator must have either an automatic control or one that is easily regulated. If the regulating unit of the incubator is complicated or demands much time or constant watching, the nurse will have less time to care for the baby.

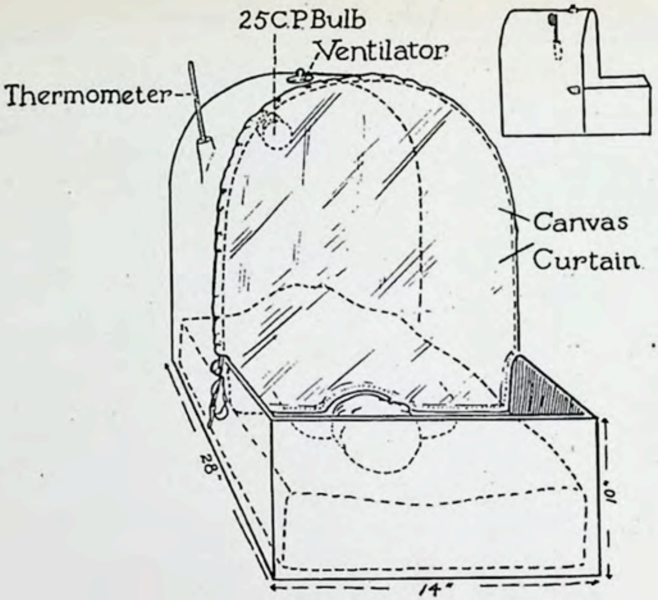


FIG. 20. Sarah Morris Hospital bed for home use. Made of galvanized sheet metal and heated with a 60-watt bulb. The curtain is made of awning cloth. The infant's body is under the hood with the head in front of the curtain.

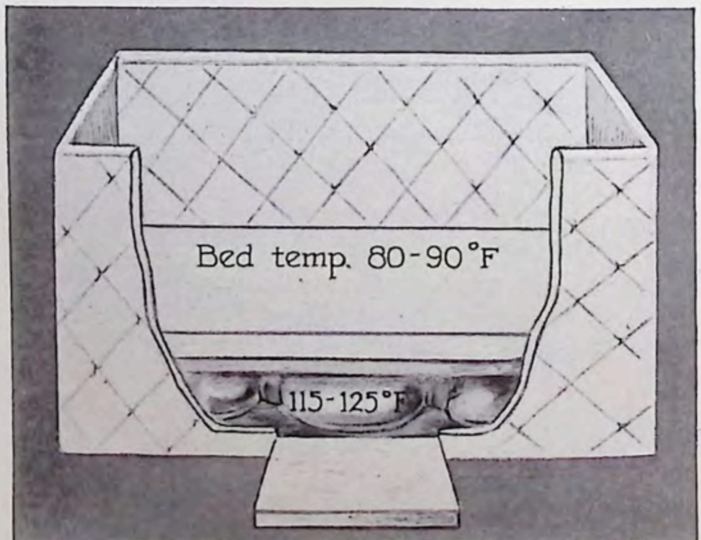


FIG. 21. Home-made, heated bed made from box. The box is a small canned-goods box. The platform is 4 inches above the floor. The box is padded inside and outside with quilting. Three-quarters of the bed is covered with a blanket.

If the incubator is not an open type, it should have a glass window at the top of the bed through which the baby can be observed.

The bed, if a closed type, should be equipped with a lid that is large enough to permit easy handling of the infant without removing it from the incubator. If the incubator is constructed so that the nurse has difficulty in working with her hands, it implies that she cannot manage the baby as carefully as she should. The bed must be built so that the nurse can easily hold the infant properly while it is being fed, otherwise the baby may aspirate or regurgitate.

Some incubators are designed so that the nurse must put her arms through sleeves in order to care for the baby. These sleeves may be an easy source of contamination to the nurse's hands and to the baby. In diapering the baby, she must be extremely careful not to contaminate the sleeves.

In incubators with metal hoods which cannot be removed, the baby's head is outside of the hood. Thus, when the baby is diapered, the diapers must be passed up over the head of the baby to be removed. This is poor technic. Such beds should be equipped with a removable hood to be satisfactory.

If a hood is placed over an ordinary crib, usually the baby is left exposed during diapering and dressing, which is an objectionable feature. This objection is overcome in such units in which the crib is made of solid aluminum or other metal and has a removable hood, or those in which the bed is completely protected by matting.

If electricity is used, the bed should be made of metal or other noninflammable material, if it is to be considered safe. If the bed is not heated by electricity, the nurse must depend on hot-water bottles, sand bags or bricks for heat. In the absence of electricity, an incubator with a false bottom or one with double walls should be used, so that the heating units can be placed in this space to avoid any possibility of their coming in contact with the baby.

As our final word for this chapter on incubators, however, we repeat: Hospital executives and nurses must realize that although an incubator is an integral part of the care of the premature infant, it is not the only important factor.

6

The Nurse and Her Technic

THE NURSE

The place occupied by the nurse in the care of the premature infant is of major importance. A nurse should not choose "The Care of the Premature Infant," as her elective, after she finishes training, unless she is sincerely interested in this branch of pediatrics. She should recognize that the essentials for success are:

Special training with a thorough understanding of aseptic nursing.

Being "premature minded."

Enthusiasm.

Conscientiousness.

Vigilance—constant care in critical periods with ability to act as occasion arises.

An understanding of the fact that care of premature infants always constitutes an emergency.

The technic used, the emergency treatments, the maintenance of a normal body temperature, the methods of feeding, the close observation of clinical symptoms and the early recognition of any pathologic manifestations are all responsibilities of the nurse.

The supervisor should establish a simple routine which can be observed by everyone in the nursery. Procedures should be written and should be executed in the designated method by everyone in the nursery. In nurseries in which each nurse carries out her own method, the result is usually a complete lack of technic and routine.

The supervisor, or her assistant, should make sure that all nurses are accurately taught the procedures. All steps should be demonstrated, and these can best be done in the premature nursery at the bedside of the baby. Neither a nurse nor an infant nurse should ever be permitted to carry out any procedure without first, having witnessed a demonstration, and second, without being personally supervised herself in carrying out the technic for the first two, three or more times if necessary. Putting nipples on bottles, feeding, diapering, making beds and all technics that the new nurse must do should first be demonstrated. She should be taught that the most minute detail in the technic is important.

Since clinical observations are of more diagnostic value than the signs detected on physical examinations, conscientious observations are of the greatest importance and attention must be given to every change in the infant's condition.

Proper management of the ward for premature infants requires that the supervisor or her assistant inspect each premature infant during the bathing period. Nurses should be taught to watch the infant's color closely. The color is a most important indication of the condition of the baby. Pallor as well as cyanosis must be noticed. With close attention, the nurse can readily detect the slightest change in the color of the infant. Since its progress and welfare is so dependent on the nursing care, the nurse must ever be alert and observant of every symptom and must be conscientious about reporting her discoveries to her supervisor and the physician in charge.

Nursing personnel must be impressed with the fact that the responsibility for infections occurring in the nursery rests with them. They must constantly be alert to prevent breaks in technic. If student nurses are in the nursery, a supervisor should always be present, so that their technic can constantly be checked. If permanent nurses are employed, only those who are at all times most conscientious about using good technic should be permitted in the nursery.

The nursing standards must be carried out during the entire 24 hours. Technic and observations during the evening and night are as important as those during the day. Never can there be any RELAXATION OF GOOD TECHNIC, nor in intelligent observations and efficient nursing care.

Unfortunately, in the organization of many nurseries, too great thought is given to elaborate equipment and not sufficient consideration to adequate nursing personnel. In many hospitals, the executive officers do not hesitate to spend large sums of money for the finest of equipment, but refuse to employ a sufficient number of nurses to permit aseptic technic. A shortage in the nursing personnel accounts for inadequate care, especially during the critical first hours of life, and may result in epidemics of diarrhea, impetigo and other types of infections among the infants.

If the premature station is a separate unit and has eight or more premature infants, the personnel should consist of a supervisor and at least three graduate nurses, one to assist the head nurse, a second to supervise the evening shift and the third to supervise at night. When premature infants are cared for in the regular nursery, one nurse during each eight-hour period should be assigned to these infants, so that they will receive the necessary attention.

Best results are obtained if permanent, well-trained personnel are employed. Since this is not always possible, if student nurses are taking care of the premature babies, they must receive adequate instruction and must be closely supervised. FOR THE 24-HOUR PERIOD, THE NURSING PERSONNEL SHOULD AVERAGE ONE NURSE FOR EVERY TWO OR THREE INFANTS. THE NUMBER OF NURSES REQUIRED ALSO DEPENDS ON WHETHER OR NOT GRADUATE OR UNDERGRADUATE NURSES ARE IN CHARGE OF THESE BABIES.

In hospital wards, the constant changing of nurses which occurs so frequently to meet the curriculum for nurses' training in general hospitals, is found to be a great disadvantage. At the Sarah Morris Hospital, a satisfactory solution has been found for some of our nursing problems through the employment of "nursery maids" (infant nurses) as a part of the personnel in the premature infant station. These young women, who are entered for one year's training in the care of newborn and young infants, spend part of their training period in the obstetric nursery and part in the children's hospital, in which the premature infant station is located. Since they remain in the station for longer periods than the average nurse in training, the personnel is changed less frequently, which is a great advantage and decreases the amount of personnel instruction necessary.

A nurses' aid or ward helper can be employed to good advantage in the premature station. She can be taught to do all the cleaning, folding of linen and other similar routine tasks, so that the nurse can spend all of her time with the care of the babies.

TECHNIC

Morbidity is always potential mortality. To prevent morbidity, asepsis must be a major factor in nursery technic and procedures. Here are presented some general principles of a safe and simple technic which can be employed in a nursery, to achieve the minimum of morbidity and maximum of asepsis.

Although technic is of paramount importance, the more complicated the method, the less chance there is that it will be adhered to consistently. Therefore, the procedure must be simple, but thorough and effective. While constantly emphasizing technic and checking to prevent breaks, it must be remembered that the welfare and progress of the infant also depends on conscientious observations and the ability of the nurse to apply her knowledge intelligently.

Prevention of infections necessitates that:

1. The nursery be kept clean at all times.
2. Hands be washed thoroughly and linen and equipment be handled properly to obviate the danger of cross-infection.
3. Asepsis be carried out in all procedures.
4. Personnel or anyone else with infections be excluded from the nursery.
5. Any infant with evidence of pathologic changes be isolated immediately.

The upper part of the infant should be considered clean and the lower part contaminated. At no time should a nurse be permitted to transfer her care from the lower part of the baby to the upper part, nor should she be allowed to transfer the care of the lower part of the bed to the upper part without washing her hands and arms. Diapering and feeding must be considered as two separate procedures. Babies should be diapered and soiled diapers removed from the nursery before feedings are started.

Cleaning the Nursery. The nursery walls should be washed at least three or four times a year. Dry mopping or sweeping should never be permitted. The floors should be washed daily. The window ledges and the furniture should be wiped every day with a damp cloth. The furniture and cupboards should be scrubbed with soap and water once a week. Diaper cans, linen hampers and waste baskets should be thoroughly scrubbed each week. After the baths are finished in the morning, the soiled linen and diapers must be removed from the nursery, waste baskets emptied, sinks scrubbed and bathing tables cleaned before the feedings are started. The bassinet must be thoroughly scrubbed with soap and water after the baby is discharged. If the mattress is covered with a rubber pillow-case, this too should be removed and thoroughly cleaned after the baby is discharged. (A rubber pillow case keeps the mattress from becoming soiled.)

The outside of the incubator must also be cleaned, and the thermometer in the bed should be washed with soap and water. Alcohol or ammonia can be used for polishing and cleansing metal incubators.

Equipment and Linen. The containers for gauze, cotton, applicators, etc., should be kept covered, except when sterile material is being withdrawn. Containers should be sterilized (preferably autoclaved) at least once each week and after any time that the containers may become contaminated. Forceps and forceps jars should be sterilized once daily and if the forceps is contaminated, it is advisable to boil it before replacing it in the solution. Forceps jars should be filled with the proper solution. Tongue blades should be autoclaved and kept sterile. A stethoscope should be kept in the nursery and should be cleaned between use on each baby. Alcohol is satisfactory for such cleansing. The tape measure employed for the measuring of the infants should be cleansed after use.

Nursery linen should, if possible, be washed separately from other hospital linen. Autoclaving the used linen is another safe precaution which is employed in many nurseries. Since the woolen shirts cannot be autoclaved, they are washed with soap in tepid water and rinsed three times in tepid water, stretched and dried.

Nurses should be taught that nothing can be put on the floor. If they are permitted to put soiled linen or bottles, etc., on the floor, they will soon be setting clean equipment there.

Handling of Linen in Relation to the Infant. A baby should never be permitted to come in contact with the nurse's uniform. The premature infant is small and can easily be held away from the uniform. A carrying blanket or a paper sheet should prevent the larger baby from coming in contact with the nurse's uniform. Linen, either clean or soiled, should not touch the uniform. It is not unusual to see a nurse walk down a hospital corridor with the soiled linen clasped closely to the front of her uniform. Handling the blankets on the bed, as illustrated on page 74, prevents contamination of the linen near the infant's face.

Hand Technic. There are two schools of thought on hand technic. One advocates thorough scrubbing, while the second believes that washing with soap under running water is sufficient.

If hands are washed 60 to 90 times during the eight hours on duty, it is almost impossible to avoid abrasion of the skin, if a stiff brush is used each time. At Sarah Morris Hospital, the use of plenty of soap while washing under running water is advocated.

The hands and arms, up to the elbows, are washed thoroughly:

1. On entering the nursery.
2. After care of each baby.
3. After diapering a baby.
4. Before feeding the infant.
5. Before pouring feedings or putting nipples on a bottle.
6. Before sterilizing or handling breast milk.
7. After using a handkerchief or Kleenex.
8. After adjusting window shades or windows or answering the telephone.
9. After any scrubbing or cleaning.

Fig. 22.

Fig. 23.

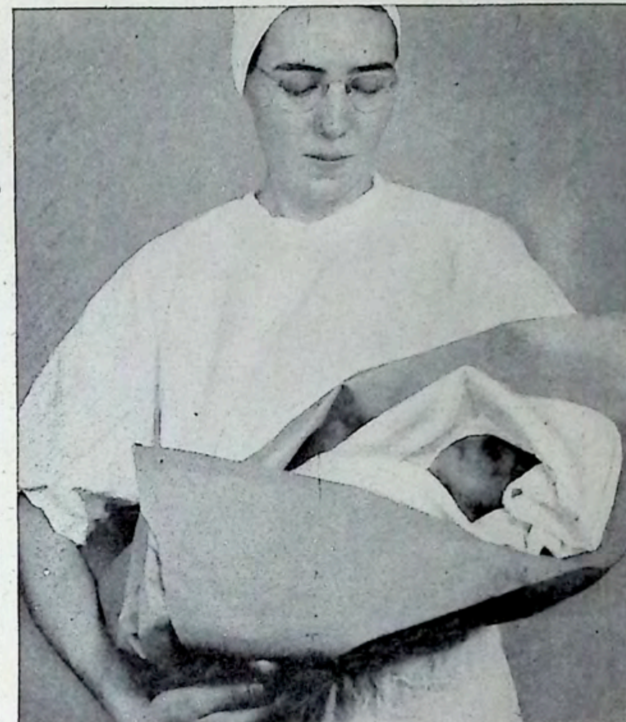


Fig. 22. Carrying baby. Do not let the baby come in contact with your uniform.

Fig. 23. Taking baby to the breast. Place a large square of autoclaved paper at the foot of the bed. Place carrying blanket on the top of the paper which will prevent the baby and the carrying blanket from coming in direct contact with the nurse's uniform. It will also prevent baby from coming in contact with the mother's bed. Paper is discarded before baby is put back into his crib.

10. If, just before caring for the upper part of the baby, the nurse has handled the legs or buttocks of the baby or the lower part of the bed.

11. Before leaving the isolation room, and again on entering the clean nursery.

Small squares of tissue paper or autoclaved squares of newspaper can be used to handle lids of sterile containers or the forceps or weights, while the nurse is working with the baby, in order to prevent contamination of these articles. To eliminate some of the hand washing, these squares may also be used for handling door knobs, windows, etc.

Dress of Personnel. Short-sleeved uniforms should be worn in the nursery, and the nurse should change into a uniform that is worn in the nursery only, before entering the nursery. If it is necessary to wear this uniform outside of the nursery, at any time, it should be covered with a clean gown. A nurse working in the obstetric department, and taking care of the mothers and the babies, should put a clean gown over her uniform before entering the nursery. It is advisable that the nurse wear a head cloth so that her hair is completely covered.

The supervisor should observe that doctors and interns put on clean gowns and wash their hands on entering the nursery and between babies. The maid, plumber and electrician, in fact everyone, should wear a gown when in the nursery.

Masks. Of what real value are masks? Physicians are agreed that at best their value is doubtful. Masks are advocated, generally, by persons who do not actually wear them. In commenting on their inefficiency in a nursery, Dr. Mandel Spivek says:

> If the infection is due to a virus, it is difficult to see how several layers of gauze will stop the virus when a Berkefeld filter cannot. If the infection is bacterial, the known inefficiency of most types of masks after a short period of time makes them ineffective. Fingering of masks and "on again—off again" tactics of the wearer complete the case against the mask as far as infections of the respiratory tract are concerned.

Some of the principal objections to the wearing of masks are:

1. They give those wearing them a sense of false security.

2. After a mask is worn for an hour, instead of being a protection, it is as great a source of infection as a soiled handkerchief would be, insofar as the infant is concerned.

3. The nurse often adjusts and handles her mask and does not wash her hands afterwards. This is especially noticeable while the nurse is feeding the baby.

4. The nurse picks up the baby to allow it to belch and, frequently, in doing so, permits the infant's face to touch the mask.

5. Masks are taken off, laid down, or put in the nurse's pocket, and when again put on, the other side of the mask may be next to the nurse's face.

6. When masks are a part of compulsory technic, they are rarely found supplied in numbers sufficient to fulfill their purpose.

Although it is admitted that the nose, throat and mouth of a nurse are sources of infection to the patient, the present technic of wearing masks, especially the gauze mask which is most commonly in use, does not solve the problem. A NURSE WITH A SORE THROAT OR A COLD SHOULD NEVER BE PERMITTED IN THE NURSERY. Many hospitals today are taking nose and throat cultures of their nurses before permitting them to work in the nursery.

IF MASKS ARE WORN:

1. To be effective, the gauze mask alone is not adequate. Some type of filler should be used (this makes the mask most uncomfortable to wear).

2. There should be a sufficient number to permit frequent changes —at least every two hours.

3. They should be washed and boiled or autoclaved after being used.

4. They should be worn over the nose and properly tied.

5. When they are removed, they should be discarded in a bag marked "soiled masks."

At the Sarah Morris Premature Station, the nurses have not worn masks for the last eight years. Hand technic is stressed and the nurse is required to stand as far away from the baby as possible when caring for it.

Isolation Technic. Morbidity is prevented only when every baby is considered as an isolated patient and is treated accordingly by means of an established and efficient routine. If the technic in a nursery is as it should be, there is no danger in keeping an isolated case in the same room with clean cases. However, due to the psychologic effect that an isolation cubicle has on personnel, and because of the general shortage of nursing personnel and proper supervision, isolation rooms are required by Board of Health regulations.

The supervisor should be permitted to isolate any infant with any symptoms of an infectious disease, and she should not have to wait 4 to 24 hours for permission from the attending physician. The time to isolate a baby is during the early stage of the manifestations of any infection. The baby's linen, feeding equipment, bathing equipment, etc., must be kept isolated. A gown should be worn by anyone coming in contact with the baby. The accepted practice is to hang the contaminated side of the gown out.

PROCEDURE TO PUT ON AND TAKE OFF GOWN

The following technic is used to put on and remove the gown:

To Put on Gown.

1. Place the palm of the hands together, slip them into gown between the back hems, grasp the inside of the gown and lift from the hook.
2. Force hands through the sleeves of the gown, avoid touching the outside of it.
3. Tie strings at the neck. Pull gown over uniform at back and tie at waist.

To Remove Gown.

1. Untie strings at the neck and waist, grasp front of the gown and pull loose from the uniform.
2. Wash hands and arms.
3. Remove the gown by slipping the fingers of the right hand under the cuff of the left sleeve and pulling cuff over the hand. (Do not let the thumb touch outside of cuff.) With the left hand still in the sleeve, grasp the right sleeve just above the cuff and draw the right hand through the sleeve. Contamination of the inside of the gown is to be avoided.
4. Hold the gown by the shoulder seams and neckband, fold and bring the palms of the hands together. Fold inside in, placing one shoulder in the other.
5. Hang on the hook by the shoulder seams, with the back hem of the gown facing outward.
6. Wash hands.

It is important to wash the hands before and after taking off the gown. All equipment used in the care of the baby should be cleansed and made ready for sterilization before the gown is removed. The handles of doors or anything not specifically used for the infant should be handled with paper squares while in the isolation room. It is not necessary to contaminate everything in the room, even though nothing in the isolation room is considered as absolutely clean. The hands must be thoroughly washed before leaving the isolation room and again thoroughly washed on entering the clean nursery. Gloves should be worn when caring for any baby isolated because of a skin condition.

When the isolated baby is discharged, the bed should be thoroughly scrubbed, aired for 24 hours and then scrubbed a second time. If the mattress is contaminated, it should be autoclaved. All equipment used for the baby should be washed with soap and water and then boiled or autoclaved, if possible. Any linen left over should be autoclaved or sent to the laundry. All other equipment in the room should be thoroughly washed with soap and water.

It is not enough to isolate the baby. The supervisor must find out what break of technic was responsible for the development of the infant's cold, pneumonia, thrush, or whatever the infection. Nurses should not be permitted to say, "Due to the premature infant's lowered resistance, it contracts infections more easily." Although this may be true, it indicates that in caring for premature infants, the nurse must be especially cautious and at all times most conscientious in using aseptic technic.

Nurses must be taught their responsibility in preventing morbidity and at no time should they be permitted to shirk this responsibility. They should be sincerely interested in the progress and welfare of the premature infant.

7

Routine of the Premature Infant Station and Routine Procedures

HOSPITAL STATION ROUTINE

The progress of the premature infant is dependent on feeding at regular intervals. The infant must be fed on time. A definite schedule must be established, and a written schedule of the day's routine for every hour of the 24 is advisable.

Sufficient personnel is necessary so that when emergencies arise, when there is an unusual number of new admissions or when unscheduled procedures are required, nurses will be available to carry out the established routine. Neglect of the infant will thus be avoided.

All babies should be observed to detect vomiting after each feeding, or cyanosis or pallor. Thermometers and thermostats and the rheostats on incubators should be checked regularly.

One day a week should be set aside to scrub furniture, cupboards, tables and other equipment. All gauze, cotton applicators and similar supplies should be autoclaved at least once a week. Formula equipment, such as containers for gauze, medicine glasses and nipples, should be autoclaved every other day. Soiled diapers are removed from the nursery routinely before feedings are given. Definite duties should be assigned to the evening, night and day nurses, and the supervisor should be responsible for the discharge of these special duties.

The routine followed at the Sarah Morris Premature Infant Station and the procedures practiced in carrying these out are given in the following pages of this chapter.

ROUTINE FOR DAY DUTY

7:00 A.M.	Hear report of night nurses.
7:10	Bathe babies.

	Check incubators and oxygen tanks.
8:30 A.M.	Clean nursery.
	Scrub bath basins and send equipment to be autoclaved.
	Pour feedings for all babies.
	Heat feedings.
	Place in ice box until needed feedings for babies on 4-hour schedule.
8:50	Feed babies on 3-hour schedules.
9:20 A.M.	Heat feedings for babies on 4-hour schedule.
9:30	Feed babies on 4-hour schedule.
	Check all babies for vomiting and cyanosis.
9:45	Pour cod-liver oil, orange juice or tea for all babies.
10:00 A.M.	Feed orange juice and cod-liver oil or tea to babies on 3-hour schedule.
10:30	Wash shirts.
	Make bath packs.
	Fold and put away linen.
11:00 A.M.	Pour feedings for babies on 3-hour schedule.
	Diaper babies on 3-hour schedule.
11:20	Heat feedings.
11:30	Feed babies on 3-hour schedule.
12:00 M.	Give cod-liver oil and orange juice to babies on 4-hour schedule.
12:30 P.M.	Pour tea for babies on 3-hour schedule.
1:00 P.M.	Give tea to babies on 3-hour schedule.
1:15	Diaper babies on 4-hour schedule.
1:20	Heat feedings.
1:30	Feed babies on 4-hour schedule.
	Check all babies for vomiting and cyanosis.
	Fold linen.
2:00 P.M.	Pour feedings for babies on 3-hour schedule.
2:10	Diaper babies on 3-hour schedule.
2:20	Heat feedings.
2:30	Feed babies on 3-hour schedule.
3:00 P.M.	Chart all required records.
	Clean nursery.

EVENING ROUTINE

4:00 P.M.	Tea for babies on 3-hour schedule and for those receiving 7 feedings.
	Water for babies still having meconium stools.

	Take temperatures and diaper all babies.
	Prepare Day Report and send to proper office before 5 P.M.
	Report on all babies receiving oxygen and those in poor condition.
5:00 P.M.	Get sterile supplies from dressing room.
	Pour feedings for all babies.
5:20	Warm feedings.
5:30	Feed babies.
6:00 P.M.	Make rounds and check for vomiting and cyanosis.
	Check oxygen tanks and rheostats.
	Fold diapers.
	Clean DeLee tables, fill in sterile supplies.
	Nursery maid makes tea, cleans ice box.
7:00 P.M.	Tea for babies on 3-hour schedule and those receiving 7 feedings.
7:45	Diaper babies on 3-hour schedule. Take temperatures of those whose temperatures were over 100° F. or below 98° F. at 4 P.M.
8:00 P.M.	Pour feedings for all babies.
	Place feedings for babies on 4-hour schedule into ice box until needed.
8:20	Heat feedings.
8:30	Feed babies on 3-hour schedule.
9:00 P.M.	Check babies and beds.
9:20	Diaper babies on 4-hour schedule.
9:30	Feed babies on 4-hour schedule.
10:00 P.M.	Tea for babies on 3-hour schedule.
10:45	Pour feedings for all babies and place those to be given at 2 A.M. in ice box.
	Diaper babies on 3-hour schedule.
11:20 P.M.	Heat feedings.
11:30	Report to night nurses.

Be sure nurseries are clean before going off duty.

DeLee tables and feeding table must be clean and used supplies replaced.

One dressing drum should be taken out to unsterile table in dressing room every evening. All empty towel boxes must be filled and taken out also.

Floor should be swept, soiled diapers and linen disposed of and waste baskets emptied.

Sterilizers should be checked for cleanliness, adequate number of clean towels and sufficient water and proper current.

All sinks should be clean.

Used 8-ounce bottles should be cleaned and taken to kitchen.

ROUTINE FOR NIGHT DUTY

11:30 P.M.	Hear report of evening nurses.
11:40-12:00	Give all babies on 3-hour schedule 12 o'clock feeding.
12:15-1 A.M.	Nursery maid: Sterilizes feeding equipment. Cleans desk. Cleans beds. Nurse: Fills jars of gauze, if necessary. Cleans DeLee tables. Checks drugs. Cleans pumping station for wet nurses. Changes sheets. Dusts. Sterilizes equipment. Checks sterile 8-ounce bottles, cotton and boric acid, and replaces used quantities. Changes gowns. Empties waste basket.
1-1:15 A.M.	Give tea and water to babies on 3-hour schedule.
1:20-1:30	Take temperatures and diaper babies on 4-hour schedule.
1:30	Feed babies on 4-hour schedule.
1:45	Take temperatures and diaper babies on 3-hour schedule and those on irregular schedule.
2:00 A.M.	Pour feedings for babies on 3-hour schedule.
2:20	Heat feedings.
2:30	Feed babies on 3-hour schedule.
3:00 A.M.	Check babies for vomiting, cyanosis or other irregularities. Check oxygen and rheostats. Eat lunch in kitchen. Fill out report on condition of infants and night report. Chart required records of all babies. Set up tables for bathing.
4-4:30 A.M.	Give tea to babies on 3-hour schedule.
4:45	Diaper all babies.
5:00 A.M.	Pour feedings for all babies.
5:30	Feed all babies.

6:00 A.M. Check all babies and beds.
Clean up nursery.
Bathe as many babies as time permits.
Give Alpine ray treatments at bath time on Mondays and Thursdays. Length of treatment indicated by supervisor.

6:45 Clean both nursery and preparation rooms thoroughly:
Sweep floor.
Change sheets.
Scour all sinks.
See that all used 8-ounce bottles are cleaned and taken to kitchen.
Dispose of soiled diapers and linen.
Change towels in sterilizers, check for water and current.

7:00 A.M. Report everything of importance to day supervisor.

ROUTINE PROCEDURES

PROCEDURE IN WASHING HANDS

Wash Hands When
Entering the nursery.
After changing baby.
Before feeding.
Between babies.
After using handkerchief, coughing, etc. (These should not be done in nursery.)
After working around nursery away from babies.

Requirements.
Soap, water and paper towel.

Procedure.
1. Use adequate water and soap and make a good lather covering up to elbow.
2. Inspect fingernails for cleanliness. (Fingernails should be kept short.)
3. Rinse well.
4. Use elbow or knee to turn off faucet.
5. Dry well with two paper towels.

PROCEDURE TO BATHE INFANT

Aim.
To bathe the premature infant quickly with minimum exposure and, at the same time, observe it carefully.
(Tub baths are given after the cord is off and the navel dry.)

Requirements.

Sterile package of
- Cotton (sufficient amount for eyes, thermometer and genitals).
- Toothpick swabs.
- One washcloth.

Cold cream.
Castile soap solution.
Alcohol (40 per cent) back rub.
Thermometer.
Clean spread.
Autoclaved waxed paper, one sheet.

Procedure. (See illustrations in Appendix.)

1. See that all doors and windows are closed.
2. Balance clean spread or sheet on scales. Be sure spread covers the scale. Put required weight on scale.
3. Spread autoclaved waxed paper on table.
4. Open autoclaved individual bath pack.
5. Fill bath basin four-fifths full of water. Temperature 100-105° F. for tub baths, 105-110° for sponge baths. Hold bath basin on edge of sink and turn faucets on with paper mouth wipes.
6. Place feeding diaper over head of bassinet, if it is not soiled.
7. Turn down top covers, folding the upper edge under.
8. Remove baby's diaper (if baby has had stool, wash buttocks with cotton and warm water), discard diaper and wash hands.
9. Cover baby with clean diaper and white blanket.
10. Turn baby slightly to side to unpin the shirt (fasten pin at head of bed). Remove shirt and place at foot of bed on top covers.
11. Pick baby up, holding one hand under shoulders and head and grasping feet with the other hand, and carry baby to scales. Be sure to hold baby away from uniform.
12. Use right hand to cover baby with spread as blanket is rolled off with the left hand. Weigh baby. Cover baby with blanket as the spread is opened up, taking care not to touch scale, and then read weight.
13. Grasp feet of baby with left hand and raise baby's feet high enough so that they can be grasped with right hand from underneath. As the baby's body is raised and pulled toward foot of scale, grasp shoulders with the left hand and lift baby out of the scale.
14. Place baby on table, open spread so that pad is completely covered. Take small piece of cotton out of pack, lubricate it with cold cream. Remove baby's individual thermometer from test tube, wipe off antiseptic solution on dry corner of cotton pledget, lubricate with cold cream and insert until temperature is taken. Top blanket covers baby while thermometer is registering.

15. Wash hands and record weight and temperature.
16. Holding baby's head firmly in left hand, wash face with clear water. Dry.
17. Moisten washcloth with sufficient soap to make a good lather, and wash baby's hair. Wrap baby in white blanket, support head and shoulders well. With left hand hold baby's head over basin and rinse off soap, being careful not to get any water in the ear canal. Dry well.
18. Observe eyes; if there is any discharge, cleanse with cotton pledget moistened in boric acid solution. When cleansing right eye, turn head well to the right and vice versa for the left eye, to prevent the solution or discharge of one eye running into the other. Cleanse from inner canthus outwards. If eyes are clean, they need not be cleansed.
19. If nostrils are clean, they are left alone. If the nostrils need cleansing, use dry cotton toothpick swabs. IT IS DANGEROUS TO LUBRICATE NOSTRILS with mineral oil.
20. Inspect mouth—DO NOT CLEANSE IT. Report any white spots.
21. Cotton toothpick swabs are used to cleanse external ear; avoid cleansing ear canal. Closely inspect back of ears for excoriation. (This area can easily become excoriated unless watched, due to the fact that the external ear has little cartilage and is hugged closely to the head.)
22. Soap washcloth well. Remove drying diaper and blanket. Quickly soap chest, arms and abdomen, then turn baby over and soap back as far as the buttocks. Again turn baby over and soap extremities. Soap large pledget of cotton and wash genitalia and buttocks. Discard the pad of cotton. Do not contaminate your fingers.
23. Submerge infant, using washcloth for rinsing. Rinse chest, arms and abdomen, then back and extremities, and genitalia last.
24. Dry baby gently. Dry chest, arms and abdomen. Apply 40 to 50 per cent alcohol. Inspect axillary region.
25. Turn baby on abdomen and dry back. Apply alcohol.
26. Again turn baby. Cover upper part of baby with blanket. Be certain that the lower part of the blanket does not touch the face.
27. Dry extremities. Apply alcohol.
28. Again cleanse genitals with washcloth. In the female infant, it may be necessary to apply mineral oil between the labia minora and labia majora to remove smegma. Oil is applied with a toothpick swab. In the male baby, the foreskin is not pushed back. Dilatation may be necessary.

29. The hands and arms are washed and the baby is returned to its crib and dressed. If possible, it is desirable to have the infant nurse or someone else make the bed while the infant is being bathed. The incubator is checked, and if the infant's temperature is under 98° F., the lid is put on the incubator.

Care must be exercised to keep the same end of the drying diaper over the upper part of the infant.

INITIAL BATH

The initial bath is not given until the baby is warm and in good condition. It may be necessary to wait from two to 24 hours.

The cord is painted with tincture of Merthiolate and a sterile dressing and band are applied. Warm sterile mineral oil is used for bathing. The chest, arms and back are cleansed and the shirt is put on the baby. The lower extremities are cleansed; the baby's length is measured and the diaper and wrapping diaper are then put on. The nurse washes her hands and then cleanses the baby's face and head.

If the head is covered with blood, soap and water are used. Blood and vernix may easily be removed from the head with a fine comb, after the head has been washed. The fine comb is covered with a few layers of gauze to facilitate later cleaning of the comb.

One drop of 1 per cent silver nitrate is put in each eye. Although almost all of the babies received in the Premature Station at the Sarah Morris Hospital have had Credé treatment before they are sent in, we find that with a second application we are able to eliminate gonorrheal ophthalmia almost completely. Most of our infants come from homes in which the poor facilities and the need to prevent exposure make Credé treatment rather difficult to do properly. Rubbing the vernix into the eyes might reinfect them.

The infant is then replaced in bed and is not handled any more than necessary. It is closely watched for cyanosis and mucus is removed when necessary. The rectal temperature is taken every four hours in order to determine the amount of heat necessary for the individual infant. The baby is checked closely for its first voiding and its first meconium stool. During the bath any external anomalies can be noted, and the skin is closely inspected for peticheal spots, birthmarks, pustules, bruises, abrasions, hot-water bottle burns and other irregularities.

SPONGE BATH

Sponge baths are given until the cord is off and the navel is dry.

The abdominal band is left on while the infant is being weighed and bathed. After the infant has been weighed and its temperature taken, the nurse washes her hands and inspects the cord. If the band is clean and the cord dressing is in place, it is not further disturbed. However, if the dressing or band is soiled, the covers are removed and the band taken off. A sterile, dry dressing is applied and another band is slipped on.

CAUTION: Do not let drying diaper or blanket come in contact with the cord.

The water for a sponge bath should be 105° F. The head, chest and arms are bathed first (lower extremities being kept covered), and then the upper back is washed. The upper part of the body is covered with a blanket, and the extremities and genitals are bathed. Since there is no further use for the washcloth, it can be used for the genitals.

CARE OF THE CORD

The cord should be covered with dry, sterile gauze. It is also desirable to have gauze underneath the cord, so that the cord will not rest on the abdomen and thus possibly cause an excoriation.

The dressing can be held in place with a slip-on band made of stockinet material, which eliminates sewing and pinning. This band should be two inches wide.

If the cord is dry, no medication is applied to it; if it is moist, tincture of Merthiolate should be used. The dressing and band should not be changed every day unless they are soiled.

The cord of the premature infant usually falls off at a later date than that of the full-term, and sometimes it may not drop off until the 14th to the 18th day. If a stump is left, the navel is cauterized with 10 per cent silver nitrate solution or with a hard silver nitrate pencil. If there is no stump, tincture of Merthiolate or alcohol is applied to the navel. Occasionally, in the extremely small premature infant, a local omphalitis may occur when the cord drops off. Usually, cauterizing the navel with a silver nitrate stick, and the application of alcohol or tincture of Merthiolate for a few days is sufficient treatment.

In most instances, the dressing and band can be discontinued two days after the cord has dropped off, if there is no evidence of hernia.

Clamps are often injurious to the thin skin of the abdomen, and the use of these on the cord frequently causes pustules and excoriation. Cord ties are preferable for the premature baby. (See "Tying and Section of the Cord.") We have seen large umbilical hernias following the use of the heavier types of umbilical clamps.

CLOTHING

It is imperative to remember that preservation of body heat must be begun immediately after birth, on the confinement bed itself.

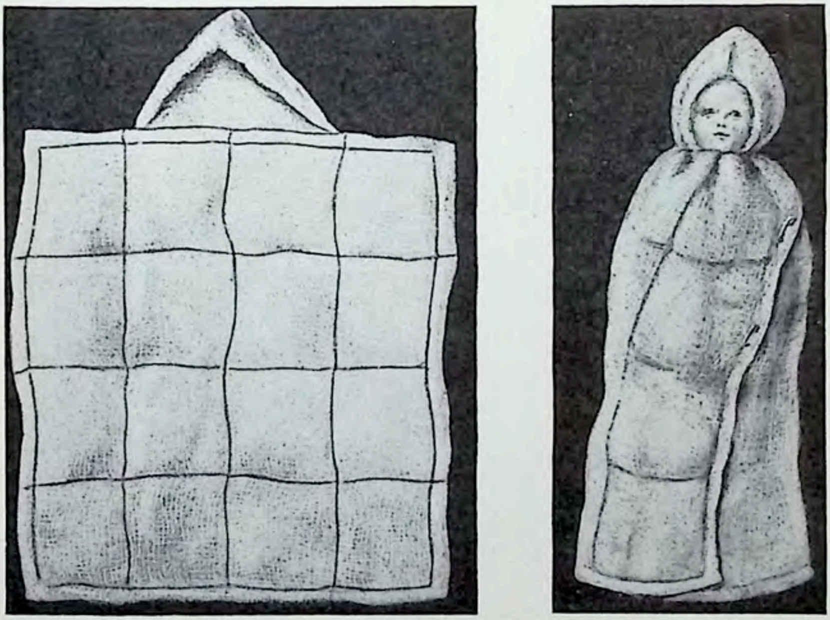


FIG. 24. Temporary emergency clothes made from gauze and cotton combination.

Temporary Clothes. At birth the infant is received into a warm blanket and immediately placed in a heated basket or heated bed.

In small prematures, for temporary emergency use, a sterile cotton-pack which completely envelops the infant, except for the face, may be applied. Cotton, however, is far inferior to wool in prevention of heat radiation, and should not be used for the more important pieces of the permanent clothing. An improvised jacket, preferably of flannel, may be placed on the outside of the cotton to hold it in place.

To the cord, genital region and anus an easily changed pad of cotton

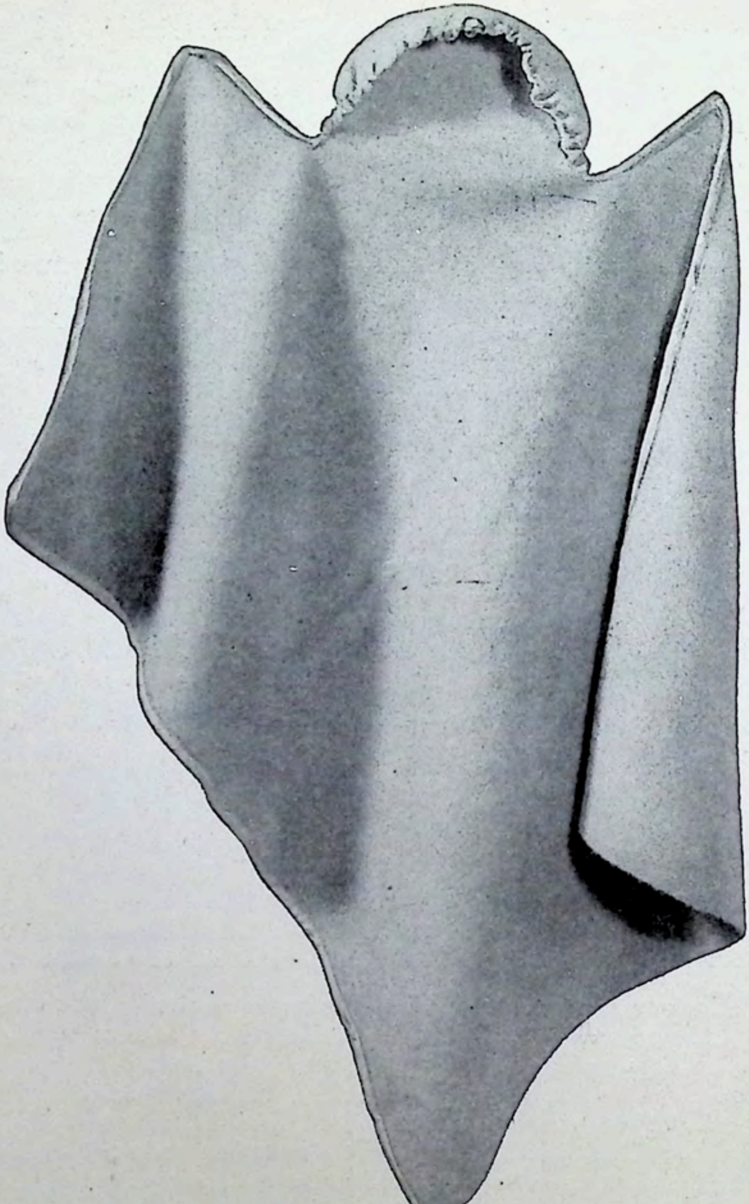


FIG. 25. Premature babies' flannel jacket and hood for wear in open incubator.

or gauze combination may be applied. Whenever the infant becomes soiled, the pad should be changed. This should not be neglected.

Permanent Clothes. In a well-equipped station, several sets of special clothes should be provided.

With open type heated beds, all garments next to the body, except napkins, should be made of light-weight flannel. A complete outfit for the use of an infant in an open type of heated bed should contain:

Four undershirts with blind sleeves (light-weight wool flannel).
Four overjackets (French piqué or cotton flannel).
Four pinning skirts (French piqué or heavy diaper material 24 by 28 inches).
Three light woolen blankets, 1 yard square.
Two dozen diapers, 18 by 20 inches (fine birdseye).
Small bibs or feeding towels.

Unless the infant is very small, only the outer shirt is worn in the summertime and in a warm oxygen chamber. The shirts must reach to the hips, so that the diaper can be wrapped over the lower border of the shirts. The Minnesota State Board of Health has interested a manufacturing concern in making a special shirt of part wool for premature babies. This shirt has blind sleeves and fastens in the back with sufficient overlap to protect the infant's back from exposure.

A small triangular diaper is used. It is fastened with a large safety pin, and the flap is placed over the pin. A warmed pinning skirt or second diaper is wrapped around the baby's legs, but loosely enough to allow the legs freedom of movement.

PROCEDURE TO DRESS BABY AFTER BATHING

The baby should always be dressed in the incubator or heated bed.

Procedure.

1. Be sure outer and woolen shirts are together.
2. Holding one hand under baby's elbow, work the sleeve on as you would a glove, making sure that the sleeve is on with finger tips at end of blind sleeve.
3. Turn baby over gently, supporting head with one hand and turning body with other. Pull shirts well together at the shoulders. In order to prevent any irritation put small safety pin crosswise through all four thicknesses of shirts about one inch from neck of garment.

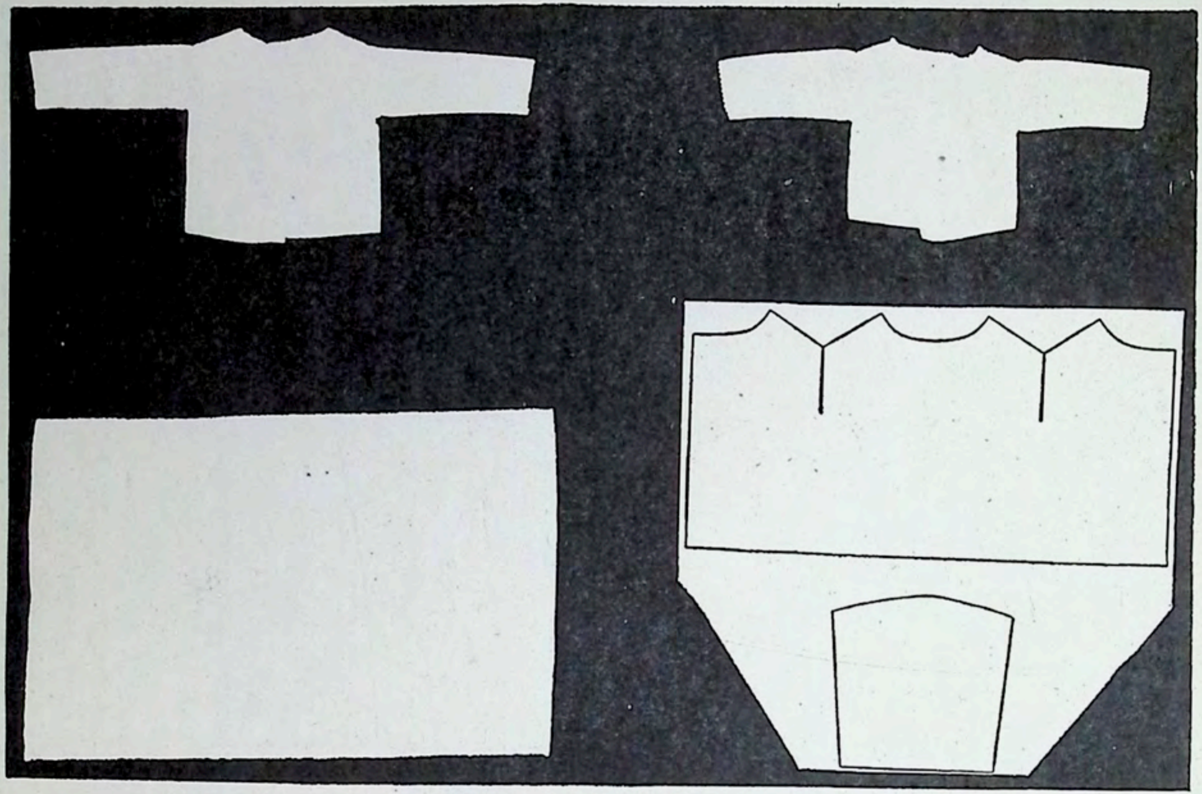


FIG. 26. Permanent clothes and pattern.

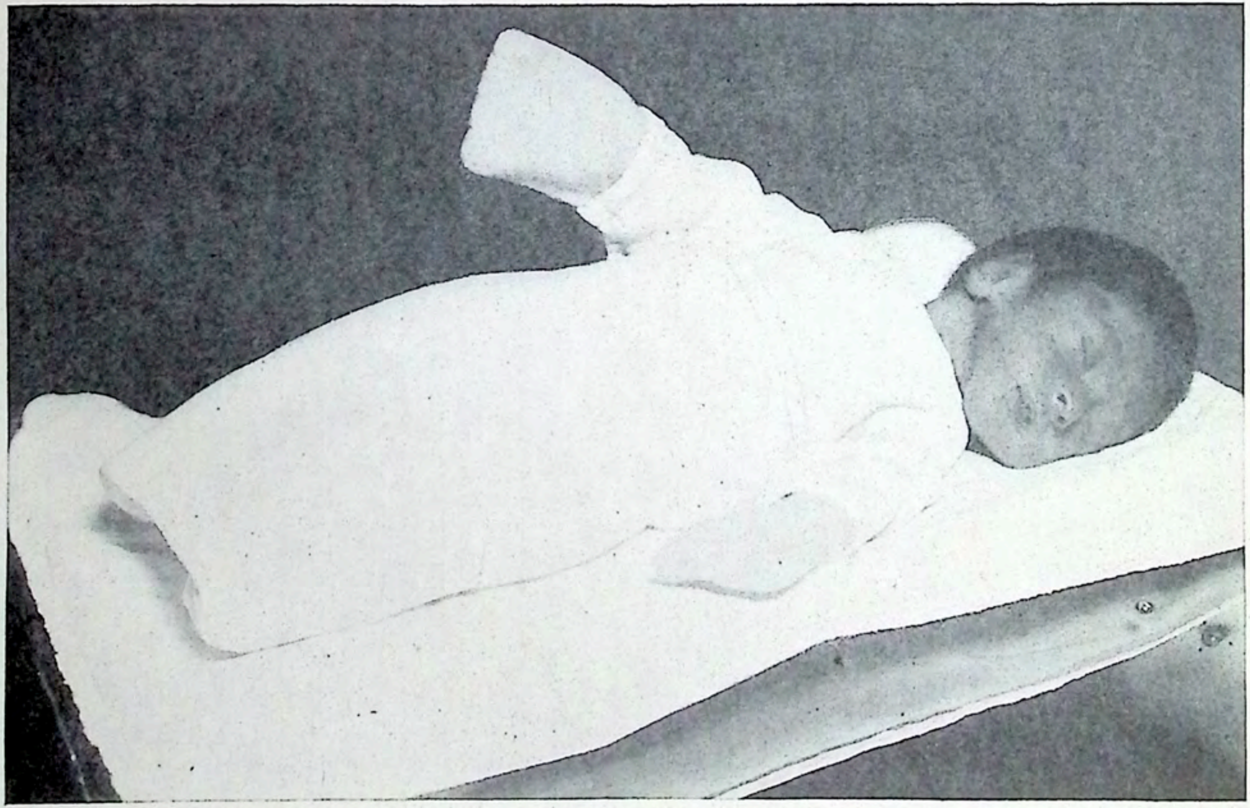


Fig. 27. Baby dressed in permanent clothes. A woolen jacket with blind sleeves.

4. Bring lower part of shirts well together (but not over buttocks) and diaper baby.

PROCEDURE TO CHANGE DIAPERS

Requirements.

Cotton pledgets and cold cream.

Procedure.

1. Wash hands and arms.
2. Inspect baby's bib for vomitus. If dry, fold and hang bib over the side, at the top of the bed.
3. Lift baby's head with left hand, turn towel under head to insure dryness.
4. Report any vomiting.
5. Throw top cover over foot of bed.
6. Grasp corner of small blanket and put it aside.
7. Remove diaper pin and fasten it at foot of bed.
8. Remove soiled diaper.
9. If infant has had a stool, leave diaper in place and cover the infant with small blanket. Moisten a pledget of cotton with warm water or boric acid solution. Cleanse buttocks, wiping towards rectum. Make certain there is no feces in the groin.
10. Leave small rubber pad at foot of bed. Take cotton and soiled diaper in one hand. Cover baby with small blanket with the other hand.
11. Put diapers in diaper can.
12. Nurse washes her hands and arms.
13. Take one diaper and a pad to baby's bed. Place at foot of bed. Clean linen is never brought to the bed until soiled linen has been removed.
14. If buttocks are red, cold cream is applied.
15. Cover small rubber pad with linen pad. Fold diaper triangularly and place on top of pad.
16. Holding pad and diaper in right hand, lift lower part of baby by grasping legs in back of the knees. Place pad and diaper under baby close to towel under head. Pull shirts down, bring right side of diaper over tightly, and then left side. Place two fingers of left hand under top of diaper, pull up bottom flap of diaper, fasten with safety pin (pin is put in vertically with point upward). The loose flap is then wrapped over the pin and tucked in to protect the pin from opening.

17. Baby is covered with a small blanket, a warm diaper is wrapped over the lower extremities.
18. Outer blanket and sheet are put on. Make certain that the infant's shoulders are covered.
19. Check rheostat on the bed.

CAUTION: Always start at the top of the bed and work down. After finishing diapering, do not touch the top of the bed or the baby's face or bib.

20. Wash hands and arms.
21. Chart stool, if baby had one. Pencil is kept clean. Unless there is some special reason, only the baby's first urination is charted.

Babies are diapered routinely before each feeding.

PROCEDURE TO TAKE TEMPERATURES

Requirements.

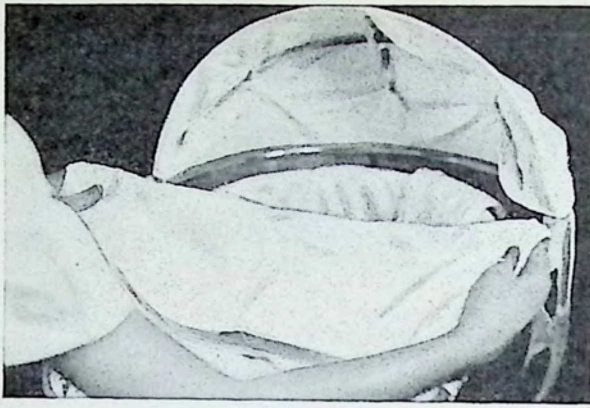
Rectal thermometer, cotton, cold cream and dry linen.

Procedure.

1. The preliminary procedure is same as for changing diapers.
2. After top blanket is folded back, get infant's individual thermometer and a pledget of cotton with lubricant on it (cold cream or oil).
3. Place thermometer at foot of bed.
4. Unfasten diapers.
5. Remove solution from thermometer by wiping it off on the corner of the cotton pledget which does *not* have lubricant on it.
6. Shake thermometer below 95° F. Lubricate thermometer, insert. Be sure the baby is covered with the small blanket while the temperature is being taken.
7. Cleanse thermometer, replace in its container, and then continue procedure as for "Changing Diapers."

Temperatures are taken routinely:
- During the bath period.
- At 4 P.M. and 1:45 A.M. for those on three-hour or irregular schedules.
- Babies on four-hour schedule, at 4 P.M. and 1:30 A.M.

The temperatures of the newborn premature infants are taken every four hours for the first three to six days. Thereafter, they are taken every eight hours. If an infant's temperature registers below 97° F.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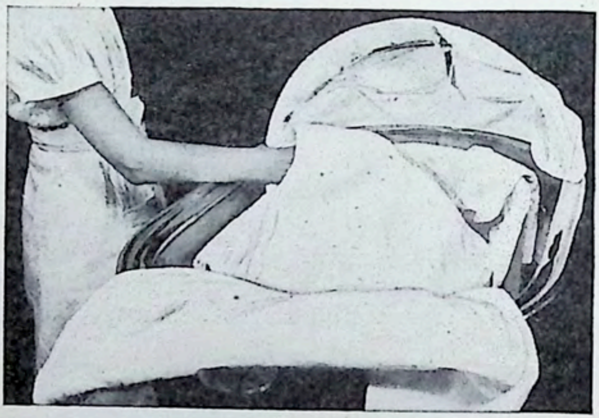
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Fig. 28. Handling linen.

(*Legend continued on opposite page*)

or above 100° F., the nurse should take its temperature again within four hours.

PROCEDURE TO MAKE THE BED

Requirements.

Bassinet protector.
Firm mattress protected with a rubber sheet.
Towel.
Small rubber pad, 8 by 10 inches.
Small quilted pad.
White cotton blanket.
Woolen blanket.
2 linen sheets.

Procedure.

1. Cover head and sides of crib with protector.
2. Cover mattress with one of the linen sheets. Be sure sheet is smooth and stretched taut over the mattress.
3. Fold towel. Place at head of mattress.
4. Put quilted pad over rubber pad and place in center of mattress.
5. Fold sheet once and place woolen blanket inside.
6. Tuck lower end of blanket and sheet under mattress at the foot of the bed.
7. Fold cotton blanket once.
8. After baby is placed in incubator, cover baby with blanket so that the closed end is near the face. (See Fig. 28.)

The towel and the pad protect the bottom sheet from becoming soiled, and this means that it will be necessary to change the sheet only once a day, thus keeping the handling of the baby down to a minimum. If the infant regurgitates, only the towel need be changed.

BREAKS IN TECHNIC

(Frequently Seen in Nurseries for Full-Term and Premature Infants.)

Equipment.

1. Bassinets adjacent to each other on a rack, making it impossible to handle the linen on one infant's bed without contaminating the adjoining bed.

A. The sheet and the blanket near the baby's face are kept clean and are not handled. When diapering baby, contamination of this part of sheet is prevented by handling extreme sides and by turning fold of sheet near baby's face inside out before placing over foot of crib.

B. The cotton blanket is folded and placed over baby so that the closed end is always next to the baby's face and is arranged by putting hand in between fold.

C. When again covering the baby, avoid touching part near face by holding blankets and sheet at extreme sides. Baby's shoulders and chest should be well covered.

2. Lack of accessible running water. Often running water is available only in the workroom or bathing room.
3. An insufficient amount of linen and diapers.
4. Inadequate facilities for isolation.
5. Lack of formula room.
6. A common carrier to take infants to their mothers to nurse. Babies are placed close together on the cart and are not placed in the same space when being returned.
7. Lack of special facilities or equipment for the care of the premature infant.
8. Improper facilities for sterilizing of feeding equipment.
9. Lack of individual thermometers. Improper sterilization of thermometers. The thermometer is put in a disinfectant solution for a few seconds and then used for the next infant.
10. Lack of individual bath basins or individual oil containers for bathing.
11. Uncovered diaper containers.
12. Soap containers without soap.
13. Insufficient towels (either paper or cloth) for hand drying. Too often one towel is used by all nurses until it is wet or soiled before another towel is obtained.
14. An insufficient number of masks. Masks are sometimes worn for a period of eight hours before they are changed.

Nursing Procedures.
1. Infrequent hand washing.
2. Improper washing of hands—soap is not always used, hands are rinsed under running water. When solutions are used, hands are often not washed, the finger tips are merely dipped in the solution.
3. Physicians walk into the nursery without first putting on gowns.
4. Masks are worn improperly and the nurse does not wash her hands after handling or adjusting her mask.
5. Masks are taken off one person and given to another person to use, or they are rinsed under running water, dried and then used again.
6. Physicians examine babies and do not wash hands between each baby.
7. The scale is improperly draped; one drape is used for several babies, or a paper towel or napkin is put in the center of the scale and the sides are left exposed.
8. When the common bathing table is used, too many babies are

bathed at one time and come in too close contact with each other, or the table is not properly cleansed or draped between baths.

9. In bathing, the nurse will wash the genitals and then, without washing her hands, will cleanse the infant's eyes or handle its face.

10. Babies are fed and diapered at the same time, and the nurse does not wash her hands after diapering the baby; she immediately gets the bottle and feeds the infant or takes it to breast.

11. Soiled diapers are left in the nursery while feedings are given.

12. The diapers are rinsed in the same sink in which the nursing bottles are washed.

13. Babies are picked up to permit belching and permitted to come in direct contact with the uniform or gown and sometimes with the mask or the nurse's face.

14. The nurse is permitted to carry soiled linen or diapers next to her uniform or gown, and the next instant carry clean linen and allow this to touch her gown or uniform.

15. Blankets and other linen are dropped on the floor and then used.

16. Lids on sterile containers are not put on securely and sterile material is exposed. Lids are taken off during the bathing period and left off for the duration of the bath.

17. Sterile feedings, oxygen lids and heat tents are placed on the floor.

18. The solution in the forceps jar often covers only the bottom of the jar and only the tip of the forceps is in the solution, yet the forceps is used to remove sterile material from a deep container. When the forceps is contaminated, it is put back into the solution for a few seconds and then considered sterile. The solutions in the forceps jars are not changed daily.

19. Stock solutions of formulas are often kept in the nursery.

20. Formulas are often prepared in the nursery.

21. The nipples on bottles are not kept covered. They may be left uncovered for one-half to one hour before the baby receives its feeding. The feedings may be carried down the hall without having the nipples covered.

22. The nurse places her finger on the nipple of the bottle to put it into the baby's mouth, thus contaminating it.

23. Sterile nipples are taken out of a container with the fingers.

24. Gavage and enema tubes are kept in the same container.

25. When the baby is taken to the breast, it is put either on top or underneath the bed covers, and thus the carrying blanket is contaminated.

26. An otoscope may be used to examine an infected ear, and then the same speculum may be used to examine the clean ear without cleansing or sterilizing it.

27. Taking a tongue blade out of the vest pocket and putting it on the infant's tongue.

28. Hesitancy of the hospital authorities and the physicians to isolate infants at the first sign of pathologic disturbances may cause further instances of infection in the nursery.

8

Immediate Care After Birth

Since the body heat must be maintained, unnecessary exposure of the infants should be carefully avoided. A warm sterile pad, towel or, preferably, a blanket, should be in readiness to receive the infant. As soon as the head is born, the face and eyelids should be gently sponged with sterile gauze, and the mucus should be removed from the air passages by carefully wiping with sterile gauze. As soon as the body is delivered, the infant and the cord should be protected from contact with feces and other foreign substances. The air passages must be cleared of all obstructing matter. Any accumulated secretion or aspirated material must be removed from the mouth and air passages by postural drainage and by aspiration with a soft rubber catheter attached to an ear syringe, special suction bulb or suction machine.

Sometimes cotton or gauze swabs may be sufficient to remove mucus which has accumulated in the throat. Trauma must be avoided. If the mucus cannot be removed otherwise, it may be necessary to pass a small-sized tracheal catheter into the larynx. This procedure must be executed with extreme care. Because they are underdeveloped, either the larynx or the trachea may be easily traumatized and complications, such as ulceration and pneumonia, may ensue. With the catheter in place, gentle insufflation may be practiced.

Great gentleness and a minimum amount of handling are important. The baby should be placed in an incubator or under a heat tent as soon as possible after the cord is tied. See "Cyanosis."

TYING AND SECTION OF THE CORD

The time elapsing between the birth of the infant and the tying of the cord depends on the general condition of the infant and, to some extent, on the obstetrician's ability to prevent the infant from becoming chilled. In the absence of severe asphyxia, permit the pulsation of the cord to weaken or to disappear before ligation. This usually requires from one to five minutes, during which time the infant will receive from 30 to 60 cc. of blood from the placenta. Whenever possible without risk, this blood should be conserved. Recently, small

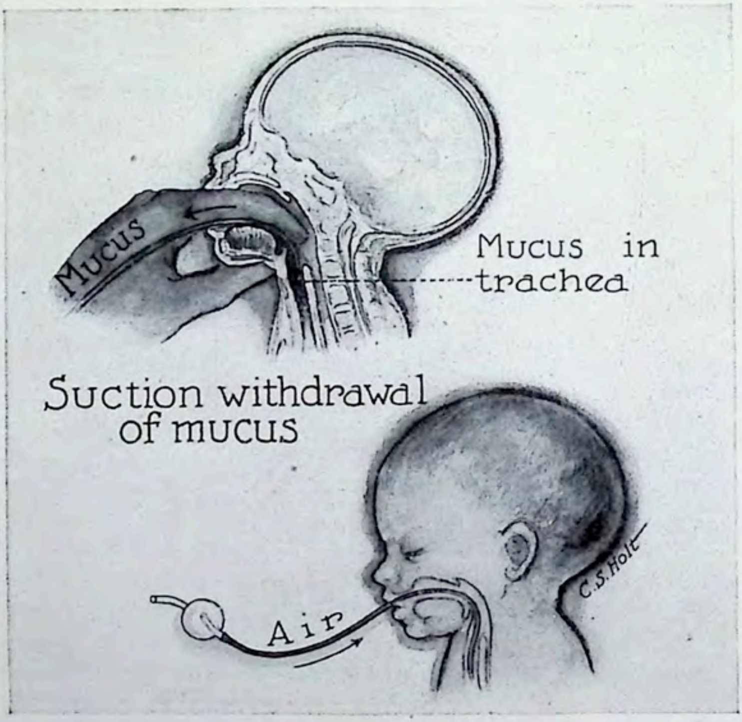


FIG. 29. Tracheal catheterization and mouth to lung insufflation by tracheal catheter.

clips have been designed, which may be used in place of tape to clamp the cord. Our experience with clips has been unsatisfactory due to frequent traumatizing of the skin. The cord should be left long enough so that if there is need for it, a second ligature can be applied closer to the abdomen.

NURSING CARE AT TIME OF DELIVERY

1. Have warm blankets ready. Prevent exposure at all times.
2. Have heated bed prepared. Check temperature of the bed or

incubator at regular intervals so that the baby will not be chilled or overheated.

3. Inspect cord.
4. Remove mucus when necessary.
5. Watch baby closely for symptoms of cyanosis.
6. Take baby's temperature one-half hour after birth, if its condition permits.
7. Have the physician's orders for stimulants, and be familiar with emergency treatment for cyanosis and apnea. Physician's orders should be in writing, if possible.
8. Do not weigh or bathe the baby until it is in good condition. Preferably, wait at least two hours before doing either, and it may be necessary to wait from six to 24 hours.
9. Have aromatic spirits of ammonia ready for emergency use.
10. Handle the baby very gently.
11. Avoid use of heavy blankets that might press on infant's chest and thus interfere with respiration.

ARRIVAL OF INFANT TRANSFERRED BY BOARD OF HEALTH

Take baby from ambulance, leaving ambulance in hall. Doctor and nurse bringing baby must wait outside, as they are not permitted in the nursery.

Place baby in bed, turn on oxygen, cover baby and inspect cord for bleeding.

Return clothes to ambulance, unless they belong to baby.

See that history is correct as to name, address, telephone number, time of birth and name of mother and father.

Find out whether baby had an injection of intramuscular blood prior to admission.

If specimen for serologic examination was secured, label properly and place in ice box.

Routine admission procedures, such as weighing, bathing and dressing are performed when the baby's condition permits.

PROCEDURE OF ADMISSION OF NEW BABY TO PREMATURE STATION

Aim.

To admit infants quickly with the least possible exposure, observe closely and note abnormalities.

Requirements.

Mineral oil (sterile).	Tape measure.
Tincture Merthiolate.	Large and small safety pins.
Silver nitrate 1%.	Diapers.
Sterile cotton and gauze.	Double shirt.
Thermometer.	Baby band of stockinet.
Test tube for thermometer.	White blanket.
Needle and thread.	Name tape.

Procedure.

1. As soon as the baby is in good condition, drape scale, and weigh baby as in bath procedure. Place piece of sterile gauze over cord. If baby has had an injection of intramuscular blood, subtract the amount from baby's weight.
2. Remove baby from scale, place on DeLee table, placing spread underneath baby. Cleanse around navel with warm mineral oil. Paint cord and surrounding area with tincture Merthiolate. Watch carefully for bleeding. Place sterile gauze dressing over cord, making sure that the cord does not touch the skin, and put on stockinet band.
3. Cleanse neck, arms, axilla, chest and back with mineral oil which has been poured into medicine glass.
4. Sew arm band with identification number on right wrist, being careful to observe number.
5. Put shirt on baby.
6. Cleanse lower part of baby, take temperature and diaper baby.
7. Measure length of baby.
8. Place warm wrapping diaper around baby.
9. Wash hands.
10. Cleanse baby's face and head. Observe baby closely.
11. Examine mouth for thrush.
12. If baby is under four days old, put one drop of 1% silver nitrate into each of baby's eyes.
13. Make note of fact if baby has stool or voids on admission.

9

Transportation

In cities and localities where there are hospitals equipped to care for premature infants, it is in most cases advisable to transport a premature infant born at home to such a hospital. Transportation is especially urged when the baby weighs less than 4½ pounds, if it is cyanotic and requires oxygen, or if the home conditions are inadequate.

If the infant is in very poor condition, oxygen should be administered before removing it from the home. It may be necessary to allow the infant to remain in a warm crib in the home for several hours or until its condition improves. While waiting for the oxygen, the nurse can use a few drops of aromatic spirits of ammonia on cotton or gauze as an inhalant. If mucus is present, it should be gently removed from the throat by swab or suction. Stimulants should be used sparingly and in minimum doses.

If no facilities for transportation of the infant are available, it can be wrapped in warm blankets, placed in a warm basket or box, and brought to the hospital in a heated car.

Premature infants should be admitted directly to the premature nursery, or to the room assigned for premature infants, and put in a heated bed at once. The physical examination can be made later. MANY TIMES, AFTER THE PHYSICIAN AND THE FAMILY HAVE CAREFULLY PREVENTED EXPOSURE OF THE BABY AT HOME, IT IS CARELESSLY STRIPPED OF ALL CLOTHING AS SOON AS IT IS BROUGHT TO THE HOSPITAL, AND PERHAPS KEPT IN AN INADEQUATELY HEATED ADMITTING ROOM FOR EXAMINATION.

PROCEDURE OF TRANSPORTATION

Equipment.

The following set-up is suggested as equipment to accompany the ambulance.*

* For copy of instruction sheet for Directions for use of Hess ambulance, see Appendix.

1. Electrical attachments that can be plugged into the dashboard, ceiling light socket or battery of the automobile so that the ambulance can be kept heated. The cord should have a lead with a clamp to ground the circuit.
2. A small tank of oxygen with a gauge.
   Sterile tube to attach to oxygen tank for administration of oxygen.
3. Package of clothing for the baby, containing:

Two blankets.	Band.
Two diapers.	Cord tie.
Woolen undershirt and outside shirt.	Three large safety pins, one small safety pin.

4. Two filled hot-water bottles wrapped inside the package to keep the clothing warm.
5. Aromatic spirits of ammonia.
6. Set-up to give intramuscular blood and to collect blood for serologic tests. This contains:

Luer syringes (one 10 cc. and two 5 cc.).	Two Wassermann test tubes, labeled "Mother" and "Father."
Three needles (Wassermann).	Sterile gauze and cotton.
Two sterile towels.	Alcohol or tincture Merthiolate.

   Tourniquet (rubber tubing).
7. History sheet, diet list and written instructions for mother.

Procedure.

An intern and a nurse supervise the transportation of the infant.

The ambulance is heated before it is taken from the hospital station, and is kept at the proper temperature by being connected to the dashboard, ceiling light socket or battery as soon as it is placed in the automobile. When the home is reached, the ambulance, oxygen and other equipment are taken into the house.

The intern and the nurse wash and warm their hands as soon as they enter the home. They then note the condition of the infant, taking care not to expose it.

If blood is needed by the infant:

The nurse places a sterile towel under its buttocks.

Only the thigh is exposed.

The nurse cleanses the area, while the doctor draws blood from one of the parents. An additional 2 cc. is taken for a Wassermann test.

After the infant has received the blood, the area is covered with sterile gauze.

If the other parent is present, the doctor also takes blood from him for serologic examination.

The doctor takes the necessary history, while the nurse dresses the infant in the clothes that were brought from the hospital. If the condition of the baby is too precarious to permit of this procedure, the clothes already on it are not removed, the infant merely being wrapped in blankets and placed in the ambulance.

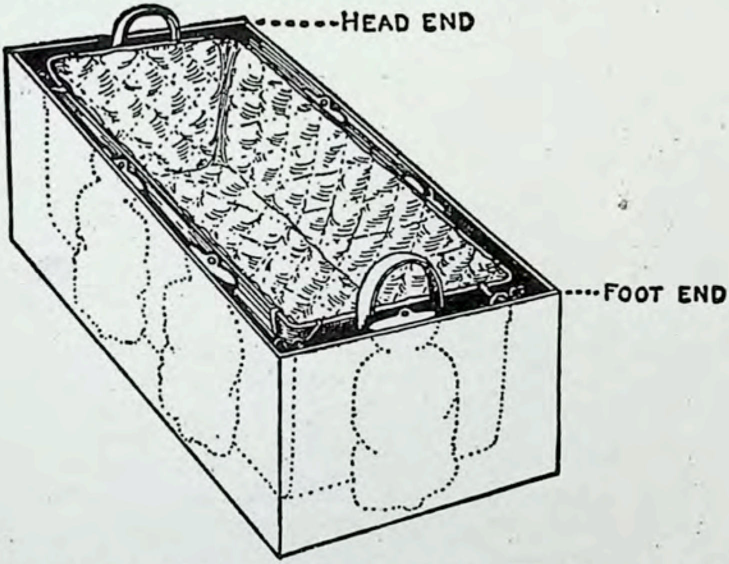


FIG. 30. Small basket equipped with hot-water bottles for purpose of transporting infant. (Children's Bureau, Department of Labor.)

Hot-water bottles are placed outside the blankets. The sterile tubing is attached to the oxygen tank and inserted through one of the small vents in the top of the ambulance. The tube is placed close to the infant's face.

Information as to the hospital address and telephone number is written down for the parents. Written instructions on hand expression of the mother's milk are also left. (However, a return visit is necessary to instruct the mother further on this procedure.) The nurse impresses the mother with the importance of making every possible effort to keep up her breast milk supply. The nurse inquires whether or not the baby has been baptized, and whether the parents wish to have this done should the baby's condition become critical.

The baby is watched closely while on its way to the hospital. If necessary, aromatic spirits of ammonia is given as an inhalant. There is a light bulb inside the ambulance which can be used for inspection of the baby. A flashlight can also be used.

It is important that in this first visit the nurse establish friendly relations with the family. The attitude of the nurse, her interest in the baby, her careful handling of the baby, her kindly answers to the many questions will do much to establish a feeling of confidence and trust on the part of the family. While taking babies to the hospital may be routine to the nurse, it is an unusual and sometimes fearful event in the mother's life, and the nurse must do everything possible to evoke the mother's and the family's co-operation.

AN IMPROVISED PORTABLE INCUBATOR

Mildred I. Parsons,[2] St. Mary's Hospital, Superior, Wisconsin, has designed a transportation bed for use in communities where special ambulances are not available.

"This is an ordinary baby basket, thirty inches long and about seventeen inches wide. A cover of three-ply veneer board is attached to one side of the basket with two hinges. At the head is a glass window which measures four by six inches. Above the window two one-inch openings are bored and below, one opening which provides for ventilation when the basket is closed. At the foot of the basket is an electric light socket with an extension cord about five feet long. A piece of asbestos is fastened to the ply-wood cover over the 30- or 40-watt bulb which provides heat before the journey to the hospital.

"A small space is provided at the foot of the basket by putting in a partition about three or four inches from the lower end and extending directly across it. This compartment may be used to carry any necessary medications and equipment.

"The entire basket is lined with asbestos and over this is a lining of wool, three-eighths of an inch thick, to help hold the heat. The mattress is made of three thicknesses of the wool material.

"After the premature infant is placed in a cotton 'baby bunting,' it is covered with a lightweight wool blanket.

"On each side of the basket, chemical heating pads are held in place by an outing flannel pocket and there is one at the foot—a total of five pads. These supply heat on the way from the home to the hospital. A thermometer at the head of the basket indicates the temperature maintained.

"Just before leaving the home, the required amount of water is poured into the heating pads as directed. They will maintain even temperature over a period of hours. They can be used, also, in the home if no electricity is available.

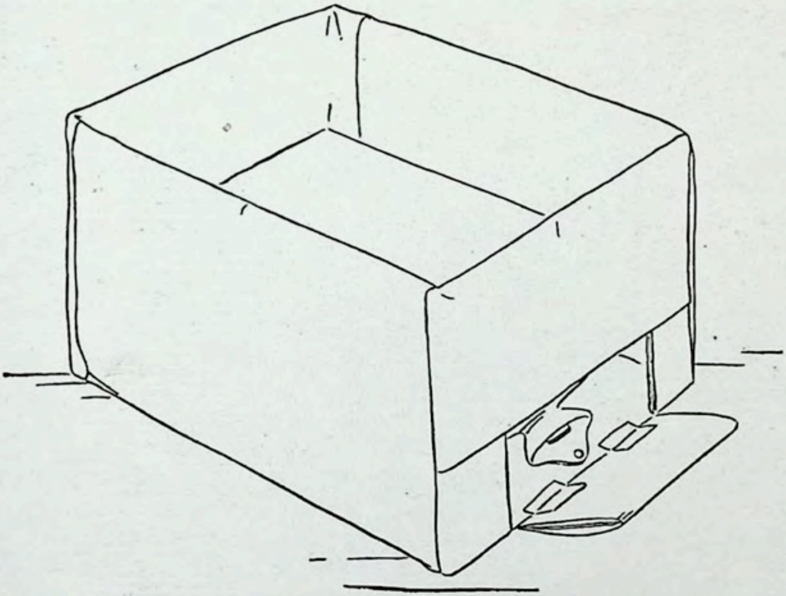


FIG. 31. Cardboard box for emergency use. Hot-water bottles are placed in the false bottom.

"The materials required for this basket are not expensive:

1 baby basket, old model.
2 yds. of asbestos, 15 inches wide.
Veneer board, 20 by 32 inches for the cover.
1 large woolen blanket used for the lining and making the mattress and cover.
1 electric bulb and fixtures.
1 thermometer.
Glass for the window.
5 chemical heating pads at 75 cents each."

TRANSPORTATION IN AN ORDINARY BASKET OR BOX

When emergency transportation is necessary and no portable ambulance of any kind is at hand, a basket or box may be prepared for this purpose by lining it with warmed, woolen blankets. Warm-water bottles or jugs are placed outside of these blankets. Care must be taken that the hot-water bottles do not come in direct contact with the infant. The infant should be carefully wrapped in one or more woolen blankets, all parts being covered except the mouth and nose.

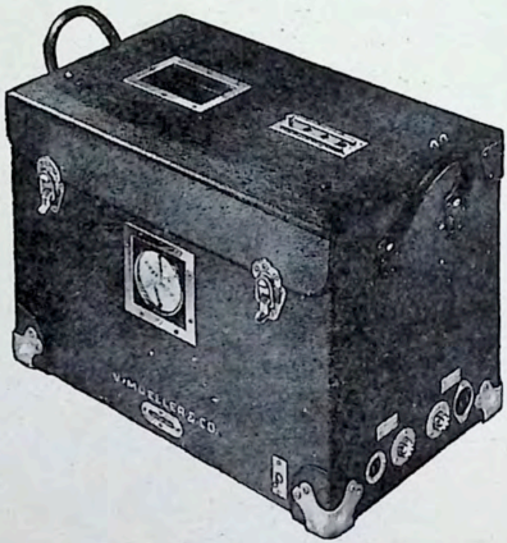


FIG. 32. Hess portable ambulance.

If the infant is to be transported by automobile, the car should be thoroughly warmed before the baby is removed from the house. Exposure must be guarded against at both ends of the trip.

10

Home Care

The factors essential to the care of the premature infant in the hospital are also necessary, with some modification, for the infant in the home.

In communities in which hospital care can be provided, the present trend is to transfer the premature infant born in the home to the hospital. If the hospital does not meet the minimum requirements necessary for the care of the premature baby, the infant may be kept at home, since it will have less opportunity to develop an infection in the home than in a poorly equipped hospital.

REQUIREMENTS

If the infant is to be cared for in the home, the following definite requirements must be met:

1. Adequate facilities must be available. These include a room that can be isolated from the other members of the family, especially from the other children.
2. A bathroom which can be heated.
3. Some type of heated bed or incubator.
4. Oxygen must be on hand ready for use.
5. The mother must be sufficiently intelligent to carry out instructions.
6. A public health or visiting nurse must be available to give instruction to the mother and to follow the infant's progress.
7. Medical supervision is necessary.

Heated Beds or Incubators. The type of incubator depends on the facilities. If electricity is available, a simple incubator heated by means of an electric light bulb can be improvised, if a more refined type of bed cannot be furnished. In the absence of electricity, hot-water bottles, jugs or bricks may be used as a temporary expedient. (See Figs. 21, 30 and 31.)

An emergency incubator can be made from a cardboard box (Fig. 31), or with an ordinary bassinet or basket. The sides should be lined with newspapers, and newspapers should also be placed underneath the mattress. These will serve for insulation. The mattress should be thin and firm to avoid the danger of suffocation. Never use a soft pillow

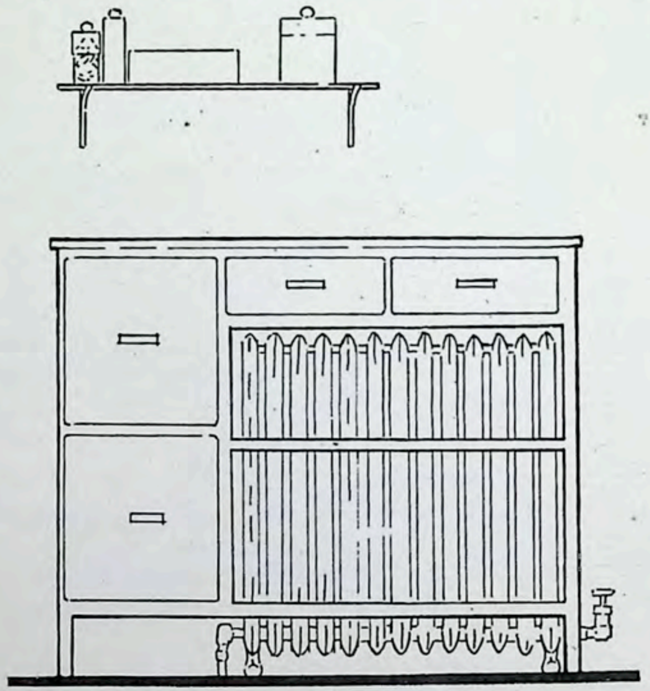


FIG. 33. Home-made heated dressing table over radiator in bathroom.

as a mattress. If the proper kind of mattress cannot be found, a stack of newspapers covered with a clean sheet or small blanket can be used.

When the bed is heated by electricity, a 25-, 40- or 60-watt light bulb, protected by a wire guard, is used as may be indicated. If the bed includes a metal hood, the baby's body remains behind the curtain under the hood, and the head is outside in front of the curtain. Covering the bed with a hood made of ticking or blanket material, or even temporarily encasing it with a blanket, will aid to conserve the heat within the bed.

Clothing. In an ordinary bassinet, a woolen or part-woolen shirt should be used, and a small flannel kimono should be worn with the back in front, so that the chest is well covered. At the same time, the kimono can be easily removed. A small, triangular diaper should be worn. Stockings may be worn, or the feet and legs may be wrapped in a warmed diaper or wrapping skirt. The baby should not be wrapped in blankets because of the danger of suffocation; the blankets should be placed over the baby.

If the baby is cared for in an electrically heated bed, fewer clothes may be necessary. If the house is cold, it may be well to keep a hood on the baby's head (see Fig. 25).

Initial exposure must be avoided.

Handling. It is safest to feed and care for the baby without removing it from the bed. The initial bath may be delayed one or more days. It may be better at first to bathe the baby only every second or third day.

The nurse should demonstrate to the mother or the attendant how to feed the baby and how to bathe, dress and handle it, as well as how to care for the heated bed. All instructions should be written. When possible, the nurse should make a daily visit during the first week. The mother should be instructed to keep in close touch with her physician. Any evidence of cyanosis, pallor, apathy, vomiting, diarrhea or skin infections should be reported at once to the physician.

Later Follow-up Care. This includes:

1. Those babies kept at home from the time of birth.
2. Premature babies cared for in the hospital and discharged when the weight approximates five pounds.

In the latter group, the hospital should co-operate with nursing organizations to give the mother the necessary instructions before the infant is discharged, and to notify the public-health or visiting nurse of the baby's discharge. During the infant's stay in the hospital, the mother should have received instructions in manual expression of her breasts and the necessary requirements for later care at home. The nurse will, during her visits, evaluate the possibilities for successful care of the infant by the mother.

Before the baby is discharged from the hospital, the mother should be permitted to come into the hospital and nurse her baby, if she has milk in her breasts. If her breasts are dry, the preparation of the formula should be demonstrated. Her instruction on the general care of the infant should include demonstrations on the method of feeding and various other technics, as bathing, dressing and handling of the baby, and making the bed.

The mother must be impressed with the importance of cleanliness, and should be instructed always to wash her hands before handling the baby and after diapering it. The supervisor should also instruct the mother as to the proper temperature and ventilation of the room. In the summer, the baby must be protected from flies and other insects. THE IMPORTANCE OF KEEPING VISITORS AWAY FROM THE BABY SHOULD BE STRESSED.

NURSING PROCEDURES IN THE MANAGEMENT AND CARE OF THE PREMATURE INFANT IN THE HOME

In the large cities and in rural communities, when physicians are anxious to have nurses go into the home and instruct the mother as to the nursing care to be given to the baby, there should be a definite understanding between the physician and nurse as to routine orders.

Nurses trained in the care of the premature infant will be acquainted with the following procedures.

ROUTINE PROCEDURES

1. Do not tie the cord until it stops pulsating, unless there is an emergency. (This insures about 30 to 60 cc. more blood to the baby.)
2. Keep the infant warm following its delivery. (Have blankets heated and ready for use.)
3. Place the baby in an improvised heated bed or in a basket near a heater or stove.
4. Artificial respiration by compression of the chest wall is the only safe method, and if used, must be performed gently to avoid trauma and at a rate not over 15 to 20 times per minute.
5. Instruct the attendant in postural drainage, that is, in lowering the head of the mattress and raising the foot of it.
6. Have on hand long applicators covered with cotton firmly attached, or gauze or a small rubber-bulb syringe, and show attendant how to use these to remove mucus from the throat.
7. Apply aromatic spirits of ammonia (a few drops) on cotton and use as an inhalant, if indicated by delayed respiration or cyanosis. This may be repeated frequently during the first six hours.
8. Instruct the attendant to watch the baby closely for any change in color. If cyanosis is noticed, the physician should be notified at once.
9. If the baby has not had a meconium stool by the third milk feeding, a small (one-half to one ounce) enema of warm tap water with a small bulb syringe should be given to avoid distention.

10. The nurse should teach the attendant how to feed the baby either with a medicine dropper or with a bottle, depending upon the stage of development.
11. A daily visit by the nurse should be made during the first week, and longer, if necessary.
12. The baby's temperature should be taken at least every six hours for the first 48 hours, and twice a day thereafter, until the baby weighs $5\frac{1}{2}$ pounds.
13. The bathing of the infant should depend entirely on the home conditions and the intelligence of the mother. Bathing every other, or every third, day is usually sufficient during the first two weeks. To prevent chilling, only the part being bathed can be exposed. The head and face should be bathed before the body. The shirt is then removed and the chest, arms and back are bathed. The clean shirt is put on and the lower extremities are bathed. Tub baths may be given when the baby is older.
14. The attendant must be taught how to cleanse the eyes and nostrils. This is done only when there is evidence of a discharge or crusting.
15. The mother must be cautioned against overheating or overdressing the baby.
16. The room should be aired and ventilated twice daily. During these times, the infant must be protected from undue exposure or removed from the room.
17. The baby should be weighed twice a week.
18. For vomiting, the nurse will:
    a. Elevate the head of the bed by putting a pad under the head of the mattress.
    b. Instruct the mother on how to make the baby belch after taking its feeding, or belching may be indicated during the feeding.
    c. Advise the mother to offer half the feeding and wait five or ten minutes before giving the remainder of the feeding.
    d. Inspect the rubber nipples, if in use, to be certain that the hole is neither too small nor too large.
19. For diarrhea and infections:
    a. Advise the mother to call the doctor at first evidence of any diarrhea, upper respiratory infection or rash.
    b. Advise the use of tea instead of water, if diarrhea appears. The physician may prefer one-half strength normal saline, Ringer's, or more dilute Hartmann's solution by mouth, if the diarrhea is excessive. Subcutaneous administration of

fluids and intramuscular injection of blood may become necessary procedures.

FEEDING SCHEDULE FOR THE PREMATURE INFANT IN THE HOME

The premature infant should be given neither water nor milk for at least 12 hours after birth. If, at the end of 12 hours, the baby is in good condition, the following feeding schedule is inaugurated:

13th hour	1 tsp. of plain, boiled water
15th hour	1½ tsp. of plain, boiled water
17th hour	1 tsp. of breast milk
19th hour	2 tsp. of water
21st hour	1½ tsp. of breast milk
23d hour	2½ tsp. of water

By the end of the second or third day, a three-hour schedule may be adopted. The amounts given will vary in each case, depending on the size and the condition of the premature infant. Increases of successive feedings should not be more than one-half of a teaspoon.

By the 4th, 5th or 6th day, the premature infant will be taking ½ to ¾ of an ounce every three hours.

By the 7th or 8th day, ¾ to 1 ounce every three hours.

By the 9th or 10th day, 1 to 1¼ ounces every three hours.

By the 12th to 14th day, the infant can usually be put on a four-hour schedule—1¾ to 2 ounces for each of the six feedings.

On the 4th day, weak tea may be substituted for water. It tends to prevent diarrhea.

Besides the breast milk, water or weak tea is offered every three hours, between feedings, in slowly increasing amounts up to ½ of an ounce. Usually water or tea is not offered at night.

The stronger and better-developed premature infant may be put to the breast by the fifth to the eighth day. In the meantime, the mother's breasts should be stimulated by expression or pumping. At its first breast feeding, allow the infant to nurse only three to five minutes. The time at the breast should be increased gradually. The first feedings at the breast will probably have to be followed by some milk given by dropper or from a bottle, the selection of method being dependent on the infant's development. When there is inadequate breast milk and the baby is sufficiently developed to be breast-fed, the nurse may suggest that the mother nurse the baby ten minutes on one breast and five minutes on the other. The time at each breast is alternated at successive feedings. (Nursing both breasts will do much towards maintaining the milk supply.)

Cod liver oil and orange juice should be started when the infant is two weeks old. Two to four drops of plain cod liver oil and four to eight drops of orange juice are given at first. This is increased every third day until the baby is taking one teaspoonful of cod liver oil and two ounces of orange juice, which should be by the end of the sixth week. The amount is then increased until the infant is receiving two or more teaspoonfuls of oil and two ounces of orange juice. If concentrated oils are used, the quantity recommended for the full-term infant must be administered or even larger amounts. Iron in some form should be added by the end of the fourth week.

The three-hour feeding schedule should be changed to a four-hour one when the baby weighs five pounds and is at least two weeks old. In this way, the mother gets more rest and the baby is less apathetic.

INSTRUCTION SHEET FOR THE HOME

Following is a sample of an instruction sheet which can be given to the family of the premature infant on its discharge from the hospital.

Feeding.

1. Wash hands before feeding baby.
2. If breast milk is adequate, and the infant sufficiently strong, the baby can be nursed at one breast at each feeding, alternating the breasts at the different feedings.
3. If there is not sufficient milk in one breast to meet the baby's requirements, it should nurse at both breasts at each feeding, ten minutes on one breast and five on the other. The entire nursing period should never exceed twenty minutes.
4. If the infant is too weak to nurse from the breast, it should be fed with a medicine dropper.
5. If the infant is given a complementary formula feeding, offer . . . ounces from a small nursing bottle after the breast feeding.
6. Nurse baby 15 minutes at 6 or 7 A.M., 10 A.M., 2 P.M., 6 P.M., 10 P.M., and sometimes at 2 A.M.
7. When the baby reaches the weight of 6 pounds, the 2 A.M. feeding can usually be omitted.
8. Boil for ten minutes all bottles and utensils used in making up or giving feedings to the baby.
9. Nipples, after being cleansed inside and outside, are thrown into boiling water and boiled for four minutes.

10. Warm all feedings and fluids before offering them to the baby. Test temperature before feeding, by letting a few drops of the fluid fall on the inside of the wrist. It should feel lukewarm.

11. Older infants are held during feedings.

12. Let baby belch during and after each feeding.

13. The hole in the nipple should be of sufficient size to allow the fluid to come out without too much effort on baby's part. To enlarge the hole, use a small needle which has been heated to red hot, and thrust it through the hole already present. One hole is sufficient. Too large a hole is dangerous, as it will allow the milk to flow faster than the infant can swallow.

14. A nipple with a small, relatively straight bulb, such as the Faultless Wonder Nipple, is preferable.

15. By the end of the second week, the infant should receive vitamin C and vitamin D in addition to that contained in the milk.

Vitamin C
Orange juice, ... teaspoonful, or
Ascorbic acid, ... tablets.
This may be given in one-half ounce of boiled water at 8 A.M. and 4 P.M. daily.
Vitamin D
Cod liver oil .... drops .... teaspoonful, or
Vitamin D concentrate (name) ...., ... drops.

For Protection of the Baby.

1. Wash hands before handling baby.
2. Keep room temperature about 75° F.
3. Do not wrap baby in blankets. Put blankets over baby.
4. Make a firm, hard bed and protect the sides from draughts.
5. Keep everyone who has a cold or sore throat away from the baby.
6. If the baby vomits, is constipated or if his stools are too frequent, report to the doctor. Do not give the baby castor oil or Castoria.

Instructions for preparation of the formula given by the doctor should be written.

FLUID MILK

Measure .... ounces of milk. Add .... level teaspoonfuls of dextrimaltose, syrup or other sugar. Add .... ounces boiled water. Boil entire mixture for three minutes over direct flame.

CANNED FLUID MILK

Boil water ten minutes. Measure .... ounces and add .... level teaspoonfuls of sugar of type ordered. Stir until dissolved. Scrub can containing milk with soap and water and rinse with boiling water. Open and add .... ounces of milk. (The physician will suggest brand of milk and carbohydrates.)

POWDERED MILK

The physician will direct the kind and amounts to be used. Instructions for mixing are noted on labels of cans.

See "Artificial Feeding" for description of milk and carbohydrates.

FOLLOW-UP AND CLINICAL CARE

At the Sarah Morris Hospital, we are fortunate in having a nurse to do the follow-up care. The day after the baby is discharged from the Premature Station, the nurse goes to the home and gives the mother a demonstration of the bathing procedure. She also teaches her how to prepare the formula if the baby is not to be breast-fed, and advises the mother on the type of clothes the baby is to wear. The mothers of the ward patients are instructed to call the Premature Station if the infant becomes ill.

When a premature infant is not under the care of a private physician, it usually receives its medical care at an infant welfare station or public-health clinic. The larger cities have special clinics for the follow-up care of premature infants only. The Board of Health of Chicago has five such clinics.

At the Michael Reese Hospital there is a clinic for premature infants only. The babies from the Premature Station of the Sarah Morris Hospital whose parents are unable to afford a private physician are referred to this clinic for follow-up care. The clinic is held two days a week under the medical supervision of two pediatricians. The service does not rotate. The graduate nurse who does the follow-up care of the infants after their discharge from the Station also manages the clinic. She is assisted by nurses from the premature infant station and by volunteers from the Infant's Aid Society.*

Care given in this clinic includes:

1. Weighing.
2. Physical examination.
3. Advice as to diet and medication, including antirachitic therapy and iron.
4. X-rays are taken when indicated.
5. Blood counts taken at regular intervals.

* The Premature Station of the Sarah Morris Hospital is endowed and maintained by the Infant's Aid Society of Chicago.

6. Anti-luetic treatment when necessary.
7. Social service assistance.

In this clinic the premature infants are also immunized against pertussis, diphtheria and smallpox. A special clinic is held twice a year. At this clinic all the infants are given Schick and Mantoux tests and instructions are given to the mothers that the children are to be returned for readings. (For details, see "Immunization of Infants," Chap. 15.)

The nurse who does the follow-up care will make home visits on any of the infants who were ill when they visited the clinic.

During the clinics the nurse interprets in detail the physician's orders and the social worker handles any social problems referred to her. Many premature infants are born of indigent parents, and the progress that the infant makes often depends on a solution of the social problems found in the home.

The special clinic care is available to premature infants until they are two years of age. At that age they are referred to the pediatric clinic. The clinic held twice yearly has no age limit.

A special clinic for premature infants has distinct advantages. If a premature infant is cared for in a clinic for normal infants, it is often judged on an unfair basis and is given overtreatment both in diet and therapeutics, simply because it is not up to the physical development of the full-term infant. The infant is given close supervision. It has been noticed that when the premature infant is followed in special clinics and given experienced medical care, it compares much more favorably with the full-term infant at the end of the first year than the premature infant who is followed in an ordinary clinic. The specialized clinic has more sympathy and understanding of the needs of the premature infant.

A special clinic also offers the physician an opportunity to study premature infants as a group and observe their physical and mental development. Statistics of value can thus be obtained.

11

Feeding

Pediatricians are of the opinion that success or failure in the care of the premature or immature infant is largely dependent on the nursing care received by the infant during the early weeks or months of life. A major consideration in this nursing care is the feeding of the baby. It is necessary for the nurse who cares for premature infants to equip herself with a thorough knowledge of the various methods and technics of feeding premature infants. The methods of feeding premature infants outlined in this chapter are those which have been employed at the Premature Station of the Sarah Morris Hospital during the past ten years.

INITIAL FEEDING

There is often a desire on the part of both physicians and nurses to begin feeding the premature infant too soon after birth. The full-term infant is fed within 8 to 24 hours after birth. Since the premature baby is small and weak, the natural tendency is to start feeding him even earlier. It has been our experience that too early feeding may often be the cause of aspiration pneumonia and is, therefore, to be avoided. The average premature infant does better if it is not fed for at least 12 hours after birth. Small premature babies (those weighing under 1,200 grams) are not fed for 24 to 48 hours. During this time the premature baby receives physiologic salt solution, subcutaneously in the thighs, one to three times daily. The amount of the injection varies from 8 to 12 cc. for the small premature infant to 15 to 20 cc. for the larger premature infant.

AMOUNT OF FOOD REQUIRED

The tendency to overfeed the young premature infant is undoubtedly one of the important factors in the mortality and morbidity found among premature babies during their first three to six weeks of life.

In the desire to have the infant gain as much as possible, overfeeding results. It is therefore essential that the nurse know the number of days the average premature baby continues to lose weight, and after it starts to gain, the amount of increase in weight that has been found to denote satisfactory progress.

In feeding the premature infant, it is essential to establish a "food tolerance" inasmuch as the intestinal tract, as well as other organs, is undeveloped. This tolerance can best be established by feeding very small quantities of food and then increasing the amount very slowly. The infant does best if fed the smallest amount of food on which it will gain weight. During the first five to seven days, the infant will continue to lose weight. After this period, if the premature baby gains weight, no increase is made in the feeding that day. If it fails to gain, an increase of only 1 to 2 cc. in each feeding is made.

The feedings of our premature infants receiving breast milk are calculated on a caloric basis. The babies usually require from 60 to 100 calories per kilogram of body weight per day to gain weight. If a premature baby is gaining on 60 calories per kilogram (2.2 pounds), we do not increase the feeding. Many of our babies receiving only 60 to 70 calories per kilogram have a very satisfactory weight curve. We have not found it necessary to give over 100 calories per kilogram until the infant is at least one month old. However, if a premature baby needs more than 100 calories per kilogram after the first month, we do not hesitate to give from 110 to 120 calories per kilogram.

The average premature infant requires 80 calories per kilogram (approximately 36 calories per pound). When a premature baby receives 80 calories per kilogram and does not gain, we do not immediately increase the feeding. The baby's weight curve is not the only criterion of its progress. The absence or presence of diarrhea or vomiting must be considered. We often find that if the baby is permitted to remain on the same feeding two or three days, it will usually start gaining very satisfactorily. We wish to emphasize, however, that each premature infant presents an individual feeding problem.

In our experience, "minimum feedings" have the advantage of:

1. Preventing abdominal distention with resulting dyspnea and possible cyanosis.
2. Lessening the tendency to develop diarrhea.
3. Decreasing vomiting.
4. Bringing about a more consistent gain in weight.

FEEDING SCHEDULE

The feeding schedule used in our Station varies with the birth weight of the infant.

TABLE V

FEEDING SCHEDULE FOR NORMAL PREMATURE INFANTS [3]

TIME OF FEEDING	FEEDINGS: BODY WEIGHT 1,250-1,500 GRAMS		FEEDINGS: BODY WEIGHT 1,500-1,850 GRAMS		FEEDINGS: BODY WEIGHT 1,850-2,400 GRAMS	
First day						
1st-12th hour ..	No feeding		No feeding		No feeding	
13th hour	Water	1-3 cc.	Water	3 cc.	Water	3-4 cc.
16th hour	Water	2-3 cc.	Water	5 cc.	Water	5-6 cc.
18th hour	Breast milk	1-3 cc.	Breast milk	3 cc.	Breast milk	3-4 cc.
20th hour	Water	3-4 cc.	Water	4-7 cc.	Water	8 cc.
22nd hour	Breast milk	3-4 cc.	Breast milk	4-5 cc.	Breast milk	5-6 cc.
24th hour	Water	5 cc.	Water	5-8 cc.	Water	10 cc.
Second day						
26th hour	Breast milk	4 cc.	Breast milk	4-6 cc.	Breast milk	8-9 cc.
28th hour	Water	6 cc.	Water	8-10 cc.	Water	10-12 cc.
30th hour	Breast milk	5 cc.	Breast milk	7-8 cc.	Breast milk	10-12 cc.
32nd hour	Water	6-8 cc.	Water	10-12 cc.	Water	12-15 cc.
34th hour	Breast milk	5-7 cc.	Breast milk	8-10 cc.	Breast milk	12-15 cc.
36th hour	Water	6-8 cc.	Water	10-12 cc.	Water	12-15 cc.
38th hour	Breast milk	6-8 cc.	Breast milk	9-12 cc.	Breast milk	14-17 cc.
40th hour	Water	6-8 cc.	Water	10-12 cc.	Water	12-15 cc.
42nd hour	Breast milk	7-10 cc.	Breast milk	10-13 cc.	Breast milk	14-18 cc.
44th hour	Water	6-8 cc.	Water	10-12 cc.	Water	12-15 cc.
46th hour	Breast milk	8-12 cc.	Breast milk	12-14 cc.	Breast milk	15-21 cc.
48th hour	Water	6-8 cc.	Water	10-12 cc.	Water	12-15 cc.
Third day						
Every 3 hours ..	Breast milk	8-12 cc.	Breast milk	12-16 cc.	Breast milk	17-24 cc.
	Water	6-8 cc.	Water	10-12 cc.	Water	12-15 cc.
Fourth day						
Every 3 hours ..	Breast milk	7-10 cc.	Breast milk	10-12 cc.	Breast milk	12-22 cc.
	S.L.A.M.*	3 cc.	S.L.A.M.*	4 cc.	S.L.A.M.*	5 cc.
	Tea	6-8 cc.	Tea	10-12 cc.	Tea	12-15 cc.
Fifth day						
Every 3 hours ..	Breast milk	9-12 cc.	Breast milk	12-14 cc.	Breast milk	14-24 cc.
	S.L.A.M.*	3 cc.	S.L.A.M.*	4 cc.	S.L.A.M.*	5 cc.
	Tea	6-8 cc.	Tea	10-12 cc.	Tea	12-15 cc.
Sixth day						
Every 3 hours ..	Breast milk	9-14 cc.	Breast milk	12-18 cc.	Breast milk	16-26 cc.
	S.L.A.M.*	3 cc.	S.L.A.M.*	4-5 cc.	S.L.A.M.*	5 cc.
	Tea	6-8 cc.	Tea	10-12 cc.	Tea	12-15 cc.
Seventh day						
Every 3 hours ..	Breast milk	10-16 cc.	Breast milk	14-20 cc.	Breast milk	18-28 cc.
	S.L.A.M.*	3 cc.	S.L.A.M.*	5 cc.	S.L.A.M.*	5 cc.
	Tea	6-8 cc.	Tea	10-12 cc.	Tea	12-15 cc.

* S.L.A.M. indicates skimmed lactic-acid milk.

Infants weighing less than 1,000 grams do not receive food by mouth for 24 to 48 hours. Two cc. of whole blood is given intramuscularly, and 8 to 12 cc. of saline solution is administered on the first day. The same amount of saline solution is given subcutaneously two or three times on the second day and then twice daily as long as indicated. Whole blood is given intramuscularly daily or every other day.

Breast-milk feedings are started in drops. The first feeding may consist of 0.3 to 0.5 cc. The infants are fed at intervals of three hours. The feedings are increased by drops at first, but later by as much as 0.5 cc. at a time. Water is not given between feedings until the third, fourth, or fifth day, when 2 cc. is given between each two feedings. Water is also given by dropper. Whiskey, one to three minims, may be added to the water or milk.

If these small infants have difficulty in swallowing, they are fed by gavage.

Infants weighing between 1,000 and 1,250 grams are usually given no food or water by mouth for at least 24 hours after birth. Two to 4 cc. of whole blood is given intramuscularly soon after birth. Saline solution (10 to 20 cc.) is administered subcutaneously 18 to 24 hours after birth. Feedings of breast milk are started with 0.5 to 1 cc. and increased by 0.5 to 1 cc. at a time. If the baby's condition permits, water or tea is given between feedings in amounts of 2 to 6 cc. Saline solution is usually given twice on the second day. If the baby vomits or does not take its feeding well the first few days, the water is omitted between feedings, and subcutaneous saline solution is continued twice daily instead. The feedings are increased very slowly and are given very carefully.

Infants weighing between 1,250 and 2,400 grams are fed according to their weight, as indicated in the schedule, Table V. It will be noted that no infant is fed either water or milk for at least 12 hours after birth.

Because of the small amount of protein contained in human milk, skimmed lactic-acid milk is added to the breast milk on the fourth or fifth day, or as soon as the premature baby is no longer having meconium stools. This will add to both the protein and mineral content of the diet. The protein also aids in preventing diarrhea. Weak black tea is substituted for the water at this time, since it also helps to prevent diarrhea.

Since, by the seventh day, most of the normal premature babies begin to evidence an increase in daily weight, we add to the feeding only when necessary, and then only in amounts of 1 to 2 cc. per feeding. If the baby is gaining steadily, the feeding is not increased.

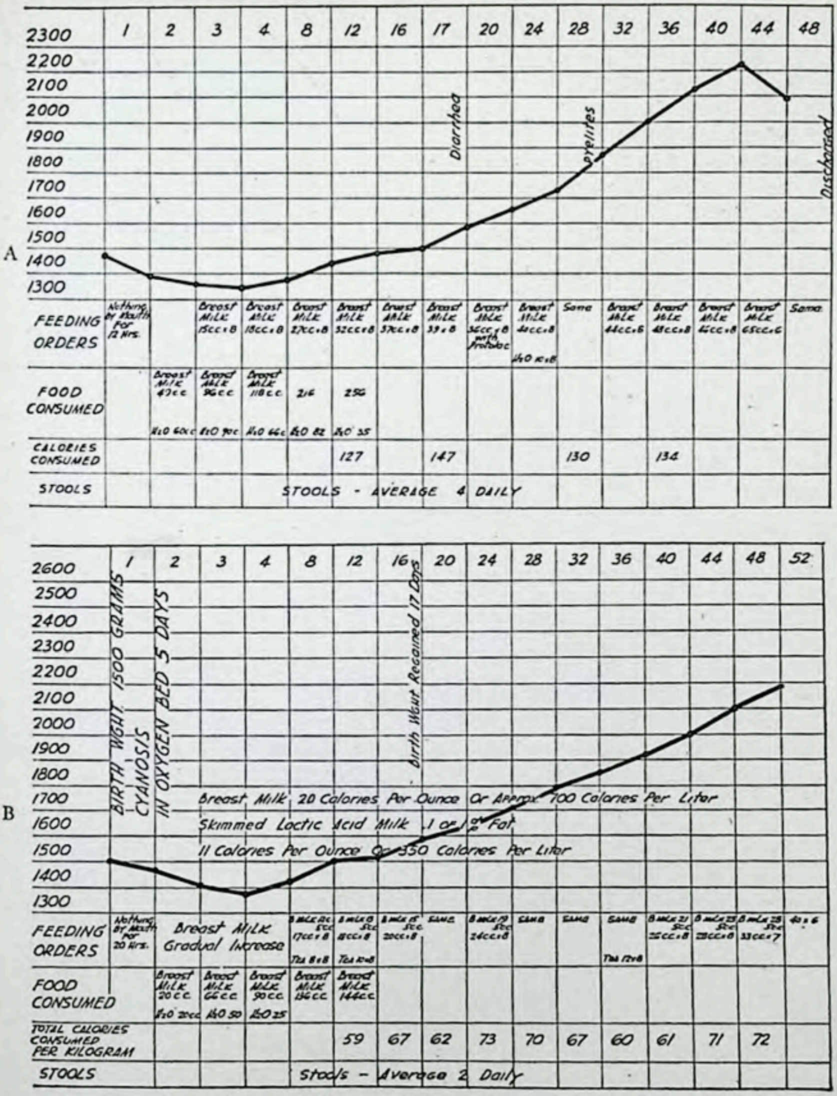


FIG. 34. Charts showing gain in weight on low and high caloric intake. These summary records of weight and feeding schedules of two premature infants illustrate the comparative gain in weight resulting from the two different types of feeding. A. Girl Flacks (a twin weighing 1,480 grams at birth) received 127 to 147 calories per kilogram. B. Boy Marshall (a triplet weighing 1,500 grams at birth) received 57 to 73 calories per kilogram. Compare his weight gain with that shown in the other baby's chart.

The following example shows how the amount of breast milk for each feeding is calculated.

The baby weighs 1,500 grams, or 1.5 kilograms, and needs 80 calories per kilogram of body weight.

80 calories $\times$ 1.5 = 120.0 calories—the total amount necessary for the entire day.

One ounce of milk provides 20 calories.

120 $\div$ 20 = 6. The baby, then, needs six ounces of milk to give it the necessary 120 calories.

30 cc. (the approximate number of cc. in 1 oz.) $\times$ 6 = 180 cc.—the total amount of milk needed in 24 hours.

The baby is to be fed every three hours, or eight times in the 24 hours: 180 cc. $\div$ 8 = 22½ cc.

Therefore the baby would receive 22½ cc. at each feeding.

KIND OF FOOD

Breast milk is the ideal food for the premature infant. It is considered of paramount importance to encourage the mother of every premature baby to keep up her supply of breast milk unless she has some disease which would contraindicate breast feeding. We request the mothers of our premature infants to express their breasts four or five times daily. The nurses employed by the Chicago Board of Health and our visiting nurses teach manual expression to the mothers in their homes. The milk thus obtained is saved and brought to us. In this way we know whether or not the mother is expressing her milk, but, more important, we know whether or not we will have to put the baby partly or wholly on an artificial feeding before it is discharged.

Human and Lactic-Acid Milk Mixtures. To increase the protein content of the diet, as has been stated, skimmed lactic-acid milk (buttermilk) is added to the feedings of many infants in proportions of one part skimmed lactic-acid milk to three parts breast milk. The lactic-acid milk used is prepared by the addition of a lactic-acid bacillus culture to sterilized skimmed milk. Whole lactic-acid milk, cultured or powdered, may later be used to replace the fat-free lactic-acid milk.

Powdered lactic-acid milk is prepared by mixing one level tablespoonful of powdered whole or skimmed lactic-acid milk with each two ounces of cooled boiled water. It is to be beaten with an egg beater to insure a smooth mixture. Carbohydrates may be added in amounts as ordered.

Human Milk with Added Calcium Caseinate. The addition of 2 per cent of calcium caseinate (Casec) has advantages similar to the addition of lactic-acid milk.

Human and Evaporated Milk or Dried Milk Mixtures. A mixture of one part evaporated milk to three parts breast milk, or an equivalent amount of dried milk, can be fed to older infants who show a stationary weight. The objective is to concentrate the milk mixture without greatly increasing its volume.

When infants are to be returned to mothers whose supply of breast milk is ample for their needs, no artificial feeding is given in the Station. When the infants are to receive artificial feedings at home, they are started on the artificial feeding in the Station when their weight approaches 2,000 grams. A small amount of cow's milk is introduced at one of the feedings, gradually replaces one feeding altogether, and then a second and third feeding until the infant is adapted to the amount and type of artificial feeding that will be given to it at home.

FEEDING TECHNICS

The method to be used in feeding the premature infant is dependent on its age and weight, that is, upon its ability to obtain its food by its own sucking efforts.

Medicine Dropper. The young premature infant is preferably fed with a medicine dropper. The dropper is protected by a rubber tubing, about 1½ inches long. The rubber tubing used should be soft and not too heavy, and should come well up on the dropper to avoid the danger of slipping off during feedings. This tubing must not protrude more than ⅛ to ¼ inch beyond the glass tip. The rubber tip prevents irritation to the mucous membrane of the mouth and helps to teach the baby to suck. All of our premature infants, regardless of their size, are at first fed with a medicine dropper.

The medicine glass, containing the feeding and the dropper, is kept covered with sterile gauze and remains in a small container of warm water while the infant is being fed. The nurse elevates the baby, supporting its head and shoulders with her left hand. The dropper is placed well back in the infant's mouth. If the baby does not suck, a firm, gentle pressure is exerted on the back of the infant's tongue. This pressure will stimulate swallowing. Feed the baby slowly and carefully so that every drop of feeding is swallowed. Any of the feeding that is allowed to run out of the baby's mouth or that is spilled on the feeding towel will be lost to the infant. If the baby has a tendency to regurgitate or vomit, or if it is too apathetic to suck or swallow, a third or a half of its feeding is given at a time, waiting five to ten minutes between the portions of the divided feeding.

The food must be kept warm, not hot or cold. If it is too cool, the baby will take it more reluctantly and be more apt to vomit. Before leaving the infant, the nurse should always inspect the back of its throat to make certain that all of the feeding has been swallowed.

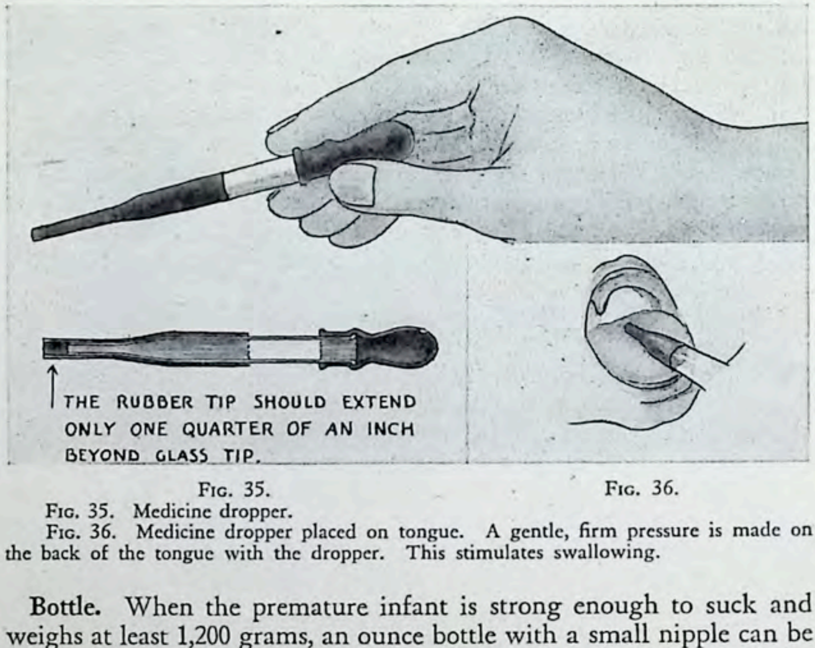


Fig. 35. Fig. 36.

Fig. 35. Medicine dropper.

Fig. 36. Medicine dropper placed on tongue. A gentle, firm pressure is made on the back of the tongue with the dropper. This stimulates swallowing.

Bottle. When the premature infant is strong enough to suck and weighs at least 1,200 grams, an ounce bottle with a small nipple can be used. A special nipple and ounce bottle for the use of premature infants are obtainable on the market.* One hole is punctured in the center of the nipple with the red-hot point of a needle. The hole must be of correct size. If it is too large, the feeding will be taken too rapidly; if it is too small, the baby will become exhausted and not be able to finish the feeding. (Fig. 39.) A bottle is never offered even to larger infants before they are three days old, and often, when the baby is very small, the bottle is not used before the infant is six to eight weeks old.

The nurse holds the baby in a slightly elevated position while she is feeding it by bottle. She can open the infant's mouth by pressing

* Universal Glass Co., Chicago, furnish small special nipples, bottles, and rubber tubing for droppers.

down on its lower jaw with the thumb of her left hand. Care must be taken not to contaminate the nipple when it is being put into the baby's mouth. If the baby does not suck readily, the nipple is pressed down on the tongue, but care is taken not to twist the bottle around.

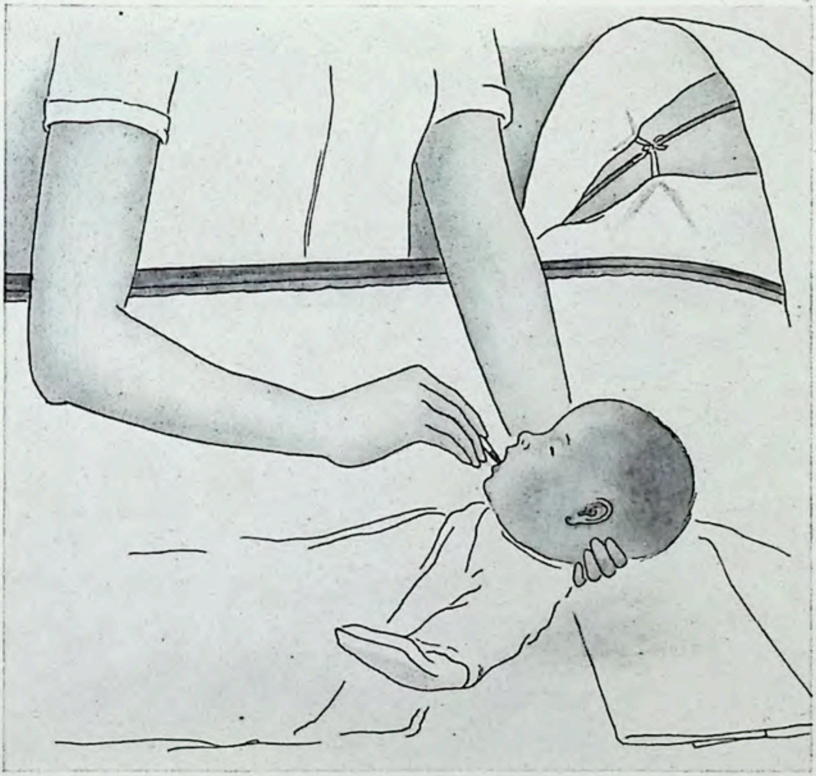


FIG. 37. Feeding with dropper.

The nurse should make sure that the nipple is placed on top of the tongue, as the tongue often adheres to the roof of the mouth when the mouth is opened. Every drop of feeding must be given. Before leaving the infant, the nurse should inspect the back of its throat to make certain that all food has been swallowed. After feeding, the baby's head is turned to one side, so that if it should regurgitate, there will be less danger of aspiration.

The amount of milk the baby is to receive in 24 hours is divided into the required number of bottles and stored in an individual rack in the refrigerator. The regular stock four-ounce nursing bottles and

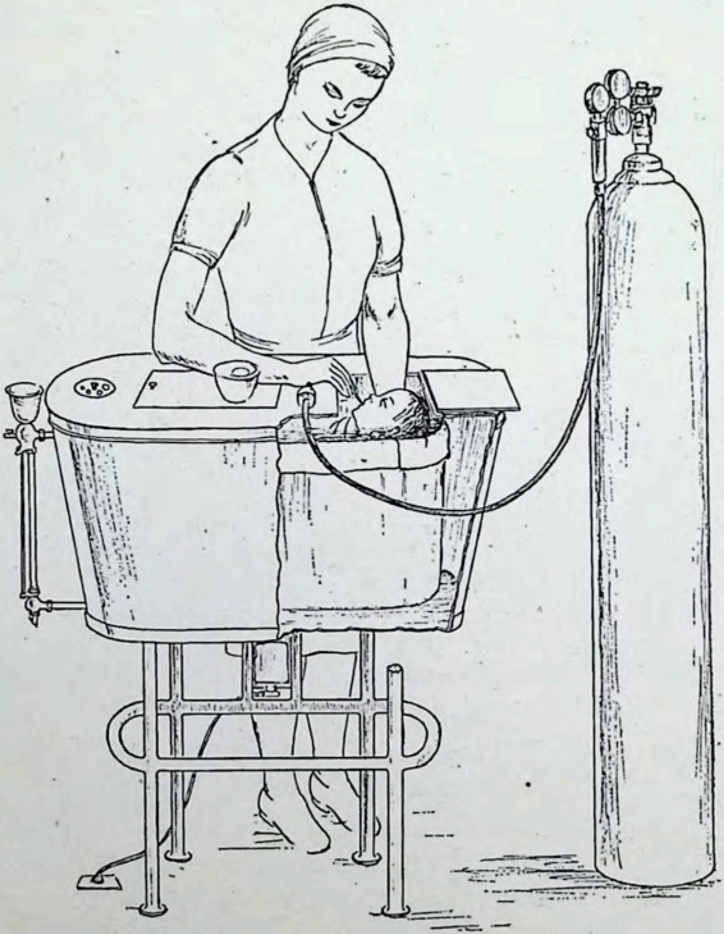


Fig. 38. Feeding in the oxygen bed.

ordinary nipples are not used until the baby weighs 1,800 or more grams.

Feeding at the breast is not advisable in the premature infant until lactation has been established and until the baby is strong enough to nurse. The infant's weight should approximate 2,000 grams, and it should be at least four or five days old. As a rule, it is safer to have the mother express her milk and feed it to the baby from a bottle until the infant is strong enough to avoid exhaustion from nursing. When the baby first starts nursing, it is put to the breast for short periods only. After it is strong enough, however, it is allowed to nurse 15 minutes on one breast and five minutes on the other. The breasts are alternated at the next feeding. By giving both breasts at each nursing the necessity of offering a complementary formula may often be avoided.

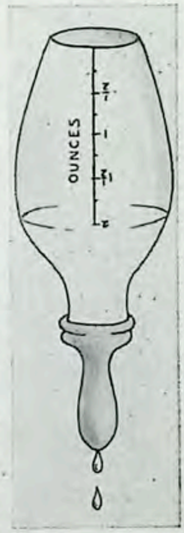


FIG. 39. Milk dropping from nipple at proper rate for nursing.

The first day that the baby is allowed to nurse at the breast, it is put to breast only once or twice. If the mother's nipple is too small, inverted or too large, it is often easier for the premature baby to nurse if a glass nipple shield or "Faultless Wonder Rubber Nipple" is placed directly over the mother's nipple. One rather large hole is punctured in the center of the rubber nipple. This nipple has given us better results than the glass nipple shield. If the mother has more milk than is necessary for the baby's needs, we advise her to express the breasts after the infant has nursed in order that the glands may remain active.

When the baby is not gaining, it is very rarely due to the fact that the mother's milk does not agree with the infant. More likely it is due to the fact that the quantity is insufficient. In these cases weighing the baby before and after feeding will indicate the amount obtained, as well as whether or not a complementary feeding will be necessary.

The supervising nurse plays an important role in obtaining breast milk for the premature baby. If she is in charge of the obstetric floor, she should see to it that a nurse is responsible for the expression of the mother's breasts. If the baby is premature, it is doubly important that the milk be expressed at regular intervals. Only too often, when there is a shortage of nurses, the mother's breasts are expressed only twice or three times daily. If the baby is transferred off the floor, the obstetric department should make every effort to avoid "drying up" of the breasts. By encouraging breast-milk expression, we are doing much to insure the premature baby's future welfare and progress, as well as shortening the period of hospitalization, a desirable economy for the family.

Catheter feeding, or gavage, is usually required for only a limited number of infants. It is a simple and efficient method of procedure if carefully practiced by an experienced nurse. Indications for feeding by gavage are:

1. If there is an increase in cyanosis when the baby attempts to swallow.
2. If dehydration is marked and it is impossible to give sufficient fluids by either dropper or bottle.

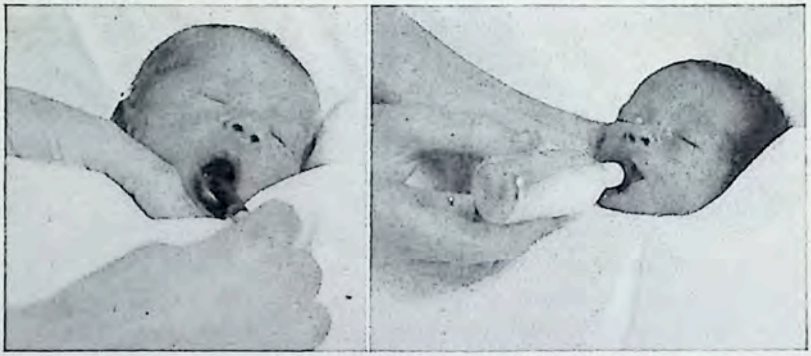


FIG. 40. Feeding the baby by bottle. Steps: 1. A feeding towel or bib is placed under baby's chin. 2. Support head and shoulders of baby while feeding. 3. Open mouth by pressing down on lower jaw with thumb. 4. When inserting nipple into mouth, hold the bottle near the bottom in order to avoid contamination of the nipple by thumb or fingers.

3. If the baby is acutely sick, has pneumonia, meningeal hemorrhage or a congenital condition that interferes with swallowing, as harelip, cleft palate, etc. Gavage in such cases is intended to aid in conserving the infant's strength.

Too often, we think of gavage as a time-saving method only. TIME SAVING, FOR ITS OWN SAKE, SHOULD NEVER ENTER AS A FACTOR IN THE CARE OF THE PREMATURE INFANT.

A catheter (No. 10 French for larger infants, No. 8 for smaller), about 14 inches in length, may be attached to the glass barrel of a small syringe. All food should be carefully measured and administered slowly with the minimum elevation required to obtain a free flow of milk. The infant should be upon its back on a flat surface, with its head in the median line and not elevated. The passage of the catheter into the esophagus is usually effected without difficulty. The poorly developed reflexes rarely cause severe retching. The catheter will not enter the larynx when being passed. It will either pass into the esophagus or turn upon itself, and in the latter case, the tip will come out of the mouth. No lubricant is required; the catheter should be passed dry.

The danger in catheter feeding comes at the time of withdrawal at the conclusion of feeding. At this time, if the catheter is not firmly compressed, or bent on itself, any milk remaining in the catheter will flow into the pharynx. As the infant usually gasps deeply at the time

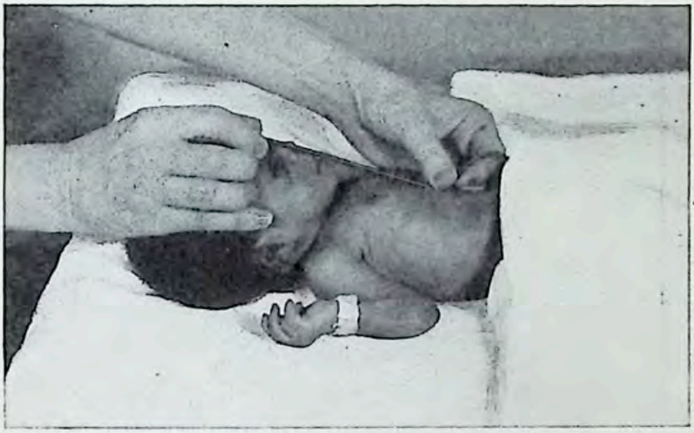
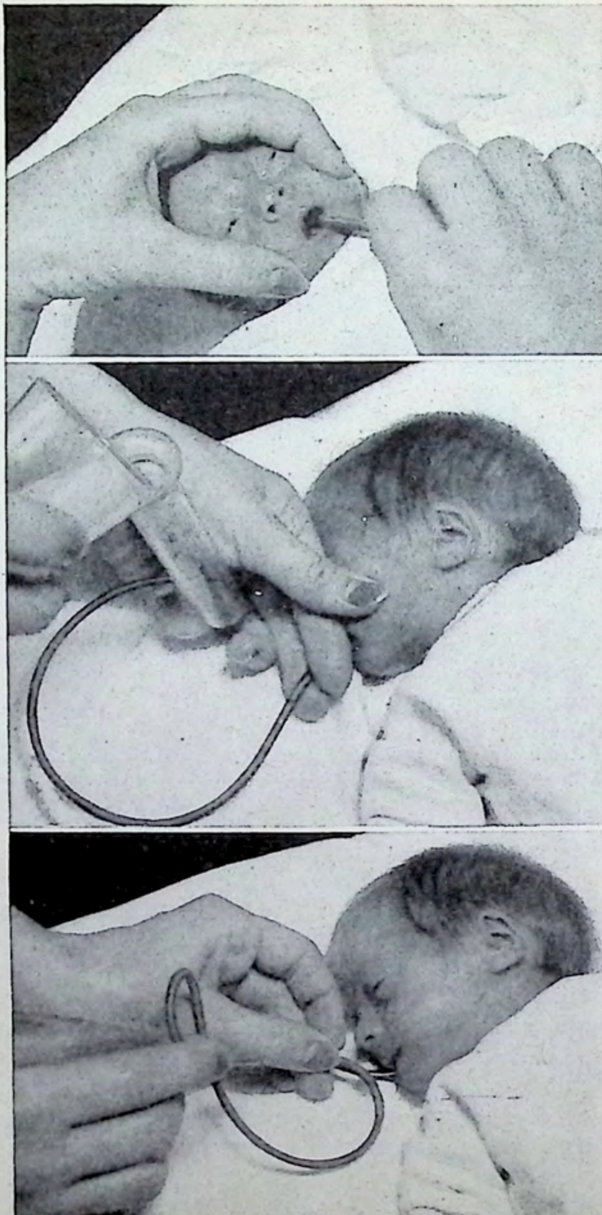


FIG. 41. Measuring the catheter. Measure the catheter from the bridge of the nose to the tip of the ensiform cartilage of the sternum, and at this point make a circle around the catheter with indelible ink. Two cm. above the first circle make a second, and 2 cm. above the latter, make a third.

of withdrawal, any food in the pharynx may be aspirated into the larynx.

The distance to which the catheter is to be passed is of great importance when we consider that this procedure must be repeated at least six to eight times daily over a considerable period of time. It has been our rule to measure the distance from the bridge of the nose to the tip of the ensiform cartilage, which is usually from 10 to 15 cm. (full-term newborn infants average about 16 cm.). The catheter is marked at this point with a circle of indelible ink, a second circle is drawn 2 cm. above this point, and a third is made 4 cm. above the first.

The catheter is passed with the glass barrel empty in order to avoid spilling food into the pharynx. When the catheter is passed to the first mark, the tip reaches to about 1 cm. above the cardia. When passed to the second mark, the eye will have entered the stomach, and when the catheter is passed to the third mark, the tip will be well



A

B

C

FIG. 42. Gavage technic.
(Legend continued on opposite page)

within the stomach. It becomes evident that each infant should have its individual catheter, as it is necessary for the nurse to have at all times a fairly definite idea as to the distance it has been passed, as well as to avoid the danger of cross infection. A nurse soon learns the distance that the catheter should be passed under the varying conditions. Most of the feedings are given with the tip of the catheter in the lower end of the esophagus, to eliminate irritation of the gastric mucosa and stimulation of the reflex at the cardia.

If the stomach is dilated, it is usually clearly outlined through the thin abdominal wall. In the presence of gastric distention, raising the infant to a vertical position and allowing it to belch before passing the catheter will often avoid the necessity of passing the catheter into the stomach. If the gastric distention is not relieved by this procedure, the catheter is passed to the second or third circle, as may be indicated, so that the tip of the catheter enters the stomach. The empty glass barrel is then raised and the air allowed to escape in this manner before feeding is begun.

The milk is allowed to flow into the stomach, the glass barrel being raised from six to eight inches above the level of the body. After the feeding, the catheter is firmly compressed or bent upon itself to avoid spilling milk into the pharynx during its removal.

Carefully elevating the child to a vertical position after feeding will allow the eruction of air and will frequently prevent cyanotic attacks. In elevating the child, flexion of the body must be avoided.

Too rapid feeding, with overdistention of the stomach, is more dangerous than too slow feeding. Usually, two or three minutes is all that is required. Turning the infant on its right side following the feeding reduces the emptying time. A single nurse can carry out catheter feeding once she becomes skilled.

The position of the infant should be changed at least once between feedings in order to avoid hypostatic pulmonary congestion.

The premature infant is not routinely belched, since all unnecessary handling is avoided. If the baby is regurgitating, and belching will aid in checking this, the child is elevated, not picked up. When the baby weighs 4½ to 5 pounds, it can be picked up after feeding to allow it to belch (Fig. 43).

A. Head is held on a flat surface with the chin upward and in a straight line with the body. The catheter is passed to the first circle without being moistened or lubricated. Most of the feedings can be carried out without passing the catheter into the stomach.

B. Turn head to side. Hold catheter and funnel in one hand. There is thus no danger of the catheter's slipping out.

C. Clamp catheter tightly in two places before it is withdrawn.

PROCEDURE TO MAKE STERILE TEA FOR INFANTS

Requirements.

Sterile tea balls (tea balls are made with black tea, tied in gauze, fastened with thread and autoclaved).
Top part of double boiler.
Sterile 8-ounce bottles.

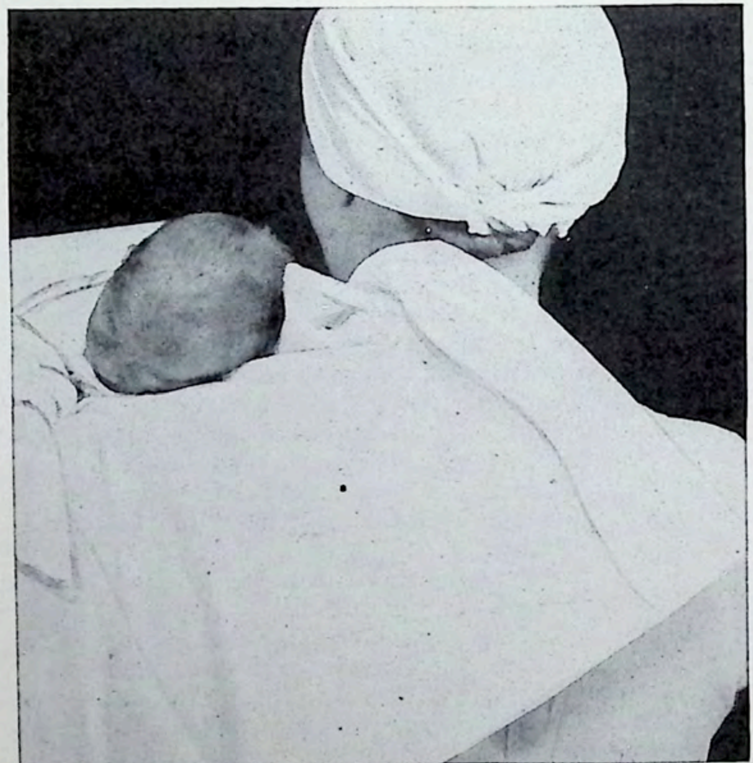


Fig. 43. Belching baby. Protect the baby from coming in contact with your uniform when belching it by placing a sheet over your shoulder. Do not have your face close to the baby.

Procedure.

1. Pour one quart of water in pan.
2. Let come to boil and boil for ten minutes.
3. Bring into nursery.
4. Remove sterile tea ball from container with forceps.

5. Suspend by string into boiling water.
6. Allow tea ball to remain in water until water is amber-colored.
7. Remove tea ball, bottle tea in sterile 8-ounce bottles and cover with rubber caps.

FORMULA ROOM

A good formula room should be equipped with adequate facilities and utensils for the preparation of feedings and the preservation of formulas under aseptic conditions. For the washing and sterilization of bottles, nipples and other similar equipment, it is best to use a small anteroom adjacent to the formula room. In some institutions, however, the bottles are sent to the central sterilization room to be autoclaved.

If a separate room cannot be provided for the preparation of the formulas, it may be advisable to autoclave the feedings, excepting those feedings prepared from milks, such as buttermilk, which cannot stand autoclaving. Milk mixtures are autoclaved for five minutes under 15 pounds of pressure. Each bottle is fitted with a rubber cap with three holes in it. The rubber cap is covered with gauze, which is held in place with a rubber band. When autoclaving is properly done, caramelization does not occur.

If breast milk exclusively is given to premature infants, it is advisable to have a special room for the measuring of feedings and the sterilization of bottles and similar equipment, unless the formula room is on the same floor. Usually, there is not enough breast milk available to permit the pouring of more than one set of feedings. The table on which the breast milk is poured should be equipped with containers for sterile gauze, sterile medicine glasses, small ounce bottles, nipples, medicine droppers and rubber bottle caps. This room should also be equipped with an electric refrigerator, electric sterilizer and an electric plate.

When pouring breast milk, the nurse should cover her uniform with a gown, wash her hands thoroughly, drape the feeding tray with sterile towels and measure feedings in a sterile cubic-centimeter graduate. The feeding is placed in a sterile medicine glass or bottle and the nipple or the glass is covered with a sterile covering to prevent contamination. The baby's name is written on the outside of the bottle with a colored, soft-lead pencil. The nurse should start to pour feedings half an hour before feeding time. These bottles are then set in a pan of hot water for ten minutes before the feeding hour. As soon as the infant is fed, the feeding equipment is placed in a pan of hot soapy water.*

PROCEDURE TO POUR FEEDINGS

Requirements.

50 cc. graduate.
Sterile medicine glasses.
Sterile bottles.
Nipples.
Bottle caps and gauze.
Feeding tray.
Breast milk, or formula as required.
Medications, if required.
Sterile towel.
Pencil for marking china.

Procedure.

1. Place tray on table.
2. Take rack of breast milk marked "use first" from icebox and place on table.
3. Place 50 cc. graduate in sterile towel on tray, unwrapping so as to keep sterile side of towel upward.
4. Take bottle or medicine glass from container.
5. Mark bottle or glass with respective baby's name.
6. Using 50 cc. graduate, accurately measure amount of feeding ordered.
7. Pour feeding into bottle, put on nipple and cover with bottle cap or gauze.
8. Exercise great care in putting on nipple so as not to contaminate it.
9. Ten minutes before feeding time, begin to warm feedings.
10. Take any necessary formulas from the icebox.

After feedings have been poured, count them to make certain none has been omitted.

Pour buttermilk slowly.

PROCEDURE TO WASH AND STERILIZE BOTTLES, NIPPLES AND OTHER SUCH FEEDING EQUIPMENT OF THE PREMATURE INFANT

Requirements.

Small bottle brush.
Large bottle brush.
Pan of soapy water.
Sterilizer.

Procedure.

1. See that sterilizers are three-fourths full of water, and turn on heat.
2. Wash nipples and medicine droppers in soapy water. See that curds of milk are out of hole in nipple.

* For further details on Formula Room Technic, see Appendix.

3. Remove rubber tip from dropper and make certain it is not split.
4. Replace, making sure that rubber tip is not more than one-fourth of an inch below glass tip.

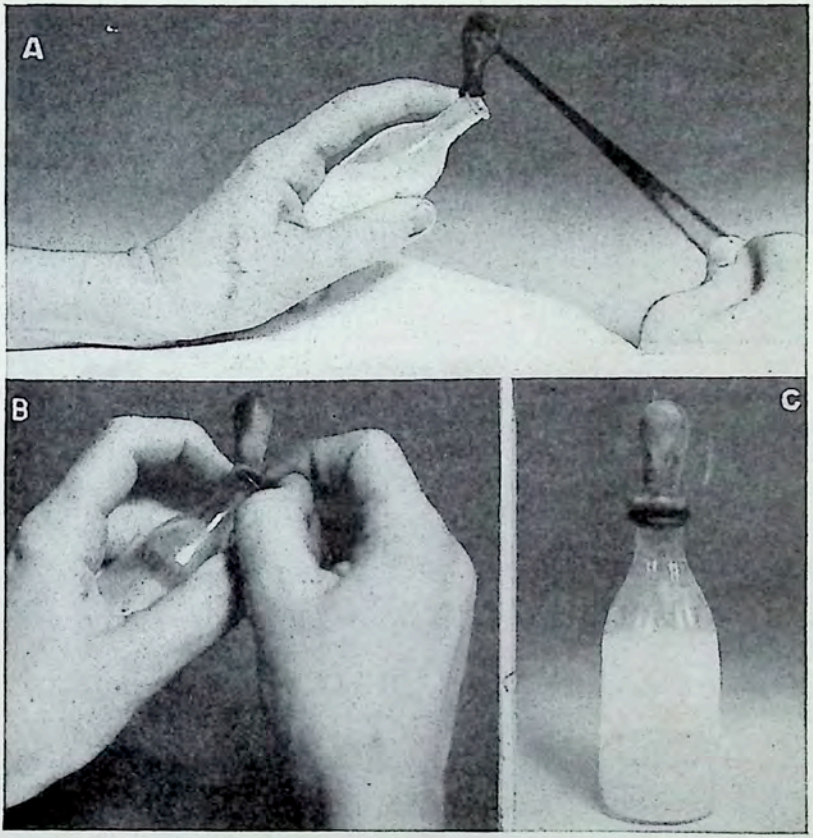


Fig. 44. Putting nipple on small bottle. A. Grasp *top* of nipple with sterile forceps and hold bottle in left hand, using forefinger (finger should be straight) to grasp lower part of nipple. B. With forefinger of right hand, grasp lower part of nipple and pull over neck of bottle. Keep forefinger straight to prevent contamination of the nipple. C. Many premature babies will take their feeding better if nipple is short. Take sterile gauze and pull nipple well down over neck of bottle to desired length.

5. Rinse nipples and droppers thoroughly with clear water.
6. Place in sterilizer as soon as the water is boiling and boil for four minutes.
7. Wash bottles and medicine glasses in soapy water, using brush.
8. Rinse thoroughly in clear water.

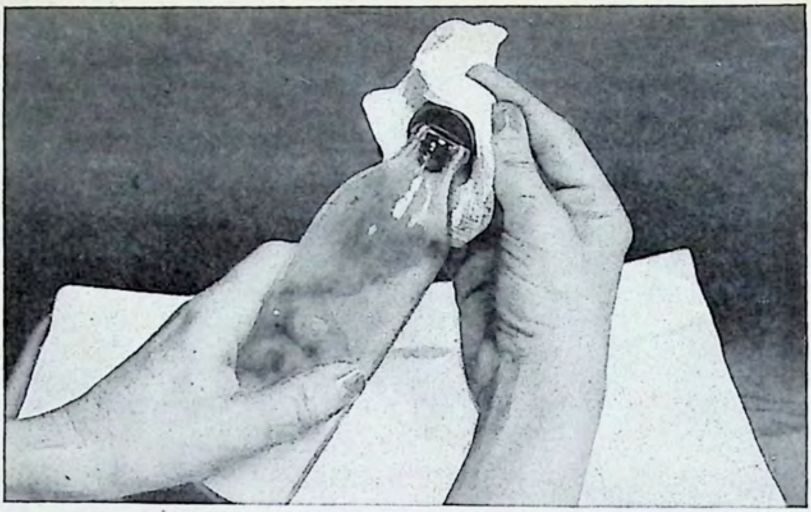


FIG. 45. Putting nipple on large bottle.

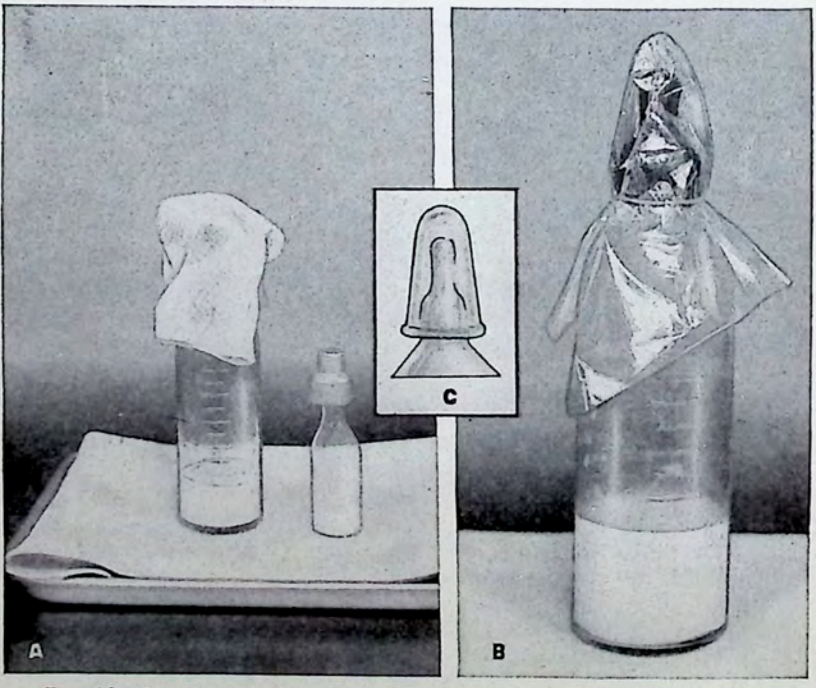


FIG. 46. Protecting nipples. A. Large nipple is completely covered with gauze. The metal cap from the top of a toxoid bottle covers the small nipple. B. The nipple can be covered with cellophane and the feeding autoclaved with nipple on bottle. C. Nipple cap of glass or aluminum.

9. After nipples and droppers have been taken out of the sterilizer, place the bottles and medicine glasses in and boil for ten minutes.

The boiling must be accurately timed, and the period of sterilization should be started when the water is actually boiling, not steaming.

Every other day autoclave the containers for gauze, bottles, glasses and nipples which are kept in the formula room.

Medicine droppers should be taken apart so that they can be properly cleansed and inspected, to make sure that the tips are not broken. All the nipples and droppers should be inspected once each week by the supervisor, and new nipples, dropper and bottle caps added if necessary. The supervisor or one of her assistants should fix the holes in the nipples so that they will be of the proper size.

The formula table should be thoroughly cleansed every time it is used. Everything in the formula room must be kept scrupulously clean. The inside of the icebox must be washed daily with soap and water.

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Breast Milk

By far the best results are obtained with the premature infant that weighs 1,500 grams or less when it is fed human milk. This is also true of the feeding of many of the larger premature infants. Since breast milk is not available to the infant from its own mother for several days after birth, milk for the infant must be secured from other sources. If the baby is born in the hospital, milk may usually be obtained from a wet nurse, if at hand, or from some mother having a surplus. When the baby is born at home, every effort should be made by the physician or public health nurse to secure mother's milk for the baby until lactation in the mother has been established. If there is any doubt as to whether the milk was collected under aseptic conditions, it must be sterilized.

When the mother does not have enough milk to meet her baby's nutritional needs, it is sometimes difficult to procure sufficient breast milk for the premature infant. In some of the larger cities, mother's milk bureaus have been established for this purpose with excellent results. One of the advantages of a milk bureau is that it is properly equipped to collect, sterilize and preserve mother's milk (see page 125). In the Premature Infant Station at Sarah Morris Hospital, wet nurses are employed who live in the hospital and supply breast milk. The mother is encouraged to keep her baby with her. The milk supplied by these wet nurses is used raw because it has been found that premature babies thrive best on raw breast milk. Boiling destroys the enzymes.

EXPRESSION OF MILK

In addition to the milk supplied by the wet nurses, the mothers of the babies at the Premature Infant Station of the Sarah Morris Hospital are expected to express their milk at home and send it to the hospital to be used. Breast milk from such outside sources must be boiled to be a safe food. Since about 80 per cent of the babies are born in the home or are transferred to us from other hospitals, it is necessary to get in contact with the mother early to give her instructions relative to the expression of her milk. The other institution or the mother's physician is requested to encourage the mother to pump her breasts.

When the baby is born at home, the visiting or public health nurse instructs the mother in "manual expression." Usually, the father or some member of the family will come to the hospital within the first four days after the baby is admitted, and the importance of maintaining the breast milk supply of the mother is explained to this person. Written instructions on the handling of the milk are sent to the mother. A diet slip is included, since diarrhea in the baby may result if the mother eats improper foods. Although such indiscretion may not affect a full-term baby, it may prove disastrous to a premature infant.

The mother is advised to use a hand pump when engorgement is excessive. Hand expression is encouraged by the end of the first week, since it is the best method of stimulating the secretion of breast milk. The importance of expressing both breasts at least four times daily, and preferably five times, is stressed. We ask the family to bring the milk to the hospital every day, and when necessary, carfare is furnished.

Routine Wassermann tests are given to all the mothers. If in any case the reaction is positive, the milk of that mother is boiled three minutes over a direct flame, cooled quickly and used only for her own baby, if necessary—as, for instance, when there is a shortage of supply.

Even though a mother has only a small amount of milk daily, we advise her to continue pumping, since even four or six ounces of mother's milk may shorten the baby's period of hospitalization and may add immeasurably to the infant's security in case of illness.

BREAST FEEDING OF THE FULL-TERM INFANT

We have already explained that there can be no definite premature infant program unless the full-term baby is being cared for properly. The breast feeding of babies in the full-term nursery should be encouraged, as well as in the premature station, if epidemics are to be kept at a minimum.

All hospitals are concerned with the prevention of epidemics in nurseries. Since diarrhea is looked upon as a serious complication in the nursery, everything possible must be done to prevent the occurrence of even a single case of diarrhea. Limiting the infants to boiled water until the breasts of the mother begin to secrete is an excellent prophylactic measure in the care of the full-term infant.

To Increase Number of Breast-Fed Infants. General suggestions which may help to increase the number of babies who are breast-fed follow:

1. Boiled water only or 5 per cent beta-lactose or glucose water can be given the first three days. At the Michael Reese Hospital boiled water is the only fluid given by mouth during the first three days. If carbohydrate solutions are used, it should be remembered that these are excellent culture media and every precaution must be taken to make and keep them sterile. They should be prepared daily.

2. It is best to eliminate any formula the first three days, unless there is a very marked weight loss, or unless the doctor orders complementary feedings. All orders for complementary feedings should be in writing.

3. Weigh the baby before and after feeding, so that if it is necessary to give the baby a complementary feeding, too much will not be given. After the baby is getting an adequate supply of milk from the breast, it is not necessary to weigh it before and after feedings.

4. Have the baby nurse on both breasts, ten minutes on one breast and five minutes on the other. Alternate the breasts on the long and short periods.

5. If a complementary feeding is given, it should be given immediately after nursing.

6. One common fault observed in many nurseries is that bottles are propped and very often left in the baby's mouth for an indefinite period, with the result that the baby has no desire to nurse when subsequently put to breast. The nurse or mother should hold the bottle for the baby.

7. Neither water nor complement is to be given the baby one hour before nursing.

8. If the baby refuses to nurse at one feeding, and nothing is given to it (neither water nor milk), it will often nurse well the next time it is put to breast.

9. The fact that a baby cries when it comes from the breast does not necessarily imply that it has not been satisfied. It may need to be belched.

10. As soon as the baby nurses well and the breast milk is ample, water and complement after nursing should be stopped.

Lactogenic and Mammogenic Hormones. Recently experimental studies have been made with the lactogenic and mammogenic hormones to investigate their influence on milk secretion. As Riddle[4] points out:

> The anterior lobe of the pituitary exercises a direct control (through its lactogenic hormone, prolactin) over milk secretion; in addition it exercises an indirect control (through estrogen, progesterone and possibly other sterols) and perhaps also a direct control (through a mammogenic pituitary hormone) over the development and growth of the mammary glands.

In his discussion of the lactogenic hormones, Riddle says:

> The most recent study is also the most complete and informative. Kenny and King treated forty-three women with prolactin for deficient lactation, beginning at different stages up to the third month post partum; forty-three other women, to whom other "galactogogues" were given or on whom routine methods of encouraging lactation were practiced, served as controls. In 74 per cent of the treated women and in only 21 per cent of the controls lactation became sufficient for the whole need of the baby until weaning at the sixth to the seventh month. The complete failures included 19 per cent of the treated women and 63 per cent of the controls. The total dose of prolactin was 900 units, which was given intramuscularly at the rate of two injections a day for five days, as follows: on the first and second days 300 units a day, on the third and fourth days 120 units a day and on the fifth day 60 units. No local or systemic ill effects were observed. The milk produced was of normal composition and quality. They recommended that treatment begin early in order that efficient nursing might be established before discharge from the hospital.

With reference to the mammogenic hormones Riddle states:

> Numerous old and new studies clearly prove that hormones of the ovary play a part in the growth of the mammary gland—in most species an estrogen induces (directly or indirectly) duct growth, and an estrogen plus progesterone induces lobule-alveolar development. Androgens, too, were later proved capable of replacing estrogens in the induction of growth in the mammary parenchyma. Still more recently desoxycorticosterone acetate and some phenanthrene and stilbene compounds not now known to occur in the body are reported to cause duct development in normal and castrate males of the species studied.

The experimental studies reported on the mammogenic and lactogenic hormones have, for the most part, been carried out on smaller animals and cows. Therefore, as yet, no conclusions are warranted as to the efficacy of their administration in humans. For the present, the best recommendations for stimulation of breast-milk secretion still seem to be direct stimulation of the breast by a hungry baby, manual expression of the breasts and hygienic management of diet.

Stimulation of Breast Milk. The important factors in the stimulation of breast milk in the mother of a premature infant are:

1. Regular expression of the milk at definite intervals—four to five times daily.
2. Complete emptying of the breasts by expression, pumping or by the infant.
3. Plenty of rest for the mother.
4. Careful supervision of the mother's diet, with three meals a day and some nourishment between meals.

METHODS OF COLLECTING

The methods of collecting breast milk are:

1. Hand pump. This is occasionally used to draw the first ounce which will be discarded.
2. Electric pump (Dr. I. A. Abt).
3. Water-suction pump. Such a pump can be attached to any standard water faucet. There are several types on the market, and some hospitals assemble their own.
4. Manual expression.

PROCEDURE FOR MANUAL EXPRESSION

The directions for manual expression are:

1. Scrub hands and nails well with soap and water for at least one minute.
2. Wash the nipple with fresh absorbent cotton and boiled cooled water.
3. Dry hands thoroughly on towel and keep them dry.
4. Have a glass that has been washed and boiled ready to receive the milk.
5. Grasp the breast gently but firmly between the thumb and fingers, with the thumb in front of the breast and the rest of the fingers on the under side. The thumb in front and the first finger beneath should rest just back of the dark area on the breast. With the thumb, first make a downward pressing motion on the

front. Then the fingers behind are carried downward to the base of the nipple. The second movement should end with a slight forward pull and with a gentle pressure at the back of the nipple which causes the milk to flow out. Do Not Touch the Nipple.

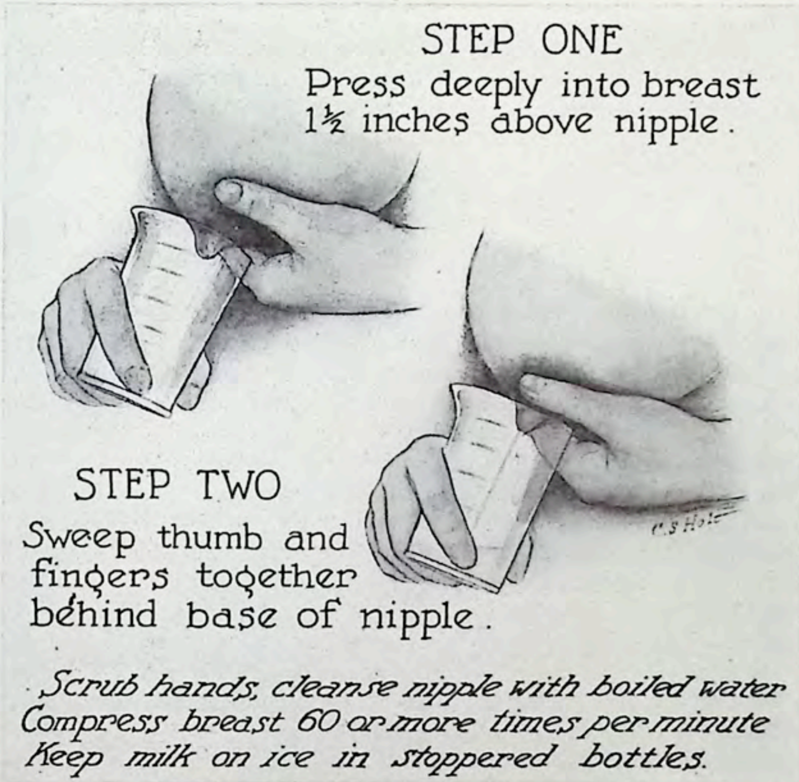

Fig. 47. Breast expression.

6. Repeat until the breast is empty.
7. Express milk regularly four or five times daily and put the day's supply in a quart bottle or a mason jar that has been washed and boiled. Avoid all contamination. Place immediately on ice.

Methods of Sterilization and Preservation. Boiling, pasteurization, fractional sterilization and the quick-freezing process are all methods that are being employed to insure that the infant receives a safe food.

Boiling. Boil the milk over a direct flame for three minutes and cool quickly.

Pasteurization.[5] Pasteurization may be accomplished by either the open-kettle or closed-sterilizer method. Both processes have been approved by the New York City Department of Health.

To use the closed-sterilizer method, heat the milk to 145° F. and maintain this temperature for thirty-five minutes. Then cool the milk rapidly; as a rule, thirty minutes is sufficient time for cooling.

In the open-kettle method, the milk is bottled and capped and placed on wire racks. These are put in the kettle, which is then filled with cold water up to the level of the bottles. The water is then heated to 165° F. and is held at this temperature for 30 minutes. Frequent, gentle stirring of the water is necessary to keep it at a constant temperature. The milk is then cooled rapidly by allowing cold water to circulate in the kettle.

After the pasteurization process has been completed, the milk is placed in the refrigerator ready for distribution. Any milk which is not distributed within 12 hours is immediately frozen for future use.

Method of Fractional Sterilization.[6] Fractional sterilization is still in use in some districts in which dry ice cannot be secured for freezing. All utensils to be used are sterilized by boiling 10 minutes. The milk is boiled vigorously for three minutes in an open kettle. It is then strained through sterile gauze. Sterile distilled water is added to retain the number of ounces present previous to boiling. The milk is poured in eight-ounce glass fruit jars, and these are sealed tight and placed in a cold-water bath that is up to the milk level. The jars of milk are boiled for 20 minutes on three successive days. At the end of this period, they are chilled, the lids are tightened and the jars are placed in the refrigerator at 40° F.

Milk preserved by this process can be kept for two years. When it is used, this canned milk must be homogenized to emulsify the fat which has risen to the top. Homogenizing may be done with a sterile egg-beater or with the regular homogenizer. Because of the caramelization, this fractionally sterilized milk is not appetizing in appearance.

In our experience, babies fed on this milk have not done as well as those fed on fresh maternal milk, and vomiting and diarrhea are more frequently seen. Since 1935, with the perfection of the new freezing process, this method has been little used.

The Quick-Freezing Process.[7] The quick-freezing process described here is the method used at the Mothers' Milk Bureau of New York City. The equipment used by this Bureau includes:

3 aluminum plates or molds—2 with depressions and 1 plain with handle.
2 sterile towels.
1 sterile glass graduate.
1 sterile syringe (2- or 4-ounce size).
1 16-ounce sterile glass jar.
2 sterile spoons.
Sterile gauze squares.
3 blocks of dry ice:
one, 10 by 10 by 5 inches.
two, 10 by 5 by 5 inches.

The process is as follows: The milk is collected and pasteurized in the routine way. A sterile field is prepared. The molds, previously sterilized by boiling, are placed on the flat surface of the large block of dry ice. When the temperature of the plate has been reduced to that of the ice (—112° F.), the depressions are filled with cold, pasteurized milk by means of the small, sterile glass syringe. The mold is covered with the flat plate on which has been placed a block of dry ice.

In about two minutes a clicking noise will be heard which indicates that the milk has frozen and separated from the metal. The flat cover is placed over the other plate as the milk wafers are transferred to the sterile glass jar with the sterile spoons. These wafers have the size and appearance of peppermint wafers, which makes them quite attractive.

When the jar has received the specified number of ounces of milk, it is capped and placed in a holding cabinet (ice-cream cabinet) where it is kept at a temperature of —15° F. If retained at this temperature, the milk will keep indefinitely.

The frozen breast milk is liquefied by immersing the jar containing the wafers in cold tap water for half an hour, or by allowing the receptacle containing the wafers to stand in an ordinary refrigerator until the milk is liquefied. When this milk is delivered to hospitals, physicians or homes, it is placed in sterile, capped bottles and packed in ice. The milk is warmed to body temperature before feeding.

Dr. Walter Eddy, at Columbia University, has shown that quick-frozen milk loses none of its vitamin content. Moreover, frozen human milk does not differ from the fresh milk in total solids, fats, carbohydrates or proteins.

Of the many processes tried in the preserving of breast milk, the Bureau at New York considers the freezing method to be the most satisfactory. It is time-consuming, however, since it takes 35 minutes to freeze one quart of milk. Moreover, the dry ice evaporates quickly and is rather expensive.

Mothers' Milk Bureaus. The Mothers' Milk Bureau in New York was established in 1921 under the direction of the Children's Welfare Federation at the request of Dr. Henry Dwight Chapin. Since then, similar maternal milk laboratories have been established in various cities. Some of these, along with statistics on the work they are doing, are shown in Table VI.

The demand for breast milk and the services of the Mothers' Milk Bureaus is well demonstrated by the wide field of distribution reported by some of these Bureaus. The Memphis Station, during the past year, has furnished milk in answer to requests from Tennessee, Mississippi and Arkansas.

At the bureau established by the Board of Health of Chicago, on the written order of the baby's physician, breast milk may be obtained free of charge. As will be noted from the table, a few other municipal organizations follow this same practice. At the Mothers' Milk Bureau of the County Medical Society of Milwaukee, Wisconsin, if the family is able to pay, a charge is made; if not the milk is given free. The Medical Society of Milwaukee County is the first milk bureau known to us to have been established by a county medical society. The Milwaukee Visiting Nurses' Association has aided in the furthering of the aims of this station.

The breast-milk laboratory should be considered as an educational center for both nurses and milk donors. The New York Bureau gives a course of lectures to student, graduate and public health nurses. Various institutions have found it of great value to send their nurses to the different bureaus to learn of the organization methods and preserving processes preliminary to instituting similar activities in their own communities.

THE WET-NURSE

In Chicago, both the Sarah Morris Hospital and the Cook County Hospital maintain wet-nurse bureaus to meet the demands of their own premature stations. The average amount of breast milk per year supplied by these wet-nurses at the Sarah Morris Hospital is 50,000 ounces, and at Cook County Hospital is 100,000 ounces.

Requirements of a Good Wet-Nurse. In our experience, even in a large city, there is difficulty in obtaining a regular supply of good wet-nurses. Among the requirements of a good wet-nurse are:

1. Good health. She should be especially free from all contagious

TABLE VI

MOTHERS' MILK STATIONS *

MOTHERS' MILK STATIONS	DAILY AVERAGE OUNCES COLLECTED	DAILY AVERAGE OUNCES DISPENSED	PRICE PAID TO MOTHERS PER OUNCE	PRICE CHARGED TO PATIENTS		METHODS USED IN PRESERVING MILK
				WARD	PRIVATE	
California Babies Hospital, Los Angeles	225	225	$.07	Varied	$.35	Freezing
Royal Victoria Hospital, Montreal, Canada	90	90	.05	.10	.20	Freezing
Mothers' Milk Laboratory, Greenwich, Conn.	100	50	.10	...	.30	Freezing
Ingleside Home, Buffalo, N. Y.	56	42	.04 plus residence in the home	.12	.20	(Mothers are in residence)
Women & Children's Hospital, Chicago, Ill.	40	40	.08 plus carfare	.13-.15	.20	
Women's Hospital, Detroit, Mich.	52	52	.10 plus carfare	.18	.20	
Directory for Mothers' Milk, Boston, Mass.	450	450	.07	.10	.30	Freezing
Hospital for Sick Babies, Toronto, Canada	150	150	.05	Own wards —free	.12½	
Children's Welfare Federation, New York City	500	500	.13 plus carfare	.25	.30	Freezing
Registry for Mothers' Milk, Pittsburgh, Pa.	150	112	.05	Varied	.30	Freezing
Mothers' Milk Bank, Memphis, Tenn.	90	83	.05	Own wards —free	.15	Freezing
Medical Society of Milwaukee County	40	40		Free if indicated	.10	Fractional sterilization
Board of Health, Chicago, Ill.	130	130	.08	Free	None sold	Freezing
Cook County Hospital, Chicago, Ill.	330	330	.05	Free	None sold	Freezing
Sarah Morris Hospital, Chicago	150	150	Wet nurses	Free	.10	Fed raw

* Taken in part from the article: Laws, Carl H., and Esther G. Skelley: A maternal milk laboratory, Amer. Jour. Nursing, 38:859, 1938.

diseases and also from local diseases of any kind, such as those involving the nose, throat, skin, etc.

2. Her mammary glands should be of such quality that she can

secrete sufficient milk of good quality, and her nipples sufficiently developed to allow of nursing or proper expression of the milk.

3. Her age should be not less than 18 nor more than 35 years.

4. The age of her baby, as compared with that of the baby she is to nurse is a matter of indifference in most instances. However, the first week of lactation should be avoided, because of the presence of colostrum and the rapidly changing quality of the breast milk, which frequently cause serious gastric and intestinal disturbances in very susceptible infants, as evidenced by vomiting, colic and diarrhea.

5. Multiparity may be considered an asset, if the nurse has demonstrated her ability to care for and feed previous cases. A multipara is also less likely to be affected by her new surroundings, especially if this be a private home.

Examination of the Wet-Nurse. The examination of the wet-nurse should always be made in a systematic manner to insure against overlooking some factor that will affect the milk.

1. A careful history should be taken as to the number of children, miscarriages and the presence of constitutional diseases in her family.

2. She should be thoroughly examined, all parts of the body being exposed. The examination should include:

a. The skin and hairy parts of the body for the presence of skin lesions and parasites, as well as for old luetic scars.

b. The breasts.

c. The genitals, including the cervix and the urethra. In all cases a cervical (and in case of any doubt, a urethral) smear should be taken and examined for gonococci.

3. An examination and search should be made for chronic infections, especially syphilis and tuberculosis.

a. A Wassermann test should be made in every case and reported on before the wet nurse is allowed to supply milk, as it is well known that a syphilitic mother shows no clinical evidence of syphilis in a great number of cases. The mouth and pharynx, neck, anus and genitals, entire skin and lymphatic glands should be inspected for evidence of syphilitic lesions.

b. The lungs and glands should be examined for symptoms of tuberculosis, and a careful history elicited as to susceptibility to colds and to recurring bronchitis.

4. The wet-nurse should be questioned as to possible exposure to contagious disease, and she should be carefully examined for evidence of acute infections of the nose, throat and ears.

5. The teeth should be examined, and defects and pyorrhea corrected, if necessary, at the expense of the family.

6. The urine should be examined for evidence of nephritis or diabetes. It should be remembered, however, that a positive reaction for sugar should not be overestimated, unless the sugar is proved to be dextrose. Very commonly, in our experience, during the early weeks of lactation a lactosuria is present. The kind of sugar can easily be determined by the phenylhydrazine test, followed by a microscopic examination of the crystals.

7. The presence of any of the nervous and psychic disturbances, such as epilepsy, insanity, or hysteria should by all means exclude the subject.

8. Throat and stool cultures should be made.

When the wet-nurse is to take a position in a private home, she should not be subjected to annoying questioning on the part of the family. This is entirely unnecessary, if she has been properly examined by the physician. We have found that such unnecessary questioning has led to nervousness and often has caused her to decline the position at a time when she was most needed.

Place of Wet-Nurse in the Household. The wet-nurse should be treated neither as a guest nor as a menial, but so far as possible should be graded according to her previous station in life. There is grave danger of mental depression on the part of a woman, well-born and sensitive, who, through misfortune or necessity, is forced to seek this means of employment. There is also danger of an exaggerated estimate of self-importance on the part of a woman but little accustomed to the luxuries of life, upon her entrance into the home of employment, particularly if attentions are paid to her. All instructions and requests should be made by the person best qualified in the individual case. A divided responsibility will always lead to future complications.

Her quarters should be well located, their ventilation should be supervised and she should be held responsible for their general cleanliness.

The wet-nurse's baby should always be kept in the room with her, so that she may feel the full responsibility for its health and care.

Diet for Mothers Furnishing Milk for Premature Infants. The diet recommended for the mother who supplies milk for the premature infant should be selected from the following foods:

Meats: Beef, lamb, chicken, fish, bacon.

Eggs: Soft cooked only.

Vegetables: Potatoes, carrots, spinach, lettuce (no vinegar), beets, string beans, canned corn, squash, asparagus, celery.

Fruits: Bananas, apples, oranges—raw. Prunes, peaches, pears, apricots, raspberries, blackberries, cherries, strawberries—all stewed only.

Cereals: Rolled oats, rice, farina, cream of wheat, hominy grits, Wheatena, cooked wheat, oats, rice and corn cereals.

Fats: Cream, butter, olive oil.

Desserts: Soft puddings, gelatines.

Breads: Wheat, rye, bran, corn, crackers, zwieback, coffee cakes and plain cakes.

Liquids: Milk, buttermilk, kazol, cocoa, weak tea and coffee, malted milk.

Soups: Broths and soups made with beef, chicken or lamb. Vegetable soups made with milk or with meat stock and vegetables.

Avoid: Fried foods, aromatic vegetables (onions, cabbage, turnips, cauliflower), acid vegetables (pie-plant, cucumbers), highly spiced or seasoned foods, salads with acid dressings, raw fruits except oranges, bananas and apples.

THE MENU FOR ONE DAY

Breakfast

Fruit (orange, prunes or apple-sauce).
Cereal with cream and sugar.
Bacon (2 slices), or some other easily digested meat if desired.
Bread, toast or rolls.
Butter.
Cocoa or milk or weak coffee.

Dinner

Broth or soup.
One meat from list given, roast beef or broiled chop.
Potatoes (old) in any form except fried.
Vegetables (squash, beets).
Light dessert (custard, gelatin).
Bread (white, rye or bran).
Butter.
Cocoa or milk or weak tea or coffee.

Supper

One meat from list given (chicken).
Potatoes (creamed).
One vegetable (asparagus).
Cereal with cream and sugar (rice).
Stewed fruit (peaches).
Bread and butter.
Cake occasionally.
Milk or cocoa.

No candies should be allowed except as a dessert with one of the main meals.

If the wet-nurse's appetite demands more food because of the large amount of milk secreted, or if insufficient fluids are taken with the meals to cover the fluid requirements, one or two midday and one night luncheon may be given. These should consist of milk and tea, malted milk or cereal decoctions, with crackers, coffee cake or other form of bread.

Constipation should be relieved by diet, mineral oil or enemas.

The Wet-Nurse's Baby. The presence of the wet-nurse's baby predisposes to her peace of mind, and whenever possible, she should have it with her. Her baby's state of health is by all means the best indication of her ability as a wet-nurse, and with this, of the presence of constitutional disease in herself. At the first sign of an acute illness on the part of the wet-nurse's baby, it should be separated entirely from any other baby as well as removed from the breast. Its illness should be given the same serious consideration as that of the other infant, so that the mother's anxiety may be relieved. It should, however, receive as much of its mother's milk as can be spared. The milk can be expressed from the breasts and fed from a bottle.

If the baby of the wet-nurse is strong and healthy, it may be of immense value in keeping up the flow of milk, in case the baby to be nursed in a private home is a weakling. When a single infant is to be nursed, the second baby is often a necessity in the promotion of the development and stimulation of the breasts of the wet-nurse. No breast can be developed to its fullest capacity with the breast pump or by hand expressions. The breasts will respond in proportion to the demand placed on them, and in most instances during the first few weeks of the life of the premature infant, when its demands are met by from 4 to 16 ounces of milk, the wet-nurse can supply sufficient milk for both babies. When her supply becomes insufficient to meet the demands, her baby can be put on partial bottle feedings of the strength as indicated by its age and development.

Nervous and Mental State of the Wet-Nurse. The nervous and mental state of the wet-nurse is of the utmost importance. A nervous, emotional or erratic woman should be excluded because of the tendency of these influences to suppress the flow of milk. Whenever possible, a woman of phlegmatic temperament is to be selected. This is especially true if the wet-nurse is to be in close contact with an infant who appears hypersensitive or hyperirritable. There is also the possibility of slight indisposition on the part of her own infant, when the wet-nurse is nervous, and she is more likely to resent the necessity of partial or entire artificial feeding of her own child to the advantage of the premature infant, when it reaches the age when it may make greater demands on her supply.

A regular schedule of work, sufficient rest and recreation will aid in keeping the wet-nurse contented and at peace with herself and the world.

Menstruation. Menstruation rarely produces any serious disturbances, although the amount of milk is frequently decreased during the first days. It is always a safe procedure to dilute the milk during the first and second days of menstruation, if the wet-nurse suffers considerable pain at these times.

Quantity of Milk to be Expected from a Good Wet-Nurse. The quantity and quality of milk vary with the glandular development of the individual wet-nurse, the state of her mental and physical health and other factors which are often only temporary in effect. The amount and variety of stimulation applied to the breasts, of which the direct nursing by a full-term infant is the most valuable, are also very important considerations. In view of the many emergencies and influencing factors, no absolute standard for quantity and quality can be set. A wet-nurse who does not secrete sufficient milk during the first few days in her new employment should not be discharged until every effort has been made to improve her milk production. Frequently, the change in environment is sufficient to reduce it temporarily.

Number of Nurses Needed. Each good wet-nurse can care for the needs of about three to five infants, depending on their weight and development, beside allowing the strippings for her own child.

Length of Lactation. No time limit is placed on the employment of a wet-nurse as long as the quality and quantity of her milk is sustained and she remains in good health. One of the wet-nurses at the Sarah Morris Hospital had a lactation period of eighteen months. Such long periods of lactation, however, are not to be advised.

Cost of Milk. The wet-nurses in the Sarah Morris Hospital receive their board and room and $35.00 per month. Figuring maintenance at $35.00 a month also, this would make the total cost of each wet-nurse to the institution $70.00 per month. With an average of 30 to 35 ounces of milk per nurse daily, or 900 to 1,050 ounces per month, the average cost per ounce of breast milk is seven to nine cents. All premature infants in the Sarah Morris Hospital receive breast milk free of charge. When milk is dispensed to patients outside the hospital, a charge of 10 cents an ounce is made.

13

Artificial Feeding

Jacobi has said: "The most important ingredient in the formula is the physician's brains." Therefore, if artificial feeding becomes necessary, the physician will select that type of milk feeding with which he has had the most experience. Various milks and milk mixtures for feeding infants are available.

MILKS AVAILABLE

1. Sweet milks
   a. Fresh
      Whole
      Skimmed
   b. Dried
      Whole
      Skimmed
      Part skimmed
2. Evaporated milks
   a. Plain
   b. Fortified with vitamin D
3. Lactic-acid milks
   a. Fresh
      Whole
      Skimmed
   b. Dried
      Whole
      Skimmed
4. Soft curd milks (so-called)
   Sofkurd
   Chymogen milk (rennet treated)
   Enzylac (pancreatic-extract treated)

All of the above milks require the addition of carbohydrates, 2 to 6 per cent.

5. Reconstructed milks
    - Olac
    - Lactogen
    - Similac
    - Protein
    - S.M.A. (Synthetic milk adapted)
6. Dried casein (calcium caseinate)
    - Casec (Mead)
    - Protolac (Borden's)
    - Larosan (Roche)

Among the carbohydrate products are:

Cane sugar (sucrose, saccharose)	Cartose
Lactose and beta-lactose	Karocorn syrup
Dextrimaltose No. 1	Malt sugar (Borchardt's)
Dextrimaltose No. 2	Mellin's Food
Dextrimaltose with vitamin B	Bananas (dried, ripe)

Sweet Milk

Composition of Cow's Milk. There are outstanding differences between human and cow's milk in both fuel value and chemical composition.

TABLE VII

CHEMICAL COMPOSITION OF HUMAN AND COW'S MILK

	PER CENT IN HUMAN MILK	PER CENT IN COW'S MILK
Protein	1.25	3.5
Fat	3.50	3.5 to 4.0
Sugar	7.00	4.0 to 5.0
Minerals	0.20	0.75

The proteins, lactalbumin, lactoglobulin and casein, differ quantitatively in the two milks and vary greatly in the type of curd formed in the stomach.

TABLE VIII

PROTEINS CONTAINED IN 100 cc. OF HUMAN AND COW'S MILK

	HUMAN	COW'S
Albumin (lactalbumin and lactoglobulin)	0.72 Gm.	0.53 Gm.
Casein	0.43 Gm.	3.02 Gm.

The differences in the character of the casein coagulum can be attributed to the difference in the quantity of albumins and casein present, rather than to chemical differences between the two. Both the lactalbumin and the casein of the two milks possess specific antigenic properties. The same may be said of the lactoglobulin which exists in small concentration in both milks.

The differences in the percentages of minerals present in human and in cow's milk are equalized, for the body uses only what is necessary for its life and growth. Both milks are insufficient in the iron necessary to meet the requirements of the premature infant, in the amounts of milk which the premature infant is able to consume. Various investigators have found that human milk contains from 0.2 to 0.4 mg. of iron per 100 cc. and cow's milk from 0.14 to 0.24 mg. per 100 cc.

It should be noted that the amounts of breast milk to be fed the premature infant, as given in Chapter 11, Table V, are the maximum that can be assimilated and may be excessive quantities for artificial feeding in the first weeks of life, because of the infant's greater difficulty in digesting cow's milk. Artificially fed infants must be closely watched at all times for evidences of overfeeding, and the first evidence of digestive disturbances or of intercurrent infections should lead to the feeding of human milk whenever possible. A smaller and slower weight increase can be expected of the artificially fed infant.

If it becomes necessary to resort to artificial feeding, the selection of a food, its preparation and its adaptation to the infant must all be given the most painstaking consideration. Opinions vary widely as to the best food for an artificial diet. Most clinicians have obtained the best results by feeding low fat mixtures.

Boiled Whole Milk. Even though the milk is to be boiled, and, as usually required by ordinance, only pasteurized milk is sold, care must be taken that the milk be fresh and carefully collected at the farm. It will then have a low bacterial content before it is pasteurized.

During the first two or three weeks, lesser quantities of whole boiled milk per kilogram or pound of body weight can be fed than in later weeks. During the first days, skimmed milk may be used in place of whole milk, in amounts approximating 66 cc. per kilogram, or one ounce per pound, of the infant's body weight. During the second week, the skimmed milk may be gradually replaced by whole milk, so that at some time during the third week, the infant will be receiving 66 or more cc. of whole milk per kilogram of body weight. By the fourth week, the infant can usually take the recommended 100 cc. of whole milk per kilogram, or 1½ ounces per pound of body weight. One of the carbohydrates can be added to the milk in the amount of 2.2 grams per kilogram (one-thirtieth ounce per pound) of body weight, and this can be increased gradually, so that by the third or fourth week 6.6 grams per kilogram (one-tenth ounce per pound) of body weight may be added. At all times an endeavor should be made to administer at least one-sixth of the infant's body weight in total fluids during the 24 hours. The whole mixture should be boiled for three to five minutes.

Evaporated Milks

Both plain and "fortified" evaporated milk are being supplied. The latter, as marketed, has been subjected to ultraviolet irradiation to increase its vitamin D content. In the 13-ounce can, the standard quantity in which most of the evaporated milks are sold, the vitamin D content is equivalent to approximately 135 I.U. The 13-ounce can of evaporated milk represents the solid content of one quart of milk, and therefore, when diluted with boiled water up to one quart, it has the same food value as a quart of fresh milk.

The chief advantages of feeding evaporated milk to the infant are that it is sterile, easily obtainable, inexpensive, and has the ability to form a small curd.

Lactic-Acid, Whole or Skimmed Mixtures

Lactic-acid milk can be prepared by the addition of one teaspoonful of U.S.P. lactic acid to one pint of whole or skimmed milk, or by fermentation through the addition of *Bacillus bulgaricus, B. acidophilus* or *Streptococcus lacticus*. In the process of fermentation, approximately 1 per cent of the lactose is lost.

The average composition of fermented skimmed lactic-acid milk is: 3.6 per cent protein, 0.5 per cent fat, 4.0 per cent lactose, 0.7 per cent lactic acid, 0.75 per cent minerals. There are 12 calories to the ounce, or 400 calories to the liter.

When fed without the addition of carbohydrates, lactic-acid milk may be classed as a milk with a high protein, low carbohydrate content, and for this reason, is valuable in the presence of a fermentative diarrhea.

We have used to advantage two preparations of whole and skimmed lactic-acid milk mixtures, one for the first weeks, and the second for later feedings. The first has the following composition:

Whole or skimmed milk	1,000
Flour (dextrinized)	10
Sucrose (cane sugar)	40

The second mixture for later feedings is prepared in the following proportions:

Whole or skimmed milk	1,000
Flour (dextrinized)	15
Sucrose (cane sugar)	60

Maltose-dextrin compounds or other carbohydrates can be substituted for the sucrose, if desired.

Directions for Preparation. Add the flour to a few tablespoonfuls of whole or skimmed milk and rub to a paste. Add whole or skimmed milk to one liter.

Bring mixture to a boil and withdraw from fire.

Add the sucrose and bring to a boil for the second time.

Bring up to one liter with boiled water.

Keep on ice.

The process should require about 20 minutes.

The same rules for feeding boiled whole or skimmed milk are applied to lactic-acid feeding. In the use of the lactic-acid mixture, it is important that infants not be kept on the skimmed milk, low fat mixture for too long a time. Addition of whole lactic-acid milk is indicated after the first few weeks, beginning with one-third whole milk and two-thirds skimmed. By the fourth week, equal parts of whole and skimmed milk should be used in the preparation of the lactic-acid milk.

Soft-Curd Milks

The soft-curd milks offer the same advantages as evaporated milk, except that they cannot be concentrated. Therefore, the schedule covering the quantity of whole boiled milk to be fed should also be applied to feeding with the soft-curd milks.

Sofkurd Milk. Sofkurd milk is available in some of the larger cities. The milk is prepared by acidification with citric acid, following which it is passed through artificial zeolite (sodium-aluminum silicate). This process removes calcium in amounts approximating 20 per cent, and therefore changes the sodium-calcium ratio of the milk. A finer, more flocculent curd results.

The process, however, does not change the appearance of the milk or interfere with the cream level. It may be used unboiled and diluted in a manner similar to pasteurized milk. It can be boiled.

Chymogen. Chymogen (rennet) milk has been used in our Station for many years as a feeding for the infants who are being prepared to go home on artificial feeding. Because Chymogen milk precipitates in a soft, fine curd, it is especially indicated in the presence of vomiting and indigestion which has been caused by large curd formation.

To PREPARE, the milk is boiled for five minutes, and cooled to 104° F. One level teaspoonful of Chymogen (Armour Company) is added to each pint of milk, and the mixture stirred gently for one-half minute. It is then allowed to stand for 15 minutes so that the mixture will clabber. Following this, it is beaten with a Dover egg beater until the curd is finely divided. Carbohydrates are added in the amount that may be indicated. A Chymogen mixture must be held at a temperature near 100° F. in order that the rennet remain active. Therefore, before adding Chymogen to the milk, it is necessary that the temperature of the milk be tested with a dairy thermometer.

Chymogen milk is fed in whole or diluted form, as would be the case with ordinary milk. It is to be emphasized to the mother that in preparing the feeding for the baby, Chymogen milk must not be heated above 100° F. Higher temperatures not only destroy the enzyme, but result in the formation of large curds that cannot pass through the nipple.

In the place of Chymogen, a rennet tablet may be used in the preparation of this form of milk.

Enzylac. Recently, Enzylac has been made available in some of the larger cities. It meets the same indications as Chymogen milk, but is simpler to use, since it is delivered by the dairy already prepared.

Enzylac is fresh Grade-A milk, the curd tension of which has been reduced physiologically by means of a proteolytic enzyme from the pancreas, supplied by the Armour Laboratories. The enzyme is permitted to act on the fresh milk before pasteurization, and produces an almost imperceptible casein curd. The temperature of pasteurization stops the activity of the enzyme at the end of the time recommended for its preparation. The food value, flavor, appearance and creaming quality of the milk remain unchanged. The enzyme treatment does not reduce the quantity of vitamins present in pasteurized milk.

Enzylac may be boiled, but because of its low curd tension, this additional step is not necessary, if facilities for constant refrigeration at 50° F. or less are available. In the preparation of milk-carbohydrate-water mixtures, Enzylac is utilized just as is any other pasteurized milk.

We have fed Enzylac, unboiled, to premature and newborn infants with good results.

Reconstructed Milks

Reconstructed milks have the advantage of being easily available, sterile and precipitating with a fine curd. Due, however, to the varying amounts of the individual food elements contained in the different reconstructed milks, and the low vitamin content of most of them, the physician should make himself familiar with the constituents of the one to be used and assess them with relation to the individual infant's needs. The baby's progress is the best indication of the success attained.

Olac (Mead) is composed of a combination of skimmed milk, virgin olive oil, calcium caseinate and dextrimaltose, with a small amount of halibut liver oil. Its composition is based on the observations of Holt, Tidwell, et al.,[8] in connection with the absorption of fat and the assimilation of protein in the premature infant. In its dry form, it contains 40.6 per cent skimmed-milk solids, 31.7 per cent dextrimaltose, 17.5 per cent olive oil, 10.1 per cent calcium caseinate and 0.1 per cent halibut liver oil.

A dilution of one ounce (3½ packed level tablespoonfuls) of powder to six ounces of boiled, cooled water yields a mixture with a composition consisting of 4 per cent protein, 3.2 per cent fat, 9.1 per cent carbohydrates, 0.6 per cent minerals, and 83.1 per cent moisture. The caloric value was found to be 23 calories per ounce or approximately 77 calories per 100 cc. of fluid mixture. A weaker dilution can be made when indicated, by the use of larger quantities of water.

Olac is a safe food and is usually well taken by the premature infant. Overfeeding must be avoided, however, as Olac predisposes to loose stools.

Lactogen (Nestle) is a spray-dried mixture of dilute, fat-enriched cow's milk with added lactose in such proportions that the prepared food approximates human milk in its percentage composition. It is homogenized before drying. Lactogen in dried form contains 25.0 per cent fat, 16.2 per cent protein, 53.3 per cent soluble carbohydrate, 3.5 per cent minerals, and 2.0 per cent water. The standard formula consists of one level tablespoonful to each two ounces of boiled water used.

Similac (M. and R. Dietetic Laboratory) is a spray-dried preparation in which the normal milk fat has been replaced by a mixture of homogenized butter fat, cocoanut and olive oil and cod liver oil. In the dried form, it contains 27.1 per cent fat, 12.5 per cent protein, 54.4 per cent soluble carbohydrates, 3.2 per cent mineral matter and 3.0 per cent moisture. In order to obtain the standard formula, one level measure of the powder (in the cup furnished by the manufacturer) is added to two ounces of boiled water.

Protein Milk (Finkelstein). Two preparations of dried "protein milk" are available: Merrell-Soule (Borden's), in which the lactic-acid milk is prepared by fermentation, and Mead's, in which the lactic-acid milk is prepared by the addition of U.S.P. lactic acid. Protein milk is indicated in the presence of fermentative diarrheas because of its high protein and low lactose content. It precipitates with a fine curd.

The composition of the dried "protein milk" is: 27 per cent butter fat, 38 per cent protein, 24 per cent lactose, 5 per cent ash, and 3 per cent free lactic acid. There are 143 calories per ounce of powder.

To make one quart of protein milk, 11 level tablespoonfuls (3 ounces by weight) of the powder is added to one quart of boiled water. This reconstructed protein milk contains: 2.25 per cent butter fat, 3.16 per cent protein, 2.0 per cent lactose, 0.42 per cent ash, and 0.25 per cent free lactic acid. There are 12.6 calories per ounce, and the pH is 3.8.

THE INDICATIONS for feeding the infant protein milk are:

1. Diarrheas and all cases of abnormal intestinal fermentation (sugar).
2. Fat indigestion with low sugar tolerance.
3. Gastro-intestinal infections associated with frequent stools.
4. Systemic infections with intestinal complications.

S.M.A. (Synthetic Milk Adapted). S.M.A. is marketed in both a powdered and a liquid concentrated form. In its commercial preparation, one-third part skimmed milk and two-thirds water are the basic constituents. To these are added a small amount of potassium, milk sugar up to the level of the amount contained in breast milk, and a variety of fats, consisting of tallow oil, cocoanut oil, cocoa butter and cod liver oil, to replace the normal fat of milk.

The formula is prepared by adding one ounce of boiled water to each measure (furnished) of the powdered form of S.M.A., or by diluting the liquid form with equal parts of water. When diluted according to directions, the average composition is: 3.5 per cent fat, 1.3 per cent protein, 7.3 per cent carbohydrates, 0.275 per cent ash. It has 20 calories per ounce or 68 per 100 cc.

S.M.A. is not suitable for infants with diarrhea.

Dried Casein

In the presence of loose stools in the breast-fed infant, and in cases of fermentative diarrhea or other diarrheal disturbances, dried casein can be added to the feeding in amounts of 2 per cent of the mixture.

Carbohydrates

During the first week or more, carbohydrates are added to the feeding in amounts of 1 or 2 per cent of the total mixture. Later, the amount can be increased to as much as 5 per cent of the total. The physician will advise as to the carbohydrate he finds preferable.

The caloric value per ounce and approximate measures of some of the more frequently used carbohydrates are shown in the following table.

For vitamin and iron additions, see Chap. 14 and 24.

Table IX

CARBOHYDRATES

CALORIC VALUE PER OUNCE AND APPROXIMATE MEASURES

CARBOHYDRATE	CALORIES PER OUNCE OF WEIGHT	TABLESPOONFULS	VOLUME IN OUNCES
Cane sugar	120	2	1.0
Lactose	120	3	1.5
Maltose-dextrin	110	3	1.5
Syrup	120	2	1.0
Barley flour	100	3	1.5
Wheat flour	100	4	2.0
Oats rolled	100	5	2.5

FORMULA

Preparation

When a whole milk is being used as the basis for an artificial feeding formula, it is desirable that the mixture be prepared to furnish 20 calories per ounce, or 65 calories per 100 cc. of formula. A standard formula with whole milk can be prepared with the following ingredients:

Whole milk	7 ounces—140 calories	
Sugar or syrup	½ ounce — 60 calories	
Water	3 ounces— 0 calories	
	10 ounces—200 calories	= 20 calories per ounce.

or

Whole milk	700 cc. —465 calories	
Sugar or syrup	50 Gm.—210 calories	
Water	300 cc. — 0 calories	
	1,000 cc. —675 calories	= 67 calories per 100 cc.

More dilute mixtures are indicated for some small infants.

If skimmed milks are used, the formula will have a caloric value of 13 to the ounce and 442 to the liter.

The formulas can be prepared with whole sweet or lactic-acid milk, Chymogen, Enzylac or Sofkurd milk.

If evaporated milk is used, a 13-ounce can should be diluted up to one quart, following which it can be used in the same amounts as whole milk.

If a reconstructed or other dried milk is used in the formula, the directions accompanying the milk are to be followed in ascertaining the amounts to be added for arriving at a given caloric content.

Schedule for Formula Feeding with Cow's Milk

It is to be emphasized that overfeeding is more harmful than underfeeding during the first few days of life.

First Day. During the first 12 hours, no food or water is given even to larger premature infants. Very small infants are not fed for 24 hours or more. After 24 hours, saline solution is given subcutaneously, as recommended for breast-fed infants (Chap. 15).

TABLE X

FEEDING SCHEDULE, FIRST 24 HOURS

Each infant offers an individual problem: The size of feeding will vary with the development of the infant and the capacity of its stomach (see Fig. 3).

GENERAL RULES
(for infants of 1,000 to 2,500 grams)

First 12 hours	No food or water
13th hour	Water—2 to 6 cc.
16th hour	Water—2 to 6 cc.
18th hour	Breast milk—2 to 6 cc.
20th hour	Water—2 to 10 cc.
22nd hour	Breast milk—2 to 10 cc.
24th hour	Water—2 to 10 cc.

In many cases, premature infants are not received at the Station until several days after birth. Such infants must, of necessity, be fed according to their condition when admitted. The first few feedings should be minimal. Dehydration is often marked and demands special consideration.

TABLE XI

FEEDING SCHEDULE OF FIRST SEVEN DAYS FOR NORMAL PREMATURE INFANTS ON COW'S MILK FORMULA

	WEIGHT IN GRAMS		
DAY	1,250-1,500	1,500-1,850	1,850-2,500
1	4-8 cc.	6-12 cc.	8-16 cc.
2	20-40 cc.	40-64 cc.	64-80 cc.
3	64-96 cc.	96-128 cc.	128-192 cc.
4	80-104 cc.	104-136 cc.	136-216 cc.
5	96-120 cc.	128-144 cc.	152-232 cc.
6	96-136 cc.	136-176 cc.	168-248 cc.
7	104-152 cc.	144-192 cc.	184-264 cc.

The amounts recommended in the above table, beginning with the second day, must be considered as experimental and will have to be modified at times, even in infants of the same age and weight. Increases must be based largely on the general condition and degree of gain in weight of the individual infant. If the infant is making satisfactory progress, it is often advisable not to increase the amount of feedings temporarily.

By the eighth day, the amount of formula given in 24 hours will approximate one-tenth of the infant's body weight. The amounts will be gradually increased by 1 or 2 cc. at a feeding during the next ten days. Most infants will be able to take one-eighth of their weight of formula by the time they are 10 or 15 days old.

Between feedings, boiled water or weak tea should be given in amounts varying from 2 to 15 cc., four times between 8 A.M. and 8 P.M.

14

Vitamins

We have observed that the ability of the mother to meet the requirements of her nursing infant, in both the quantity and quality of her breast milk, is largely dependent on the adequacy of her diet. This in turn is measured not only by the quantity of fats, proteins, carbohydrates and salts but also by its vitamin content.

Dunham and Bierman,[9] in their study on the diet of the lactating mother, state:

> There is good reason to believe that more effective efforts are being made to provide adequate diets for lactating cows than for lactating women.
>
> Studies of diets of city and village families in relation to size of income and number in family have shown that in each income class the larger the family the fewer are the protective foods that are purchased. Lactating women need these protective foods in larger amounts than nonlactating women. Human milk will obviously be deficient in certain elements unless special efforts are made to educate lactating women with regard to food purchases and to the use of protective foods (such as milk, tomatoes and citrus fruits, leafy green and yellow vegetables and eggs). If, for economic reasons, it is not possible for lactating women to secure these foods in sufficient quantity to protect their own health as well as that of the infant, ways must be found to supplement their diets. It is, of course, well known that even if the nursing mother's diet is adequate, the premature infant's food will need to be supplemented in certain respects, for example with vitamin D and iron, and probably with vitamins A, B_1 and C also.

Premature infants, whether they are breast or artificially fed, must be given liberal amounts of the so-called "protective foods" in order to aid their bodies to build satisfactory reserves of vitamin and minerals. Because of their prematurity, these infants have suffered great curtailment of these reserves.

VITAMIN A

Vitamin A is found in the liver oil of many salt-water fish. It is abundant in cod-liver oil and particularly so in the liver oil of the halibut and tuna; and many animal fats, such as butter, egg, liver and kidney also contain this vitamin. Substances belonging to the group of carotenoid pigments can act as precursors of vitamin A; the most important of these is beta-carotene, a yellow pigment found in carrots and in many green vegetables. Carotene is also a constituent of milk fat. Certain animal fats, such as lard, and vegetable oils in general are notoriously poor sources of the vitamin A factor.

The recommended allowance of vitamin A for pregnant and nursing women has been set at 5,000 units or more daily. This quota may be supplied mainly by liberal amounts of milk, butter, cheese, eggs, green leafy vegetables, and when indicated, by the addition of fish liver oils. If the mother's diet is adequately supplied with vitamin A, the premature infant fed at the breast will receive a large part of the required vitamin A. Most infants are born with a meager amount of vitamin A in the liver.

A good grade of cod-liver oil contains an average of 1,000 units per gram, or approximately 4,000 units per teaspoonful. Other sources are considered in the discussion of the percomorph group.

THE VITAMIN B COMPLEX

It is now agreed that what was once thought to be a single water soluble accessory factor is actually a group of factors,[10] closely associated in nature. These elements are widely distributed in vegetables, fruits and animal foods; they are found in eggs and in the whey of milk, and are particularly abundant in liver and yeast and in the germ of cereals, but are lost in the process of milling. As a result of this loss, deficiencies are likely to develop, if refined cereals constitute too large a part of the diet.

Of the ten or more factors demonstrated in animal experiments to compose the vitamin B complex, three, thiamin, riboflavin and nicotinic acid, are of proved value in man, and two others, pyridoxine and pantothenic acid, may be necessary for normal tissue respiration in the human.

Thiamin (B_1). Under normal conditions thiamin is found in all tissues of the body. Thiamin is necessary in the metabolism of carbohydrate and in the formation of fat from carbohydrate. Lack of thiamin leads to beriberi, neuritis and malnutrition. The following foods contain thiamin in varying concentrations: whole grains, milk, eggs, lean meat, liver, vegetables (cabbage, carrots, spinach, peas and beans), oranges, tomatoes and yeast. It was first synthesized as thiamin hydrochloride in 1936, and it is this product which is most commonly in use for therapeutic purposes. It is marketed in tablets and in solution.

Fifty I.U. of B_1 is accepted as a suitable optimum for a month-old, full-term infant. Cowgill[11] maintains that the average full-term, month-old infant, who is given its daily caloric feeding of human milk with the maximum amount of vitamin B_1 would receive approximately 80 I.U.

In the presence of anorexia, diarrheal conditions, increased elevation of metabolic rate seen in acute illness in the premature infant, the daily addition of 1 mg. (333 I.U.) or more of thiamin hydrochloride can be administered with beneficial effect. If there is doubt as to its complete absorption, the thiamin hydrochloride can be injected hypodermically.

The vitamin B complex concentrates now available for therapeutic use contain at least the important five factors. We have found that these can also be fed with profitable effect wherever it is thought that the infant is not receiving a sufficient amount of more than one of these factors in its food.

Recently there have been reports in the litearture of toxic effects that followed administration of excessive doses of vitamin-B complex.

Riboflavin (B_2 or G). Riboflavin is of importance in human nutrition, since it is apparently necessary for the metabolism of practically all living cells. Children deprived of this vitamin fail to grow and at times exhibit lesions of the skin and lips, fissuring at the corners of the mouth, inflammation of the tongue, conjunctivitis and vascularization of the cornea, later resulting in interstitial keratitis. Photophobia and lacrimation accompany the latter.

Riboflavin is usually found in abundant quantities in conjunction with thiamin. It can be extracted from natural sources or be prepared synthetically. In each 100 grams the following foods contain riboflavin in units:[12]

Liver	800-1,200	Carrots	30- 75
Yeast, dry	750-2,500	Oranges	15- 65
Egg yolk	150- 300	Tomatoes	12- 28
Wheat germ	150- 404	Spinach	100-175
Bananas	26- 50	Potatoes	15- 31

1.5 mg. = 500 Sherman units.

It has been estimated that 1.5 mg. (500 Sherman units) would meet the daily requirements for riboflavin of children up to ten years of age. For therapeutic purposes, it is available in the synthetic form in tablets and capsules. It can also be provided in the vitamin B complex preparations available when a dietetic deficiency is present. The optimal requirement of the premature infant is unknown, but it is probable that the usual intake of human or cow's milk by the premature infant supplies an adequate amount of this vitamin. If the vitamin-B complex is added to the diet to supply thiamin, there will be no question of the infant's receiving a sufficient quantity of riboflavin.

Nicotinic Acid. Nicotinic acid, in its natural distribution, is closely related to riboflavin and thiamin, and, as in the case of both the latter, deficiency is likely to occur when milled cereals constitute a major part of the diet. Nicotinic acid is found in large quantities in liver, yeast, lean meat, wheat germ, milk and eggs, and loses very little of its potency during the process of cooking. Consequently, pellagra, the disease caused by a deficiency of nicotinic acid, is seldom seen unless the diet is very seriously depleted. Although the exact daily requirement is unknown, it is estimated at 0.3 mg. per kilogram of body weight. Nicotinic acid and nicotinic acid amide are available in tablet form and in solution. The most practical form for administration is through the use of one of the vitamin B complex solutions. It is probably unnecessary to add nicotinic acid to the average premature infant's formula.

Excessive doses of nicotinic acid may cause flushing and itching of the skin.

Pyridoxine (B_6). Pyridoxine can be prepared synthetically or extracted from natural sources such as yeast, wheat germ, rice, bran and fish muscle and many other foods. This vitamin apparently is associated with the utilization of unsaturated fatty acids and also may aid in the production of the respiratory enzyme which is involved in muscle metabolism. Its principal clinical applications to date are as an adjuvant to treatment of patients with beriberi and pellagra who have had adequate amounts of thiamin, riboflavin and nicotinic acid but in whom nervous irritability, weakness and abdominal pain may persist. Such symptoms have responded to treatment with pyridoxine. It has also been used in the postencephalitic type of Parkinson's disease and pseudohypertrophic muscular dystrophy with benefit.

The prophylactic dose of the synthetic product for children has not been established, although 1 to 3 mg. have been suggested. With our present interpretation of the needs of the premature infant, we believe that the diets already recommended meet the infant's requirements in most instances without further supplementing them with the synthetic product.

Synthetic pyridoxine hydrochloride is supplied as 1 mg. tablets.

Pantothenic Acid. Our present knowledge of the function of pantothenic acid is still vague. However, it is probably associated with riboflavin in the prevention of certain skin lesions in man.

VITAMIN C

It may be assumed that the premature infant requires the same amount of vitamin C as is necessary for the mature infant.[13] Since the average breast and cow's milk do not provide a sufficient amount of vitamin C for the infant, orange juice or ascorbic acid must be added to the diet. This should be started in the second week of life.

Since 40 cc. of average, good orange juice would be required to meet the vitamin C needs of the infant, it is advisable to supply the early requisites of the premature infant through the use of ascorbic acid. The amount should vary from 25 mg., at first, to 50 mg., depending on the weight of the infant. A gradual substitution of orange juice should be made, so that by the time the infant weighs 2,500 grams, it will receive an average of 40 to 60 cc. of orange juice daily. One fluid ounce of orange juice is equivalent to 15 mg. of ascorbic acid. Tomatoes are also rich in vitamin C, and for older infants either the raw or canned juice may be used in double the amounts recommended for orange juice.

VITAMIN D

Rickets will result if there is an insufficient amount of vitamin D in the diet of an infant. The prematurely born infant tends to grow more rapidly than the infant born at term and should, therefore, in relation to its weight, have at least two to four times the amount of vitamin D usually recommended for the full-term infant. Vitamin D should be given to the premature infant by the end of the second week of life. In the full-term infant, for routine prophylaxis against rickets in its early months, 800 units * of vitamin D per day is considered a minimum dosage if fish oils or concentrated preparations in oil are fed, or 400 units, if given in the form of a vitamin D milk. The concentrated form of vitamin D is preferable for the premature infant, and it should be one that contains adequate amounts of vitamin A as well.

* International Unit (I.U.) of the League of Nations and U. S. Pharmacopœia Unit (U.S.P.) represent the same standard for assay of vitamins A and D.

Liver-Oil Products. According to U.S.P. standards, cod-liver oil must contain at least 85 units of vitamin D per gram. (One gram, or 1 cc., of the oils by measure is equal to 38 drops from the dropper furnished by the manufacturer.) Many of the good cod-liver oils on the market contain 100 or more units per gram (about 400 units per teaspoonful). The relatively low concentration of vitamin D in cod-liver oil makes it difficult to administer a sufficient amount to the premature infant, since some of these small infants experience an intolerance to large amounts of cod-liver oil.

The livers of species of fish other than the cod contain a higher concentration of vitamin D, and in addition many of them are also abundant in vitamin A. The fish highest in vitamin D are the *Percomorphi,* and the blue-finned tuna leads with the enormous concentration of 40,000 I.U. per gram. Manufacturers, combining oils from various species, market the final mixtures which have the same concentration as viosterol in oil, namely, 10,000 I.U. of vitamin D per gram (one drop contains 222 I.U.). Percomorph oil is standardized at about 60,000 units of vitamin A per gram, 100 times the concentration of standard cod-liver oil. Such products have the advantage of being easily administered in drops and are, therefore, practicable for use with the premature infant.

Irradiated Ergosterol. Several concentrated products are available, however, which contain 100 times as many vitamin D units as cod-liver oil. They are standardized at 10,000 units per gram (minimum requirements, 9,000 units) or, approximately, 222 units per drop. Among these are calciferol * (viosterol) in oil, produced by irradiating ergosterol with ultraviolet rays (the Steenbock method) or with cathode rays (Knudsen method). These do not contain vitamin A.

The dosage of these concentrated vitamins for the premature infant should begin with five drops (1,000 units) in the second week of life and should be steadily increased so that 20 or even 30 drops are given by the end of the eighth week. The increase is gauged by the rate of growth and the weight of the child. The concentrated preparations of vitamin D do not mix well with milk, therefore the infant should be fed from a dropper or spoon in order that it receive the full dosage.

Vitamin D Milk. Three kinds of vitamin D milk are produced; one is irradiated milk, activated either by ultraviolet or by cathode rays. This contains an average of 135 I.U. per quart. A second type is developed by feeding irradiated yeast to cows. The vitamin created is largely calciferol and contains 430 I.U. per quart. A third variety is a

* One International Unit of vitamin D equals 0.025 microgram of calciferol.

fortified milk, to which a concentrate of either activated cholesterol or calciferol has been added after milking, in an amount to give 400 units per quart. The amount of vitamin D contained in any of these varieties of milk is too small to protect the premature infant because of the minimal quantity of milk which these infants can consume. Nevertheless, vitamin D is believed to be especially active when dispersed in these various types of milk.

Ultraviolet Irradiation. Ultraviolet irradiation with a mercury-vapor arc is a good source of vitamin D. At the Sarah Morris Hospital the infants are exposed to ultraviolet rays twice each week. This treatment is given in addition to the fish-oil concentrates.

The quartz-lamp therapy is started when the baby is one week old, and an exposure of 10 seconds is given to the front of the infant and then to the back. The time is increased by 10 seconds to the front and 10 to the back at each exposure until the baby is receiving a 2½ minute exposure to the back and 2½ minutes to the front. The lamp is placed 30 inches from the baby. The baby's eyes must be protected with a towel during the treatment. In the Negro babies, it is often necessary to give a longer exposure because of the difference in pigmentation.

Overexposure may result in irritability, vomiting and increased body temperature. The exposure time varies with the amount of cod-liver oil or other antirachitic methods prescribed.

VITAMIN E

With our limited knowledge of the human requirement for vitamin E, our chief interest in it at present in relation to the premature infant lies in some information obtained in animal experimentation. In the female, vitamin E is concerned with the nutrition of the embryo, and probably involved in spermatogenesis in the male. It has been used with varying success in the prophylactic treatment of cases of habitual and threatened abortion in the human.

Vitamin E is found in abundance in wheat and rice germ oil, soy bean, palm and peanut oil.

VITAMIN K

Vitamin K therapy promises most encouraging results in the prevention and treatment of hemorrhage in the newborn. The low prothrombin content of the blood of the premature infant seems to be due to failure to receive sufficient vitamin K in utero. The administrations of the vitamin to the mother, even as late as an hour or two before delivery, increases the infant's prothrombin sufficiently to protect it from hemorrhage not caused by trauma. A similar response, possibly less striking, is obtained by giving vitamin K to the infant after birth. Some clinics have, as a prophylactic measure, established the custom of giving vitamin K subcutaneously to all premature infants shortly after birth. This procedure is not as yet routinely followed in our Station, but it is used on the first suspicion of hemorrhage from intracranial or other sources. (See "Hemorrhage," Chap. 18.)

Vitamin K is found in only a few plants, alfalfa, kale, spinach, carrot tops and tomatoes, but it is also present in some of the vegetable oils, particularly soy bean oil. Vitamin K is also synthesized by intestinal bacteria, and for this reason, after the intestinal flora has been set up in the premature infant, an adequate amount of the vitamin is present. For its absorption from the gastrointestinal tract, bile is necessary, and for its synthesis to prothrombin (a factor necessary for normal coagulation of blood), a normally functioning liver is necessary. For this reason, a hemorrhagic tendency is frequently associated with obstruction of the biliary ducts.

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General Therapeutic Measures

Dehydration develops more rapidly and with more serious significance in the premature infant than it does in the full-term child. In the small premature baby, feeding difficulties are present from birth, due largely to the small amount of both water and milk which can be given at each feeding. The proportionately larger skin surface, as compared to its weight, results in the loss of an increased percentage of moisture through the body surface of the premature infant, as compared with the larger infant. Acute illnesses, such as vomiting, diarrhea and all infections cause rapid depletion of the fluids, and often great loss in electrolytes (minerals). Infants received at the Premature Station of the Sarah Morris Hospital several days after birth are frequently in a state of severe dehydration and demand special care.

Requirements for fluids can, in most instances, be met by oral administration. In some conditions, it may be necessary to introduce saline solutions or blood subcutaneously or intravenously.

Oral Administration of Fluids—See "Feeding," Chapter 11.

HYPODERMOCLYSIS

Physiologic salt solution or Ringer's solution, both of which are isotonic with blood, are most frequently used in the subcutaneous administration of fluids. Glucose, in concentrations up to 5 per cent, may be added for temporary use. It must be noted, however, that in some infants glucose acts as a hypertonic solution and may cause edema of the subcutaneous tissues, following which absorption stops.

The needle (20 gauge) is best inserted into the subcutaneous tissues of the abdomen, lumbar regions or thighs. It is advisable to avoid the tissues of the chest so as not to interfere with respiration. The fluid may be administered by the drip method, or directly with a Luer syringe. When the drip method is used, as much as one-fiftieth of the body weight (50 cc. per kilogram, or 20 cc. per pound) can be given at one treatment. The rate of drip can be regulated by raising or lowering the reservoir, or by clamp. The reservoir and tubing should be kept warm by use of hot-water or thermos bottles. The needle should be held in place by adhesive tape. It may, however, be necessary to shift the needle occasionally.

The amount of solution administered by syringe will naturally be less, and will be repeated more frequently, if indicated.

At the Premature Station of the Sarah Morris Hospital, the procedure, as recommended on the instruction sheet for nurses, is as follows:

PROCEDURE FOR ADMINISTRATION OF SUBCUTANEOUS FLUIDS

Requirements.

Package with:
- 20 cc. Luer syringe and 2 medicine glasses.
- 2 sterile towels.
- 4 20-gauge needles with stylet.
- Cotton.
- Alcohol, 60 per cent.

Warmed solution of either
- Normal saline (0.9 per cent), or
- Ringer's solution, or
- 5 per cent glucose in normal saline.

Procedure.

1. Place equipment on table. Open package. Arrange materials conveniently with forceps. Pour solution in medicine glasses.
2. Without removing baby from bassinet, place sterile towel under buttocks and prepare inner aspect of thighs, abdomen or lumbar region with 60 per cent alcohol.
3. After the physician has administered the fluid, or started it by the drip method, cover area on thighs with sterile gauze and diaper baby.
4. Watch absorption of fluid.
   The child is to be subjected to a minimum of exposure during the procedure.
5. Sterilize and set up the package with sterile Luer syringe, medicine glasses and other details.

INTRAMUSCULAR ADMINISTRATION OF BLOOD

In the presence of intracranial hemorrhage, melena, inanition and various infections, the intramuscular administration of human blood at regular intervals of from 12 to 24 hours, offers one of the most valuable therapeutic measures. The amount will vary from 4 cc. in small infants to 20 cc. in larger ones. Since shock may occur if too large quantities of blood are injected at one site, it is advisable, at times, to use two locations and divide the dose. The thigh, lumbar regions and buttock muscles are the sites of choice for intramuscular injections.

Vitamin K therapy has largely replaced the intramuscular injection of blood as therapy in the presence of hemorrhage. There still remains a field, however, for the use of blood when hemorrhage occurs in an infant with a normal prothrombin time. (See "Hemorrhage," Chap. 18.)

The instruction sheet used for nurses at the Sarah Morris Hospital is as follows:

PROCEDURE FOR INTRAMUSCULAR INJECTION OF BLOOD

Aim.

To inject blood intramuscularly with least possible exposure.

Requirements.

Package with:

10 cc. Luer syringe. Gauze.
2 Wassermann test needles. Cotton.
Sterile towel.

Tourniquet.
Stool.
Visitor's gown, mask and cap.
60 per cent alcohol.
Wassermann test tube (if serology test is to be obtained).

Procedure.

1. Place stool so that donor may rest arm on table.
2. Have equipment within reach.
3. Donor should wear gown, mask and cap if he is to enter nursery.
4. Scrub hands.
5. Cleanse arm of donor and apply tourniquet.
6. Arrange sterile towel under baby's buttocks and prepare buttocks

or other site to be used. (If baby had blood previously, use a site different from the one last injected.)

7. The injection can usually be given without removing the baby from its bed.
8. As soon as the injection has been given to baby, apply slight pressure. When bleeding stops, apply clean sterile cotton and diaper baby.
9. If Wassermann test on parent has not been obtained previously, do so at this time. Mark tube of blood and set in icebox, placing the corresponding slip on desk spindle.
10. Watch baby's thighs, or other location used, for absorption.

INTRAPERITONEAL ADMINISTRATION OF FLUIDS

Intraperitoneal administration of fluids has been discarded in our Station because of the danger of intestinal perforation and of interference with cardiac and respiratory functions. If it is used, only physiologic saline, Ringer's solution or blood should be administered. Glucose solutions, we have found, cause edema of the peritoneum with eventual cessation of absorption.

INTRAVENOUS INFUSIONS (VENOCLYSIS)

Much skill is required in entering the small veins of the premature infant without resorting to surgical procedure. The veins of choice for the administration of fluids are those of the ankle, elbow and scalp. Any of these, or the longitudinal sinus or neck veins, may be used to obtain blood for serologic examinations.

A small needle with a sharp, short bevel should be used. The rate of flow should not exceed 4 cc. per minute. The possibility of tearing or cutting the fragile veins must be borne in mind. Therefore, only nonirritating fluids or blood should be used.

PROCEDURE FOR CONTINUOUS INTRAVENOUS DRIP OF SALINE SOLUTION AND DEXTROSE

Indications.

Dehydration.	Acidosis.
Toxicosis.	Sepsis.

Solutions.

Physiologic sodium chloride or Ringer's solution, plus dextrose, 2 to 5 per cent.

Amount.
For small infants—20-50 cc. per kilogram of body weight.

Site.
Elbow, ankle veins, or scalp veins.

Rate of Flow for Infants.
2-4 cc. per minute for the first 30 cc., later 1 or 2 cc. per minute.

Duration.
May be repeated once or twice in 24 hours.

Keep Solution Warm.
Hot-water bags at cylinder and tubing—12 inches from cannula. Special reservoirs fitted with warm water jackets are sold.

TRANSFUSION

Transfusion of human blood offers one of the outstanding forms of therapy, if judiciously applied. However, excessive amounts and too rapid administration may result in sudden death.

The Spivek [14] "cut-down" method of isolating and entering the vein, described in Fig. 48 for entering the long saphenous vein, is equally applicable to the elbow veins and, in some instances, to veins of the scalp. Human serum and various saline solutions may be given in the same way.

The drip method is used to administer citrated whole blood (0.2 per cent sodium citrate) or human serum. The serum has the advantage because it does not require typing and is especially useful when the condition does not indicate a need for blood cells. When indicated, the blood or serum may be followed by a saline solution, or saline solution with 2 to 5 per cent glucose added.

A too rapid flow of these injections, or the administration of too great amounts at one time, must be avoided. It is safer to leave the needle in situ to be used again. The needle should be tested with saline for patency, before it is used a second or third time, and should be removed within 24 hours. If blood or a saline solution is given rapidly by syringe, the amount injected at one time should not exceed one-fiftieth of the body weight. The solutions should not be allowed to become cold. However, if too much heat is applied to the reservoir or tubing, the blood or serum may coagulate.

Transfusions of blood or serum supply the infant with plasma proteins, electrolytes, immune bodies and fluid. The chief indications for transfusion are dehydration, hemorrhage, intoxication and sepsis.

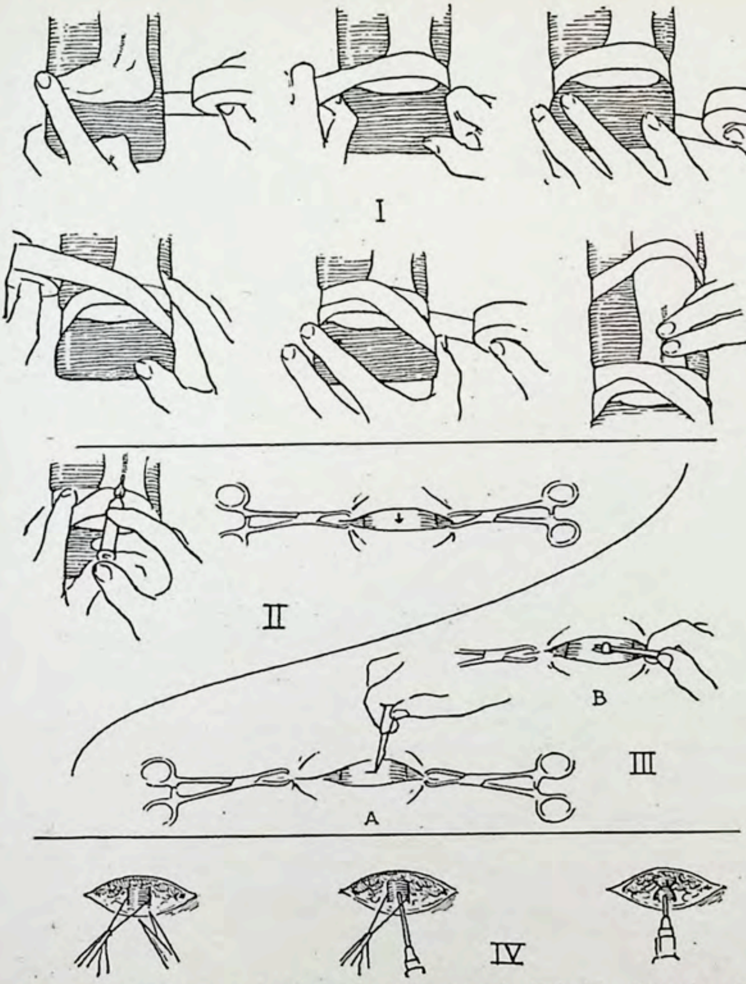

Fig. 48. Cut-down method to isolate and enter vein (Spivak). Operation: I. Binding the foot to the splint with adhesive tape. The tape starts on the posterior surface of the splint on the heel side, goes over the foot and the toes to the other side, then back to the point of origin, then over the instep and around the splint again. The last picture shows the upper adhesive band and the method of palpating the saphena magna. II. Injecting novocain directly over the vein site and draping with towels. III. The method of making the small incision and scooping up the vein. IV. Exposure of the vein, silk thread ligature passed under it. Incision of upper wall of vein made with fine scissors. Blunt bevel needle passed into vein, which is later to be held in place by tying ligature.

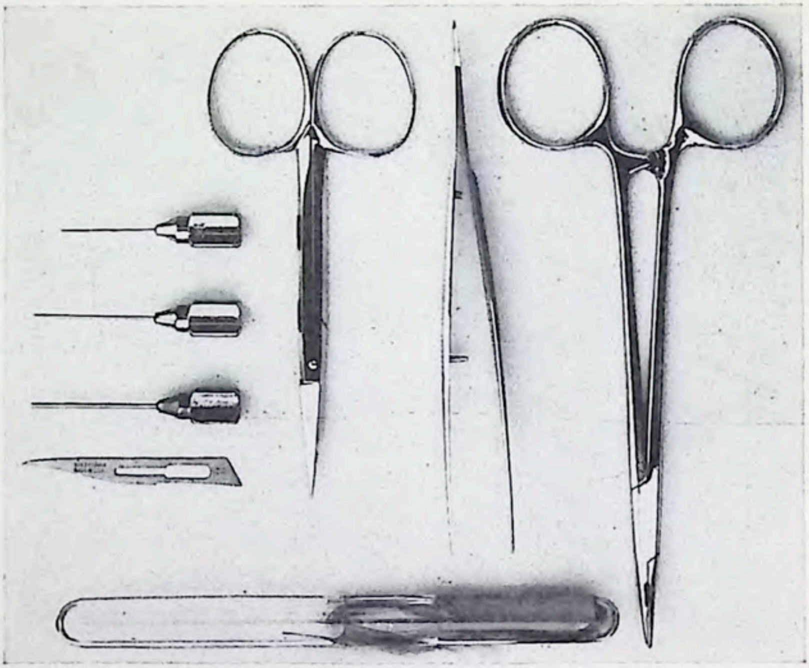

Fig. 49. Instruments used in cut-down method to isolate and enter vein: small artery clamp; conjunctiva tissue forceps; small straight tissue scissors; sharp pointed knife blade; blunt beveled needles, 3 sizes; silk thread.

HYDROTHERAPY

Warm, plain water baths or mustard baths are beneficial in shock therapy. There are few conditions in which cool baths are indicated in the care of the premature infant.

Warm Bath. The bath should not be warmer than 105° F. and should be kept above 100° F. The infant should be rubbed gently while in the tub. A thermometer should be kept in the water so that the temperature will be known throughout the procedure. In adding warm water from time to time, it is to be borne in mind that the premature infant is easily burned, and that the danger of infection in such wounds is great.

Mustard Bath. Mustard baths are helpful in producing counter-irritation and hyperemia in asphyxia, atelectasis, bronchitis, pneumonia, cardiac failure and abdominal distention. One level tablespoonful of mustard to a gallon of water is of sufficient strength for use with the premature infant. The mustard should be placed in a small gauze bag and squeezed into the water, so that it will be equally distributed. The water should not be warmer than 105° F. at any time. Mild friction only should be used while the infant is in the bath. It may be necessary to continue the bath for as long as three to six minutes. Following this bath, the infant should be washed quickly with fresh, warm water and wrapped in a warm blanket.

Cool Bath. The temperature of the water for a cool bath should be 100° F. when the baby is first put into the bath, and then may be lowered gradually to 95° F. Gentle friction should be employed while the child is in the bath. The bathing period should not last more than three to five minutes.

(For detailed instructions to nurses on bathing procedures, see Chap. 7.)

INHALATIONS

Plain or medicated steam is rarely used in the care of the premature infant. If the humidity of the air in the room is too low, it may be increased by turning on the hot-water faucet, by hanging wet sheets on a ward screen, or by the use of a humidifier. Most of the conditions in which inhalations are indicated in the older infants will be better met by oxygen administration to the premature baby.

OXYGEN ADMINISTRATION

Oxygen therapy is one of the most valuable aids in our care of the premature infant. In the Premature Station at the Sarah Morris Hospital, all infants weighing less than 1,500 grams are placed in the oxygen chamber for periods varying from one day to as long as several weeks. All infants showing respiratory or cardiac embarrassment or persistent abdominal distention are also placed in the oxygen chamber. (See "Oxygen Therapy," Chap. 16.)

GAVAGE

See "Feeding," Chap. 11.

GASTRIC LAVAGE

Ordinarily, in the care of the premature infant, the catheter is passed for the relief of gastric distention due to air or gas. It is seldom necessary to wash out the stomach. For ordinary lavage, warm water alone is used, although occasionally there may be an indication for adding one to five drops of aromatic spirits of ammonia or a few drops of whiskey. A soft rubber catheter, such as is recommended for gavage, should be used. In order that the location of the tip of the catheter will be known to the nurse, the measurements of the distance necessary to reach the greater curvature of the stomach should be marked on the catheter in accordance with the instructions given in "Gavage Feeding."

Little danger should be encountered in passing the catheter, since it will either enter the esophagus or turn on itself and return through the mouth. The great danger is in withdrawing the catheter, when food may be spilled in the pharynx. During this procedure, the infant usually gasps, and as a result, the child may aspirate the food into its lungs. It is therefore necessary that the catheter be tightly pinched or bent to avoid such an accident. Should the infant show evidence of vomiting, the head should be lowered and feeding stopped temporarily.

INTESTINAL IRRIGATION

Enemas of saline solutions, weak soap solutions or solutions of water containing one teaspoonful of glycerin and 15 drops of oil of peppermint to two ounces of solution are most frequently used to relieve distention of the colon by gas or feces. For the average four-pound infant, two ounces may be considered as a maximum for one enema, and smaller infants should receive lesser amounts. It may be necessary to repeat the enema at stated intervals, but in order to avoid exhaustion, the enemas should not be administered too closely.

A soft rubber catheter attached to a small funnel or glass barrel of a syringe is used. Usually, the length of an ordinary catheter will allow sufficient elevation of the funnel. The temperature of the solution should be between 95° and 100° F., except in the presence of a high fever in the infant. In such a case, when an antipyretic effect is desirable, a solution with a temperature as low as 90° F. may be used.

Irrigation of the lower bowel usually results in increased peristalsis in the lower ileum, if it is also involved in the distention.

SPINAL PUNCTURE

When the spinal puncture is successfully performed without injury to the venous plexus surrounding the canal, the spinal fluid obtained is of distinct diagnostic significance. Therapeutically, however, its value is limited since the maximum amount of fluid to be obtained from the small premature infant is usually not more than 1 or 2 cc., while the meningeal hemorrhage may be much in excess of that amount.

The soft structures of the skull, the small skull bones and the wide sutures permit considerable expansion. Therefore, if the brain substance itself is not injured by hemorrhage, there may be little impairment of vital function. (See *Technic of Spinal Puncture* under "Hemorrhage," Chap. 18.) After a study of the spinal fluid of 170 premature infants, Glaser [15] concludes that acute meningeal congestion may result in finding a hazy cerebrospinal fluid containing red cells, without there having been rupture of the vessels of the meninges. He also found that 55 per cent of the infants examined had a positive, indirect van den Bergh reaction. This may be considered as a physiologic phenomenon. A positive, direct van den Bergh reaction is at least suggestive of meningeal hemorrhage. The index of the cerebrospinal fluid is usually highest during the second week of life or later, and there is almost always a direct relationship between the icterus index of the blood serum and that of the cerebrospinal fluid. It is probably due, in part at least, to the immaturity of the anatomic and physiologic blood-cerebrospinal fluid barrier.

Cyanosis may be paroxysmal or intermittent in infants with subtentorial meningeal hemorrhage, depending on the presence or absence of intermittent pressure by a blood clot on the medulla oblongata.

In the Premature Station of the Sarah Morris Hospital, the number of spinal punctures performed on the premature infants has decreased from year to year, due to the fact that they are chiefly of diagnostic importance only, and, as has been said, of limited value as therapeutic procedures. In case of serious doubt as to the presence of damaging cerebral injury, spinal puncture is justified; it must be performed, however, with a minimum amount of trauma to the infant. It may also be of diagnostic importance in the differentiation of cerebral injury, atelectasis, and congenital cardiac and systemic infections.

IMMUNIZATION OF INFANTS

All the infants who visit the special out-patient clinic for premature infants at the Sarah Morris Hospital are given protective inoculations against pertussis, diphtheria and smallpox, and are also given Schick and tuberculin tests.

The inoculations against pertussis are started at the age of six months. A total of 8 cc. single strength is given at two- or three-week intervals, according to the following schedule:

1st week	1 cc., left biceps area
2d week	2 cc., right triceps area
3d week	2 cc., left triceps area
4th week	3 cc., 1.5 cc. over each deltoid area

Diphtheria immunization is started at 10 months. Three injections of plain toxoid, 1 cc. at each injection, are used at intervals of three to four weeks. Coincident with the diphtheria injections tetanus toxoid is administered.

Schick and tuberculin tests are made between the ages of 14 and 18 months. These are read three days after inoculation, and on the day of return, the infants are vaccinated against smallpox.

Between the ages of 18 months and 2 years, all children are returned for revaccination against pertussis. They are given one injection of 2 cc. of the single strength vaccine.

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Oxygen Therapy

Oxygen is as necessary to many premature infants as external heat or breast milk. The administration of oxygen is indicated:

1. If the infant weighs under 1,500 grams. At the Premature Station of the Sarah Morris Hospital, oxygen is given routinely to such small infants. Most premature infants, and especially the smaller ones, have atelectatic areas in the lungs, and therefore will make better progress if oxygen is given.

2. If asphyxia or narcosis is present in the infant due to the administration of morphine, scopolamine or barbiturates to the mother during labor.

3. Whenever cyanosis is present.

4. If exhaustion or intracranial hemorrhage is present in the infant. A long, hard labor or a difficult delivery can be expected to cause either or both.

5. When prematurity is caused by abruptio placentae, placenta praevia or pneumonia, or if the mother has toxemia.

Even larger premature infants will make better progress if oxygen is given for from one to two hours after birth. In the presence of deeper cyanosis, it may be necessary to keep the infant in the oxygen chamber for three to ten days, or longer.

Discontinuance of oxygen therapy is determined by the infant's condition during the bathing period. If its color remains good and its cry is spontaneous, it may be taken out of the oxygen chamber or oxygen therapy may be discontinued with safety for trial periods. Oxygen therapy is usually continued 6 to 24 hours after the condition is satisfactory.

METHODS OF ADMINISTRATION

Some type of a chamber or hood should be used to obtain the best possible results. Administration of oxygen by nasal catheter or mask is not as satisfactory as by means of a chamber. If a mask is used, the nurse should either hold it in position, or place it in such a manner that the oxygen will not be wasted.

To administer oxygen through the nose, a No. 10 rubber French catheter is inserted into one nostril. The eye of the catheter should be cut off to prevent the flow of oxygen from being blocked by the nasal membranes, which can close the opening on the lateral wall. The flow of oxygen must be regulated before the catheter is inserted. Bubbles, 120 to 150 per minute, are allowed to flow through a bottle of water. The catheter must be inserted most cautiously to prevent trauma, and should be held in place with adhesive tape.

When the Hess bed is used, the bed itself becomes a closed chamber, if the oxygen lid is in place. The air-oxygen flow meter on the lid controls the percentage, and an oxygen-air mixture of from 40 to 80 per cent, as may be indicated,* may be obtained. Usually, the premature infant receives 40 per cent oxygen. A higher per cent of oxygen is used for short periods only if the infant is extremely cyanotic. When, in case of emergency, it is desirable rapidly to raise the percentage of oxygen in the bed, the flow meter can be closed temporarily, thus excluding outside air. An improvised oxygen chamber can be made by draping the bed with rubberized sheeting. A window is cut at the head end of the sheeting and covered with the celluloid of an x-ray film.

When oxygen is used for the premature infant, it should be administered continuously, not intermittently.

While the infant is in the oxygen bed, it should be carefully observed at regular intervals so that any change in its condition will not be neglected. The bed should also be inspected at regular periods to make certain that the heat-regulating mechanism of the bed is in order to prevent overheating the infant. An excessive bed temperature causes dehydration of the infant and is a frequent cause of a high body temperature. In fact, in the presence of a temperature above normal in the infant, overheating within the bed should at all times be suspected as a possible cause. Furthermore, overheating may also cause the infant to perspire, and it may thus lead to pustule formation and impetigo.

If, on admission, the infant's temperature is below 97° F., external heat must in all instances be continued until the infant's rectal temperature registers 97° F. or higher. The infant's general condition will furnish the best indication for further continuation of external heat or the degree to be maintained in the surrounding temperature.

* Instructions for regulating various percentages of oxygen are on a plate fixed on the lid.

Since the use of an electric bulb in the oxygen bed is dangerous, a flashlight held outside the bed is employed, if more light is required for close observation of the infant.

Clothing of Infant in Oxygen Bed. The infant does not wear a woolen shirt while in the oxygen bed, unless it weighs less than three pounds. A wrapping diaper is usually used for the feet. If the baby's temperature is 99° F. or over, the top blanket is rolled down to the foot of the bed, and only the small blanket is left on the baby.

PROCEDURE TO CHANGE DIAPERS OF BABIES IN HESS OXYGEN BEDS

Procedure.

1. Check amount of oxygen in tank.
2. Open top door of bed and check towel under baby's head for vomitus.
3. Close top door, open lower door, and move baby down in bed to facilitate work.
4. Diaper baby.
5. Move baby back to correct position when finished.
6. See that outlet of oxygen tube is not obstructed.

Do not place soiled diaper on top of oxygen lid.

17

Asphyxia and Cyanosis

The possibility of asphyxiation of the premature infant must be borne in mind throughout the entire period of labor. The heart tones should be carefully watched. In case of prolapse of the cord, if it cannot be replaced, it may be necessary to induce a rapid delivery of the infant. Toxemias of pregnancy, eclampsia and narcosis, following the administration of morphine, scopolamine and barbiturates may have a depressing effect on the infant and may result in retarded respiratory response.

CAUSES

The causes of asphyxia and cyanosis may be classified as congenital, acquired and general.

Congenital disorders which predispose to cyanosis are: cerebral agenesis, tracheo-esophageal fistula, enlarged thymus, atelectasis (congenital), ailments of the heart, diaphragmatic hernia and general debility (prematurity).

The acquired causes of cyanosis are manifold: cerebral edema, cerebral hemorrhage, depression of the respiratory center incurred by drugs and anesthetics, obstructed air passages due to amniotic fluid, mucus and blood, atelectasis (secondary), pulmonary edema and pneumonia, abdominal distention and sepsis.

General causes of cyanosis may be hypothermia, due to immaturity or exposure and chilling of the infant, or hyperthermia, due to overheating or infection such as sepsis and pneumonia; errors in feeding technic, such as too early or too rapid feeding and feedings in excess of the capacity of the stomach, which may provoke aspiration of food.

PROPHYLAXIS

Delay premature delivery whenever justifiable.

Avoid opiates, scopolamine and barbiturates at the time approaching delivery.

Minimize the use of general anesthesia.
Handle gently at all times.
Prevent chilling and overheating.
Clear air passages before resuscitation.

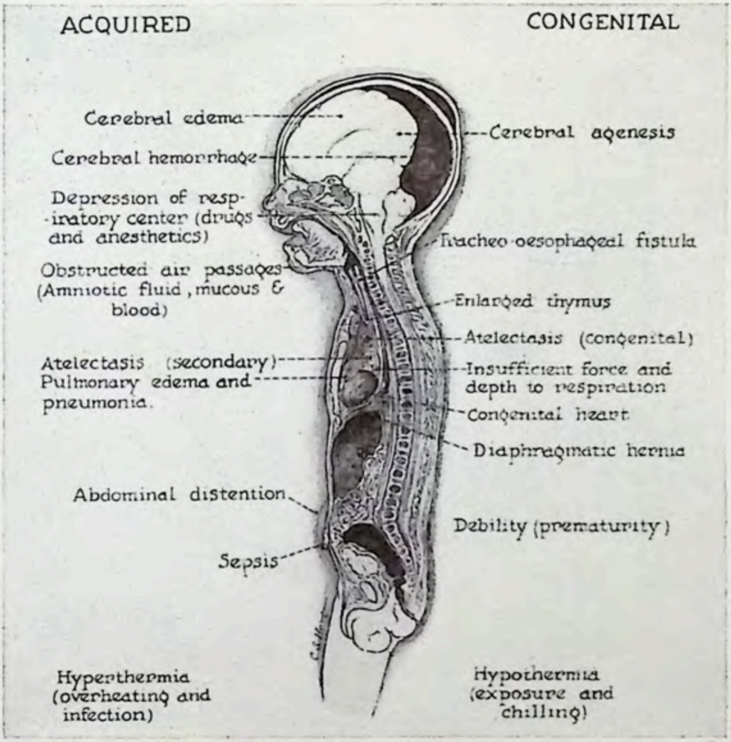

Fig. 50. Causes of cyanosis.

Administer oxygen.
Delay bathing and feeding until cardiac and respiratory functions are well established.

TREATMENT

In order to institute intelligent therapeutic measures, every effort should be made to ascertain the underlying causes, without undue handling of the infant. The infant should be examined for cardiac and pulmonary anomalies, and the possibility of intracranial hemorrhage should be considered.

If the procedures recommended in the chapter "Immediate Care" fail to result in regular respirations, the chest may be gently compressed and relaxed, with the thumb of the right hand on one lateral wall and the four fingers of the same hand on the opposite side of the chest. This manipulation should be repeated, without undue trauma, from 16 to 20 times a minute. To insure success in severe cases it

FIG. 51. Artificial respiration.

should be continued for at least one minute. At the same time, a nurse or assistant should wipe the excess of mucus from the nose and throat. If possible, the procedure should be managed without removing the baby from the heated bed. In extreme cases, the process must be repeated. Careless handling and traumatizing of the infant or too rapid performance of artificial respiration does more harm than good and must, therefore, be avoided. There must be definite indications for any manipulation. If the infant appears to be recovering spontaneously, it should not be disturbed.

A number of respirators are now being marketed, none of which, however, is suitable for the resuscitation of small premature infants.

Adrenalin in doses of one minim (1 to 1,000) may be administered subcutaneously at regular intervals of one hour or less frequently.

This drug is a powerful stimulant and overdosage must be avoided in small infants.

Aromatic spirits of ammonia (5 to 6 drops on cotton) should be used as an inhalant. (Caution—Do not let cotton moistened with aromatics touch the baby's face. It might cause a slight irritation.)

SUMMARY OF NURSING CARE

The nurse caring for the premature infant must be qualified to administer emergency treatment for cyanosis. She must also be able to detect the slightest change of color in the infant, pallor as well as cyanosis.

The infant who is cyanotic must be handled with utmost care and gentleness.

The back of the throat should be regularly inspected for mucus and fluid. If these are present, gentle suction is used, or the throat may be swabbed with a long cotton applicator covered with gauze.

Oxygen should be administered.

Aromatic spirits of ammonia may be used as an inhalant.

If the baby should become cyanotic while being fed, feeding must be stopped immediately. Food is then withheld from 15 minutes to 24 hours, depending on the condition of the infant.

Abdominal distention should always be relieved.

18

Hemorrhage in the Newborn Premature

Although hemorrhage in full-term infants must at all times receive serious consideration, many of these children with moderate bleeding of the mucous membranes and cord would undoubtedly recover spontaneously. In the case of the premature infant, however, the consequences may be far more grave.

In the care of the premature infant, it must be remembered that several factors may be responsible for hemorrhage. Of prime importance are the immaturity of the vascular system resulting in capillary permeability, the quality and quantity of blood platelets, and the presence of hypoprothrombinemia. The success of treatment depends on the accuracy of the diagnosis as indicated both by the clinical data and by the laboratory observations.

PROTHROMBIN CLOTTING TIME AND VITAMIN-K DEFICIENCY

The prothrombin clotting time of the blood is of great importance in its relationship to hemorrhage. Poncher and Kato [16] found that the average prothrombin time of the first day of life, as determined by the micromethod described by Kato, is 46.5 seconds for the premature infant and 43.2 seconds for the normal, mature newborn. By the sixth to the tenth day of life, the majority of infants showed an average normal prothrombin time of 25 seconds.

Prolongation of prothrombin time, due to hypoprothrombinemia, is manifested in what have been termed clinical and subclinical types. The infants who display both prolongation of blood prothrombin time and actual manifestations of hemorrhage are classed as clinical types, while those who disclose only the prolongation of prothrombin time, constitute the subclinical group. Poncher and Kato declare that when the prothrombin time, by the micromethod, is prolonged beyond two minutes, a presumptive diagnosis of subclinical hypoprothrombinemia must be made. Both forms of hypoprothrombinemia are due to a deficiency of vitamin K and differ only in the degree of such deficiency. Hence, the specific therapy required is identical in the two groups. It is, however, to be remembered that a prolonged prothrombin time does not of necessity indicate that a hemorrhagic tendency is present.

The Quick method of estimating prothrombin time (requiring at least 1 cc. of blood) and the Kato micro test both require a fresh thromboplastin solution. These are therefore not practical if a good laboratory is not available. Under such circumstances, the capillary tube method for estimating the blood coagulation time will give a fairly definite idea as to whether or not coagulation is delayed. A coagulation time of over five minutes by the capillary tube test may be considered as an indication for vitamin K therapy.

INTRACRANIAL HEMORRHAGE

Intracranial hemorrhage is the most frequent pathologic condition noted at autopsy of premature infants. In 168 autopsies among the first 386 infants who died in our Station, it was observed that intracranial hemorrhages, if massive, or if resulting in destructive injury to the brain itself, were usually followed by early death. Mention has already been made of the frequent presence of blood dyscrasias in these babies, and the incomplete development of their vascular system and more especially of the intracranial vessels. Other factors in prematurity help to explain why many of these infants have intracranial hemorrhage. Often they are born to mothers suffering from toxemia of pregnancy, eclampsia, nephritis or cardiac disease. Many of the labors are precipitate, or the infants are delivered by cesarean section, in which they are subjected to rapid changes of atmospheric pressure.

However, intracranial hemorrhage is not infrequent even without a history of pathologic changes in the mother or birth trauma. In the group of cases observed by Kato and Poncher, asphyxia due to compression of the skull and too rapid release of this pressure may have been the causative factor. Compression of the cord is another, although more remote, cause.

The outstanding symptoms of intracranial hemorrhage are varied.

1. Cyanosis may be intermittent or constant, but constitutes one of the most important symptoms, since it is almost invariably present in infants with intracranial hemorrhage.

2. Dark-red color between cyanotic attacks is often seen. Frequently premature infants have this dark-red color for 12 to 18 hours before

the cyanotic attacks occur. If there is severe atelectasis, the skin may be pallid or appear mottled.

3. Frequent periods of apnea occur.

4. The fontanelle is almost always flush. Noticeable bulging of the fontanelle is rare.

5. At least early, the infant is flaccid.

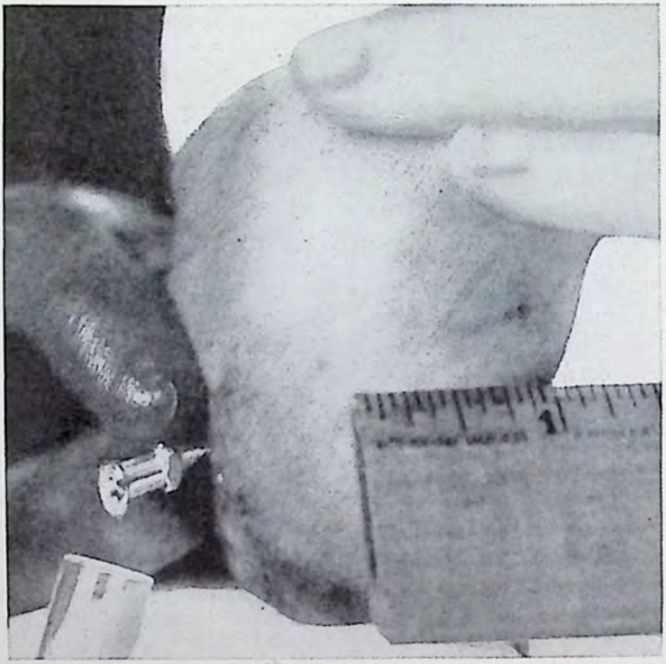

FIG. 52. Spinal puncture; infant supported in sitting position (Glaser).

6. The infant takes its feedings poorly and often vomits.

7. The temperature curve is almost always normal or subnormal, unless the hemorrhage involves the heat-regulating center, in which case hyperthermia may be extreme.

8. A few infants develop nystagmus.

9. Generalized convulsions or twitchings are extremely rare in premature infants suffering from intracranial hemorrhage.

On physical examination, the deep reflexes are often found increased over the normal. Early spasticity is rare. Spinal puncture should be avoided, since the small amount of fluid which can be removed has little therapeutic effect in the presence of any considerable hemorrhage. A spinal puncture is sometimes performed in order to differentiate between atelectasis, congenital cardiac conditions and intracranial hemorrhage. If the spinal tap is performed without injury to the spinal structures, and if the spinal canal is not blocked, bloody spinal fluid which does not coagulate may be obtained. At a later date, the spinal puncture may reveal xanthochromic fluid. The latter is also frequently seen in infants who develop a deep jaundice. The resulting pathologic changes vary directly with the location and extent of the injury.

Technic for Spinal Puncture. The technic for lumbar puncture in premature infants described by Glaser [15] continues satisfactory.

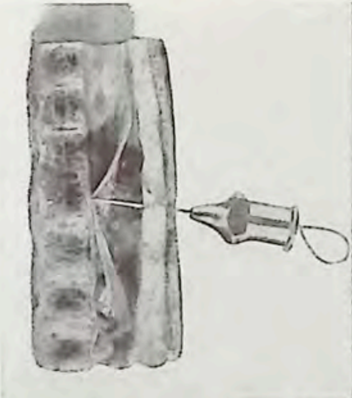

FIG. 53. Spinal puncture; mechanism of faulty tap (Glaser).

> This consists in using a small hypodermic needle (No. 25) with a shortened dull point for performing the puncture and having the infant held in a sitting position so that the lumbar portion of the dural sac is distended by pressure from above of the column of fluid within it. This helps to avoid the most common cause of faulty lumbar punctures in premature infants, the detachment of the posterior wall of the spinal dura mater by the entering needle and the pushing forward of this posterior wall against the anterior wall, resulting in a dry tap, or a bloody tap, if both dural walls are pierced and the posterior vertebral venous plexus is injured. This is doubtless responsible for many faulty taps.

If the brain structures are uninjured, the soft structures of the skull, the small skull bones and the sutures may allow sufficient expansion of the skull without immediate serious results. Furthermore, the tendency of the hemorrhage to be absorbed without organization of the clot may avoid serious physical injury. A less fortunate outcome is seen in those cases in which the hemorrhage is great, causing pressure on vital structures within the cranium. This may result in paresis or paralysis of the face and extremities and may further interfere with circulatory and respiratory centers. Such massive hemorrhages, and more especially those in which the brain structures themselves are injured, frequently result in mental defects. Probably the most fortunate outcome in such extensive injuries is the death of the infant.

TREATMENT OF HEMORRHAGE

Immediate treatment in cases of suspected hemorrhage:

1. Avoid trauma of any kind.
2. Place the infant in a warm bed, the head and upper part of the body moderately elevated.
3. Artificial respiration may be more injurious than helpful.
4. Oxygen should be administered to all such infants, preferably in a closed chamber. A 40 per cent mixture is recommended. (Ordinary air contains 20 per cent.)
5. In the event of serious loss of weight or indication of pronounced dehydration, subcutaneous injections of fluid at regular intervals may be indicated.

The intramuscular injection of whole blood at regular intervals of once or twice daily has been a common practice. Although it is difficult to evaluate the benefit of this procedure, it can certainly be carried out without ill effect. It is likely that the blood injected intramuscularly (in amounts of 4 to 12 cc., depending on the size of the infant) may be of further value from the standpoint of furnishing nutrition and antibodies.

Intravenous transfusion with whole blood or human serum may be indicated in cases in which there has been considerable loss of blood and in which the infants are not responding to vitamin-K therapy. (See "Transfusion," Chap. 15.)

Many of these infants swallow with difficulty and rarely can nurse either the bottle or breast. It, therefore, becomes necessary to feed them with a medicine dropper or by gavage. The food must be carefully selected, and the use of breast milk is strongly urged. The feedings must be small and increased very gradually.

Vitamin-K Therapy. In the type of case in which a deficiency of vitamin K can be demonstrated, the treatment with this vitamin represents an outstanding achievement in hemorrhage in the premature and newborn infant.

Twenty-two of our newborn premature patients with hemorrhagic disease were given vitamin-K therapy by Poncher and Kato.[17] The frequency of clinical forms of bleeding in this series was:

Hematemesis	16 cases
Melena	8 cases
From the cord	8 cases

Cutaneous	3 cases
Cerebral symptoms	3 cases
Hematuria	3 cases

In the majority of instances, two or three of these symptoms occurred in the same case.

Vitamin K was administered in doses varying from 1 to 10 mg., and the effect of the therapy was demonstrated by the cessation of hemorrhage as well as the shortening of the prothrombin time within two to six hours after medication. The average prothrombin time for all cases during the 24 hours following treatment was reduced to 26 seconds, whereas before treatment the prothrombin time had been prolonged beyond five minutes in 12 cases.

Medicinal products available are of two types. One is an extract of alfalfa in oil and contains the natural fat-soluble vitamin. The other is represented by a group of synthetic products whose base is naphthoquinone. As far as is known at present, vitamin K from natural sources has no definite advantage over the synthetic products.

Synthetic water-soluble products are suitable for hypodermic injection. Parenteral therapy is more desirable than oral therapy in the treatment of infants, especially those who are vomiting, have pathologic conditions of the liver or are suffering from severe hemorrhage which makes rapid control desirable.

One mg. of the synthetic vitamin given at birth will usually hold the prothrombin at almost normal levels throughout the newborn period. It is our custom to give 1 mg. of a synthetic product intramuscularly, and if there is no apparent lessening of the bleeding within four hours, the dose is repeated. It can be repeated if hemorrhage continues.

19

The Skin and the Eyes

CARE OF THE SKIN

Few hospitals are in entire accord on the methods to be used in the care of the skin of the newborn infant. They do agree, however, that excessive irritation of the skin, whether it be from bathing, application of oil or the neglect of the removal of excessive vernix, leads to the development of intertrigo, papules, benign pustules or even impetigo. The delicate skin of the infant must be protected against excessive irritation regardless of the method of care adopted. After making an exhaustive study of newborn infants, Sanford[18] concludes that notwithstanding the measures used, approximately 10 per cent of all babies showed some type of skin irritation.

Discussion of Methods of Care of the Skin

The principal methods of care of the skin employed by hospitals are "no bathing," oil baths, and soap and water baths.

Bathing. "No BATHING" is a procedure which was first suggested in 1931 and popularized largely by the study made by Sanford. Only the excess blood is gently wiped off after birth; the vernix caseosa is not removed. After 7 or more days, daily baths for the baby are usually begun. It is advisable, however, in order to prevent excoriation, to remove the vernix from the neck, axillae and groin of the premature infant. Each time the diapers are changed, the buttocks are cleansed with sterile water or sterile oil.

OIL BATHS. Oil, when used, should always be autoclaved and must be warmed before it is applied. Excess oil should be wiped off, since it may chill the surface of the skin when it cools. Mineral oil or a good grade of olive oil is best.

The continuous use of oil over a long time may cause a seborrhea of the skin, especially if the oil is heavy, or if excessive amounts are applied to the skin. Oil in summer predisposes the skin to prickly heat and pustules.

Soap and Water Baths. Regardless of size, except for an initial oil cleansing, all the babies in the Premature Station of the Sarah Morris Hospital receive a daily bath of soap and water, if their condition warrants. After the bath, the baby is rubbed with 40 per cent alcohol which has not been warmed. Such a rub does not cause drying of the skin, but does aid in keeping it in good condition. Sterile oil is used for the initial bath only, in order to remove the vernix. Afterwards, if the infant's skin is dry, oil or cold cream may be applied immediately after the soap and water bath is given.

The room temperature during the bath should be at least 80° F.; otherwise the infant should be cleansed without being removed from the warm bed. Tub bathing for the infants can be instituted when the cord is off and the navel dry.

Ammoniated Mercury. In many nurseries, applications of ammoniated mercury are given to full-term infants during their first three days of life. This procedure is not advisable for the premature baby, as ammoniated mercury acts as an irritant and frequently causes a papular rash.

Prickly Heat. When the baby has prickly heat, a bath containing starch or Linit is given once or twice daily. One tablespoonful of starch is mixed with six quarts of water for the bath. The application of bismuth subgallate (Dermatol powder) is also effective; one teaspoonful of Dermatol powder added to two ounces of calamine lotion has been found satisfactory. Exposure of the unclothed baby in the bed to warm air will often result in a rapid disappearance of prickly heat and intertrigo.

If the folds of the skin become chafed, they should be separated by a thin layer of cotton, which should be changed several times each day.

Skin Infections. Pustular dermatitis, while relatively benign and usually not serious in the individual baby, is epidemiologically of great importance. It spreads easily and may assume epidemic character in any nursery, if proper technic is not used. Regardless of the routine followed in the care of the baby's skin, pustular dermatitis will invariably occur if a nursery is overcrowded and if there is insufficient or inadequately trained personnel.

In order to obtain a true insight into the extent of an epidemic, it is necessary to follow up all the babies who have been discharged from the hospital apparently normal, since in the next few days they may develop lesions. When a case of pustular dermatitis is found in the nursery, checking back will often reveal other recent cases. The treatment of the individual case of pustular dermatitis is less important than the epidemiologic control, since in most instances the lesions heal with little treatment. As yet, specific treatment for this condition is lacking, and each physician has his own preference.

One difficulty in the epidemiologic control is the reluctance of many hospital authorities and physicians to call a dermatitis an impetigo, even though pustular lesions are present, because it implies a break in technic or poor nursing care. Furthermore, impetigo necessitates the isolation of the infant, which may mean that special nurses must be employed and which may also alarm the parents. This unwillingness or lethargy in the recognition of pustular dermatitis frequently leads to delay in proper isolation and thus increases the danger of an epidemic.

Technic of Care. The most important detail of nursing care is aseptic technic and immediate isolation of the baby.

In caring for infants with skin disorders, it is not enough that the nurse wash her hands thoroughly; she must wear rubber gloves whenever she handles the baby. A sufficient number of pairs of autoclaved gloves should be available so that a clean pair of gloves can be used each time. No matter how thoroughly the nurse washes or scrubs her hands after handling a baby with impetigo, some of the organisms may become lodged in the skin of her hands. If she does not wear clean gloves, she may be responsible for transferring the disease to that baby when she handles another infant at a later date.

Long-sleeved gowns should be worn so that the nurse's arms, as well as her hands, are covered. After removal of her gown and gloves, the nurse should wash her hands thoroughly before leaving the isolation room, and again on entering the clean nursery.

If any small pustules appear on the infant, the uncovered end of a sterile toothpick or blunt needle is used to open them and remove the overlying skin. The medication will, therefore, come in thorough contact with the raw surface of the lesion. Tincture of Merthiolate or 10 per cent silver nitrate is applied. We have found five per cent sulfanilamide or sulfathiazole ointment very effective. Sometimes, when the infant's skin is covered with a fine rash, Merthiolate ointment is applied. If it causes further irritation, its use is discontinued. The woolen shirt is always removed when a rash is present.

A fine rash is often present on the skin of infants whose prematurity was caused by a toxemia of pregnancy. Soap may be contraindicated, if it irritates the skin. Boiled water or starch water is then used.

Furunculosis. Furunculosis is most often due to poor technic, overheating or delayed diaper changing.

If boric dressings are used in treatment, it is advisable to change them at 10-minute intervals. If they are allowed to remain on the baby for an hour or more, they will cool and chill the infant. Quartz-lamp therapy (local treatment) daily is helpful. Furunculosis in the premature infant responds well to sulfathiazole in daily doses of 1 gr. to the pound of body weight. However, this drug is applicable only to generalized and severe cases.

The furuncle should not be incised until it is about ready to open spontaneously.

Sore Buttocks. For the routine cleansing of the buttocks, warm tap water is usually sufficient. The use of oil in removing the meconium is preferable to water. When the buttocks are excoriated, boric acid can be used in cleansing, as it aids in healing.

Proper washing and sterilization of diapers are important in the prevention of sore buttocks. A saturated solution of boric acid, or a 1:10,000 solution of mercuric bichloride can be used for the final rinse in washing the diapers. A small amount of the chemical will remain in the diaper after drying and will limit bacterial decomposition.

Exposure to the air is the most effective treatment for sore buttocks. The baby is placed on its abdomen (head turned to the side), the chest and lower extremities are covered, so that only the buttocks are exposed. A heat lamp (25 watts) at a distance of 20 inches can be used at intervals. Where Alpine-ray lamps are available, a local treatment (distance 10 inches) to the buttocks for 10 seconds daily is also helpful.

At home the mother is usually anxious to apply some medication to the buttocks locally. The following paste is often used successfully:

Balsam of Peru	4.0 cc.
Zinc oxide	6.0 Gm.
Starch	6.0 Gm.
Lanolin	30.0 Gm.

Hemangiomata or Nevi. Hemangiomata or nevi are more common among premature than among full-term infants. This is especially true of premature infants of low birth weight. In the premature infant, the greater tendency to such permanent dilatation and increased growth of the cutaneous blood vessels is in all probability related to the immaturity of its vascular system.

In their simplest form, the nevi occur as small, red, punctate lesions with a few capillary vessels running from them in various directions. Such nevi have a tendency to improve gradually without treatment. In the form commonly known as "wine mark," the nevi appear more frequently on the forehead, eyebrows, back of the neck and body as irregular patches which range in hue from bright pink to dull purplish red. These are usually unilateral and may be quite extensive. The superficial types tend to improve spontaneously without treatment.

A subcutaneous vascular growth of venous character often involves the skin and may form a soft compressible tumor of faint, bluish tint, or if the tumor is more superficial, it will be bright red in color. This last form, known as "nevus cavernosus," has a tendency to increase in size and frequently requires treatment with radium, x-ray, carbon dioxide snow or electrolysis.

Edema. Edema may be localized or general. Among the localized conditions are those due to trauma to any part of the body. The genital organs, including both the labia in the female and scrotum in the male, are frequently involved. The edema may involve the feet and hands, back and the whole of the lower extremities. In small premature infants it may develop shortly after birth. The condition is usually transient and disappears spontaneously with proper feeding and general care.

Sclerema. Sclerema is not uncommon in small premature infants and may occur even in utero. It is seen only in the newborn, and is usually first noted between the second day and second week of life. Premature, debilitated and hereditary syphilitic infants are especially affected.

Sclerema is characterized by an intense induration of the superficial tissues which seems to be due chiefly to solidification of the subcutaneous fat. The younger the infant, the thinner is its cushion of fat. According to Langer and Knoepfelmacher, the subcutaneous fat in the infant contains chiefly palmitic and stearic acids, with proportionately only a small amount of oleic acid. The fat of the newborn infant is therefore, even at body temperature, somewhat harder than the fat of the adult, which is rich in oleic acid. However, the usually very high water content of the fatty tissue of the newborn infant gives the skin a normal softness during ordinary temperature. Clearly, therefore, the oleic-acid-poor fatty tissue would begin to feel hard when the water disappears from the interstitial spaces of the fatty tissue.

In infants whose temperatures are below normal, sclerema occurs more frequently, but the condition is not simply a sequel to the hypothermia. Sclerema is often seen in the calves or the thighs, sometimes in the cheeks, but may extend over a greater part of the body and may be especially marked on the buttocks and back in the regions where adipose tissue is abundant. The color may be normal or slightly blue or tinged with yellow. The limbs become stiff and board-like. The skin is cold to the touch and the infant becomes weak. The duration of the disease is generally not more than three or four days. If recovery takes place, there is a gradual improvement in the circulation and nutrition, and later a disappearance of the areas of induration. In the premature infant, the mortality from sclerema is high.

Treatment consists primarily in furnishing sufficient heat and stimulating the respiration and circulation by means of oxygen inhalation. Warm baths with gentle massage may be helpful. When the infant has difficulty in swallowing, gavage feeding should be instituted. Breast milk is the food of choice.

Ecchymotic Hemorrhages. Many small premature infants develop areas of ecchymosis; some of them are spontaneous, while others follow trauma. If the infant's progress remains satisfactory, these areas disappear spontaneously and do not require any therapeutic measures.

CARE OF THE EYES

If there is any uncertainty as to whether or not the infant has received adequate protective treatment for the eyes before admission to the Station, a 1 per cent silver nitrate solution or 25 per cent argyrol should be used to prevent ophthalmia neonatorum. The silver nitrate solution should be neutralized with normal saline. An old silver nitrate solution which has undergone decomposition should be avoided, as it may irritate the sensitive conjunctiva. Often, especially in premature infants, the application of silver nitrate will result in some inflammatory reaction of the conjunctiva in the first 6 to 12 hours after its application. Such an inflammation can be relieved by cleansing the eye gently with cotton moistened with cool saline or boric acid solution. This is not to be confused with the more serious specific ophthalmia which may develop on the second or third day.

Gonorrheal Ophthalmia

On the slightest suspicion that the conjunctivitis might be specific in nature, bacteriologic studies of the purulent discharge should be made. All cases of ophthalmia in the premature infant should be referred to the eye department for diagnosis and treatment.

Nursing Care. In the Premature Station of the Sarah Morris Hospital the following measures are initiated under the direction of the oculist:

1. If only one eye is involved, a protective shield is placed over the uninfected eye to prevent transference to it of the infection.

2. Irrigation of the infected eye at very low pressure with cool saline is carried out, even as often as every 15 to 30 minutes, if necessary.

3. The glass irrigating tip, which is protected by soft rubber tubing, is never allowed to touch the cornea during the irrigation process.
4. The tip is held at the inner canthus of the eye, and the head is turned to the right or left, away from the eye not under treatment.
5. The nurse holds the eyelids open by pressing gently on the upper and lower lids, taking care to avoid trauma.
6. The saline is allowed to trickle slowly, without force.
7. Any crusting of the lids is gently wiped off with eye-cotton that has been moistened with saline.
8. The infant must be well protected while the eye is being irrigated. The baby is removed from the incubator in order to irrigate the eye more thoroughly, but at the same time, it must be kept warmly wrapped.

The responsibility of irrigating eyes should be assumed by a nurse experienced in this procedure.

20

Diseases of the Respiratory Tract

CONGENITAL ANOMALIES

Fetal Bronchiectasis

Fetal bronchiectasis is a rare condition of the newborn which may affect the whole or only part of one lung. Hydremic degeneration of an entire bronchus is termed "universal bronchiectasis." When this occurs, the lung structure is replaced by cystic formations which contain a serous fluid in which are found ciliated epithelium and nuclei. A second form, known as atelectatic bronchiectasis, is due usually to lack of development of certain portions of the lung, which later become cirrhotic from pressure by a bronchus.

Diagnosis. Because of the equalizing growth of the healthy lung, the diagnosis is possible only in the presence of deadening of the sounds over one-half of the thorax. X-ray studies assist in localizing the lesion, although they may not determine the type of lesion.

In the premature infant, such lesions increase the respiratory handicap under which these children labor, and if they are extensive, death with symptoms of asphyxia usually occurs soon after birth. The development of inflammatory complications makes the outlook still more grave.

Atelectasis

Atelectasis is also referred to as acquired asphyxia, although it may be congenital, since it is a persistence of the fetal state in the entire lung or part of it. In the congenital type of atelectasis, the lung is not wholly expanded at birth, while in the acquired form, collapse of the previously expanded lung occurs. The congenital type is seen chiefly in the premature or debilitated infant, and is due either to a developmental anomaly or to an absence of strength in the respiratory muscles sufficient to inflate the lungs. The acquired form most frequently results from obstruction of the bronchi or alveoli by intrathoracic exudates or from diaphragmatic hernias or deformities of the spinal column.

Atelectasis is, to some extent, physiologic during the first few days after birth and gradually disappears as the infant's strength increases. When associated with asphyxia at birth, it is often entirely overcome with the aid of the therapy used to revive the infant.

Pulmonary atelectasis also occurs after cerebral hemorrhage, induced by injury to the respiratory center, and is characterized by small respiratory excursions and decreased exchange of gases.

Pathology. The anterior portion of the lungs is most frequently the portion expanded, the para vertebral part being atelectatic. When death occurs early, it is usually found that a large portion of the lung is not inflated. The atelectatic lung is brownish-red, does not crepitate, is quite vascular and shows the lobular outline on the surface.

Symptoms. Frequently, some infants with atelectasis have a history of asphyxia at birth, while others may have no symptoms that attract attention to the lungs. Some of the infants with this condition are noticeably quiet, cry weakly, have feeble voices and a marked grayish pallor and sleep much. The temperature is usually below normal; occasionally, there is some edema of the extremities or slight puffiness of the face.

Physical Signs. On inspection the breathing is shallow and often irregular.

Palpation is negative, unless râles are plentiful, when fremitus may be felt. Vocal fremitus is absent.

On percussion, resonance is usually apparent over the entire chest, and only posteriorly can diminished resonance be detected. The collapsed spaces are surrounded by areas which are overdistended with air, which accounts for the fact that resonance is not interfered with to any great extent. Small areas of collapse do not give any evidence of dullness. If only one lung is involved, a difference can usually be discerned.

On auscultation, the breathing sounds are quite feeble and the expiratory sound, particularly, may be almost inaudible. The sounds may be somewhat harsher than normal, but are rarely bronchial in character. The most conspicuous physical sign is the presence of crepitant râles, the so-called atelectatic crepitation, which is usually best heard over the bases of the lungs, when the infant is induced to take a deep inspiration.

Diagnosis. The diagnosis of atelectasis is made more easily from the symptoms, the shallow breathing, the stupor, the asphyxial attacks and the debilitated condition of the infant than from the physical signs, which are likely to be ambiguous and not well defined.

Areas of collapse and bronchopneumonia may be present in the same lung. Pneumonia in an atelectatic lung is not easily recognized. The absence of respiratory sounds, accompanied by dyspnea and ineffectual cough, indicates an inflammatory condition.

Differential Diagnosis. A number of conditions must be considered in making a differential diagnosis of atelectasis. Most important of these are:

1. General debility with quantitative and qualitative lack of development, attended by impaired respiratory, cardiac and digestive functions.
2. Cerebral injury associated with hemorrhage. This is one of the most difficult pathologic conditions to differentiate because of the tendency toward involvement of the respiratory centers, especially in basilar hemorrhages. A careful inquiry should be made for a history of opisthotonos and clonic contractions of the extremities or facial muscles.
3. Hyperplasia of the thymus and, occasionally, of the thyroid gland, with associated stridulous respiration, retraction of the diaphragm and local physical appearances, which must be differentiated.
4. Cyanosis from other causes. Although cyanosis frequently accompanies atelectasis, it may also be due directly to the aspiration of food into the larynx, permitted by the absence of well-developed pharyngeal and laryngeal reflexes. Cyanosis in the premature infant may also follow mechanical interference with respiration during the act of drinking, or interference with the action of the diaphragm because of gastric distention.
5. Congenital heart disease.
6. Congenital diaphragmatic hernia.
7. Pneumothorax and pneumomediastinum.

Radiographic examination is of particular value in differentiating atelectasis, hyperplasia of the thymus and diaphragmatic hernia.

Treatment. The physical condition of these infants is often so precarious that undue roughness in the application of restorative measures can do infinitely more harm than good. The less manipulation necessary to overcome the cyanotic attacks, the less will be the danger of injuring the infant at this critical time, either by overstimulation mechanically or by medication. The object of treatment is directed toward the expansion of the lungs through deep breathing. This may be accomplished by crying; if the child does not cry well every day, it should be made to do so. In mild cases, cutaneous stimulation is sufficient, and therefore the child is spanked very gently fifteen or twenty times, thrice daily. The resulting crying tends to expand the collapsed portions of lung and to expel mucus from the bronchi. A mustard bath is often beneficial. (For directions on giving a mustard bath, see "General Therapeutics," Chap. 15.) The purpose of the bath is both to divert the blood from the lungs to the cutaneous vessels, and to aid in the expansion of the collapsed areas. Expansion of the collapsed lung is much more easily accomplished during the first few days, and the difficulty increases proportionately with the length of time that elapses after birth.

The infant should not be allowed to lie quietly in one position; its position must be frequently changed. Further treatment should be similar to that recommended for attacks of cyanosis. (Chapter 17.)

Since the temperature is so often subnormal, infants with atelectasis must be kept warm, either by being surrounded with hot-water bottles or else by being kept in some kind of a heated bed. Feeding is an important problem, since it is essential to increase the general nutrition in order to improve the function of the respiratory center and muscles. (See "Feeding," Chap. 11.)

Oxygen therapy is of primary importance, and can be administered either in an oxygen chamber or by means of a nasal catheter. (See "Oxygen Therapy," Chap. 16.) A tank should be kept in close proximity to the infant's bed. Cutaneous stimulation and artificial respiration, or even the use of forcible means of inflating the lung with a catheter in the trachea, may be necessary, but their danger must not be underestimated. (See "Pneumothorax and Pneumomediastinum".) The use of drugs hypodermically, such as camphor, caffeine, epinephrine, coramine and alphalobeline, is not of much value. However, aromatic spirits of ammonia, in doses of one to three drops, well diluted, is worth trying.

PNEUMONIA

Etiology. Bronchitis during the first few days of life may be the result of aspiration of infectious material, or it may accompany a general septic infection. The vaginal secretion always contains microorganisms which may cause infection, should aspiration occur during the infant's passage through the birth canal. After birth, infection of the bronchi may reach the child from an infected mother or attendant, or from a third person through the agency of feeding utensils, spoons or other articles. Infections in the upper air passages may spread directly to the deeper structure of the respiratory passages, and there produce bronchitis or bronchopneumonia.

Symptoms. The onset is most often insidious in the newborn infant. At first, a slight nasal discharge and a cough of varying severity may possibly be noted, although these symptoms may be entirely absent in weak infants. Soon, increased frequency of respiration appears, accompanied by dilatation of the alae nasi. The cough in the more mature infant becomes worse, and the respiration increases to 60 or 80 per minute. Attacks of cyanosis occur, their severity in most cases corresponding to the severity of the pneumonia. Older infants display great restlessness, with inability to sleep; cyanosis becomes continuous, but convulsions are infrequent. The temperature may be only slightly elevated or even subnormal. There is a noticeable loss of weight, the stools may become dyspeptic and greenish and contain mucus and undigested particles. The prostration may be extreme and the infants become apathetic or stuporous. Abdominal distention is of frequent occurrence and constitutes a serious complication.

The severity of these early symptoms is due either to the sudden intense congestion of the small alveoli, which interferes with the bronchopulmonary apparatus almost as much as does consolidation, or to the intensity of the infection.

Physical Signs. The usual physical observations of bronchitis or bronchopneumonia are often lacking or are only suggested in the pulmonary inflammation of the premature or debilitated infant. This is especially true when the involved areas are small, as they often are when the respiratory efforts are weak and their amplitude small. In addition, it is often the atelectatic portion of the lung which is involved, and if this is centrally situated, the air may fail to gain access to it.

Diagnosis. Because of the similarity in physical findings, pneumonia, in premature infants, may be easily confounded with atelectasis. Mechanical irritation may be necessary to make the infant cry or breathe deeply, thus enabling the detection of the various abnormal sounds. However, since, even if the physical signs are elicited, they are difficult to evaluate in these small infants, the clinical symptoms are of more diagnostic significance. A careful study of the history from birth may be of great assistance. The differential diagnosis is largely dependent on the time of onset.

Prognosis. The younger the infant and the shorter the intra-uterine life, the higher is the mortality.

Treatment. Prophylaxis. The prevention of pneumonia in premature infants requires that these weak babies be protected against infection from every source. Any person suffering from a respiratory tract infection should be excluded from the nursery. In institutions in which many babies are taken care of by one nurse, the attendant should wash her hands before and after she handles each baby. If the premature infant is in the newborn nursery, it should be isolated from the other babies. Only when the attendants are thoroughly trained in the principles of aseptic nursing is it safe to leave the infant in close proximity to others who have respiratory infections. All utensils should be individualized and should be sterilized before use. Feeder spoons, glasses, nipples, bottles, stomach tubes and other similar equipment must be boiled before they come in contact with the child or its food. If the infant is to be cared for in the home, the necessity for its being kept isolated from the other members of the family must be emphasized to the mother. If the mother has a coryza or bronchitis, she must exercise particular care not to contaminate her hands with nasal or bronchial secretions, nor to breathe or cough into the face of the baby. If she has a respiratory-tract infection, it would be best if she could stay away from the baby entirely, but if there is no one else to care for it, the mother must be instructed to wear a mask. Individual, sterilized feeding equipment for the baby in the home is essential.

As soon as these babies can be removed from their incubators, they are to be kept in large, well-ventilated rooms, which are not overheated. The babies should be given the benefit of open air and sunshine as soon as their development warrants.

General Treatment. The treatment of pneumonia is pre-eminently that of watchful expectancy. Overtreatment must be avoided, since these feeble infants are unable to withstand overmanipulation or stimulation. Generally, pneumonia in robust infants is an acute self-limited disease, but in premature infants, the course is apt to be somewhat subacute without the tendency to limitation. The indications in the treatment are to support the heart and conserve the strength. The feeding problem of the premature infant is not easy at any time, but during an attack of pneumonia, it becomes doubly difficult.

The hygiene of pneumonia requires that the child receive plenty of warm fresh air. The one best therapeutic measure is the continuous administration of oxygen at the first suspicion of pneumonia. This is most satisfactorily carried out in an oxygen chamber or by nasal catheter. The prime indications are for promotion of elimination and a sufficient administration of fluids. Stimulation of the respiratory tract is best accomplished by mild counterirritation to the chest and the use of warm applications to the extremities. The routine use of drugs, such as cardiac and respiratory stimulants, is not favored. Whiskey or brandy may be administered in quantities varying from 5 to 30 drops every three hours depending on the indications and weight of the infant. Aromatic spirits of ammonia, in doses of one to five drops, is one of the most effective stimulants. Both the whiskey and the ammonia should be given in the milk feedings, or well diluted in at least eight parts of water. In cases of emergency, sudden heart failure or weakness accompanying a sudden drop in temperature, the use of one or two minims of adrenalin, 1 in 1,000 solution, or of one-half grain of caffeine sodium benzoate to the dose, given hypodermically, will be found to be a quick-acting, reliable heart and respiratory stimulant.

Sulfathiazole. More recently we have had occasion to use sulfathiazole in the treatment of pneumonia, with apparently beneficial results. The average dose for a four-pound infant is 7.7 grains in 24 hours for two days, and then 5 grains daily until improvement is well established. If sulfathiazole causes too much vomiting or cyanosis, the amount is decreased. Sometimes it has been necessary to discontinue the drug.

Whole blood may be given intramuscularly every day or every other day. A small transfusion may be indicated.

If the infant shows a noticeable rise in temperature, the use of hydrotherapy may be considered. Temperatures up to 101° F. are well borne, and do not require interference. Since, generally, the temperature tends to remain subnormal, cool or even tepid baths must be avoided, and warm or hot mustard baths given instead. The most satisfactory hydrotherapeutic measure used for the reduction of an unduly high temperature is the tepid pack. The temperature of the tepid bath may range from 100° to 105° F., depending on the condition of the child.

The disturbances of the nervous system which are occasionally prominent in older and stronger children during a pneumonic process are only slight in the premature infant. When present, mild hydrotherapy offers the best results.

The use of coal-tar products is contraindicated.

Frequent, regular changes of the infant's position in bed are imperative for the successful care of the pneumonias in premature infants.

Feeding. Small feedings are advisable to aid in preventing distention, vomiting and diarrhea. Feeding by gavage is often desirable. However, this is not always possible, and it may be easier to feed the baby with a dropper or a small bottle, especially if much mucus accumulates.

Nursing Care. Handle and disturb the infant as little as possible. Keep the baby warm. If possible, regulate incubator so that the baby's temperature is slightly elevated.

To prevent dehydration or excessive loss of weight, give the baby weak tea or glucose solution between feedings. If the infant is too weak to take this by dropper or bottle, subcutaneous fluids are usually given once or twice a day.

The head of the bed may be elevated, if dyspnea is noticeable.

The baby should not be bathed or weighed unless its condition permits such handling. Sometimes mustard baths seem to be beneficial for these infants.

The nurse should watch these babies closely and should have a stimulant ready in case of emergency.

PNEUMOTHORAX AND PNEUMOMEDIASTINUM

From the limited number of reports [19-22] of pneumothorax and pneumomediastinum in newborn infants, it appears that these conditions have been largely overlooked. Premature and full-term infants alike are subject to rupture of the lungs.

The cardinal symptoms are dyspnea and cyanosis, due to respiratory and circulatory embarrassment. In most instances the infant will go into shock; more exceptionally, however, the symptoms may be gradual in onset, if the escape of air from the lung has been slow.

Either condition may develop and become clinically evident at any time in the first week of life, and only rarely later. Birth trauma, too strenuous attempts at performing artificial respiration or inflation of the lungs through a catheter, or collection of mucus or aspirated food in the bronchi may be active factors in the development of pneumothorax or pneumomediastinum.

Silver [21] reports a case of spontaneous pneumothorax due to a ball-valve type of obstruction in which his first plates show a marked emphysema and his later plates rupture of the lung with pneumothorax. Occasionally a late case will follow acute inflammatory conditions.

In both conditions it is difficult to make a diagnosis from the physical signs alone. Hyperresonance associated with diminished breath sound should lead to the suspicion that air has escaped either into the mediastinum or the pleural cavity. When the pneumothorax is partial, the heart is not necessarily displaced. The diagnosis will be made in most cases, and should be confirmed in all cases, by the use of the fluoroscope and anterior-posterior and lateral roentgenograms.

In pneumothorax, the lung is seen as partially or completely collapsed toward the mediastinum. The diaphragm on the affected side ascends more sharply than on the normal side, the steepness of the ascent depending on the degree of pneumothorax. The pulmonary markings are absent wherever the tissue of the lungs has been replaced by air. If the tension is great, the mediastinal contents are displaced toward the opposite side in proportion to the positive pressure, and the intercostal spaces will be somewhat wider on the affected side. Subcutaneous emphysema with crepitation may develop.

Gumbiner[23] has recently described four cases of pneumomediastinum which occurred at the Michael Reese Hospital in a period of a few months. The symptomatology was practically identical with that of pneumothorax. In each instance it was necessary to take lateral roentgenograms in order to confirm the diagnosis. The small amount of air present in the anterior mediastinum was hidden behind the sternum, and therefore not visible in the anterior-posterior plates.

Treatment. Prophylaxis in the form of avoidance of trauma to the respiratory apparatus of all newborn infants is necessary. This applies especially to those cases in which artificial respiration is necessary. Too enthusiastic use of the laryngeal and tracheal catheter undoubtedly accounts for a considerable percentage of the cases. Either condition may develop spontaneously through plugging of a bronchus with mucus or foreign material, if such an obstruction allows air to enter the lung but prevents its egress. Emphysema and later rupture of the lung tissue result. For infants whose respiratory and cardiac functions are considerably handicapped, the best symptomatic treatment results from withdrawal of air by aspiration. The regions selected for aspiration will of necessity be dependent on the location of the air. It may be necessary to repeat aspiration.

In most cases spontaneous recovery without interference occurs. Oxygen therapy and supportive measures are always indicated.

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Disorders of the Gastro-intestinal Tract

DISEASES OF THE ORAL CAVITY

Thrush

(Sprue, Mycotic Stomatitis)

Etiology. Premature and weak infants, and, more especially, those suffering from nutritional disturbances are susceptible to thrush. The causative agent, the *Saccharomyces albicans* (*Oidium albicans*), is a mold fungus which grows not only as a yeast but also produces mycelia and spores. The yeast-like cells form buds precisely like true yeast cells. Thrush occurs only when a lesion of the mucous membranes is present, and such a lesion in the premature infant is usually caused by mechanical injury. The source of infection is ordinarily from the nipple, although it may be carried into the mouth through utensils or soiled pledgets.

Symptoms. The importance of thrush is probably always secondary and its significance symptomatic. It may be an indicator of a serious general affection or an essentially lowered resistance, although it is seen frequently in those infants who are apparently in good health. In the premature infant, it sometimes attacks the esophagus and has been described as invading the blood stream. In the more robust premature infants, it usually appears as small, white punctiform and flat eruptions on the tongue, gums and inside of the cheeks. In infants with lowered vitality, thrush may resemble an extensive membrane, covering the whole buccal cavity. In the severe cases, it is also frequently associated with aphthous stomatitis.

Usually, the most serious symptom is the inclination of the infant to refuse its food. However, thrush may also be associated with vomiting, and, as has been intimated, is frequently a complicating factor in severe nutritional disturbances.

Prognosis. Thrush in the full-term infant is usually cured within a few days. In the premature infant, however, unless the treatment is very carefully done, the trauma suffered in the course of local applications may cause new local lesions which readily become infected, thus frequently prolonging the course of the disease.

Treatment. Since thrush is due to lack of cleanliness and to trauma, prophylaxis should be the first consideration. In the early care of the mouth of the newborn, every effort should be made to avoid trauma to the mucous membrane. If proper technic is observed in the daily routine, thrush will not be spread from one infant to another. If the infant is breast-fed, the mother's nipples must be washed with boiled water or with a solution of boric acid. If the infant is bottle-fed, the nipples and bottles should be carefully boiled after each feeding, and only such nipples should be used as can be completely everted so that both the inside and outside can be thoroughly cleansed. The nurse should use every precaution in the care of her hands and dress and all objects which may be carried between babies.

Every form of local treatment must be applied with utmost care in order not to abrade the sensitive mucous membranes. The disease can be cured by gently sponging the mouth of the infant with a solution of sodium biborate, 10 gr. to 1 ounce of boiled water (this is preferable to boric acid). This procedure can be carried out after each feeding and between feedings with the aid of a toothpick swab. Also effective is the application of a 1 per cent aqueous solution of gentian violet several times a day.

Nursing Care of Thrush. The use of borax nipples in the nursing care of thrush is not advisable. The best method is to swab the tongue and cheeks with the solution, using a long cotton applicator.

When borax and soda are used, the tongue and cheeks are swabbed every one and one-half hours the first day, every three hours on the second day and every six hours on the third day. By that time the mouth is usually clean. When gentian violet is used, it is applied twice a day.

When the baby is cared for in the home, the mother is advised to make a solution with two teaspoonfuls of sodium biborate and one-half teaspoon baking soda added to one pint of boiled water.

When the infant refuses to nurse, or when the nipple irritates the mouth, it may be necessary to resort to feeding with a medicine dropper or by means of gavage. As an essential part of the treatment, every effort should be made to improve the general health of the premature infant by proper feeding, cleanliness and good hygienic surroundings.

Stomatitis

The term "stomatitis" is applied to inflammations of the mucous membrane of the mouth. The types most commonly seen are the traumatic ulcerations, which usually involve the palate. They may be slight and superficial or, by secondary infection, become serious lesions. The simple traumatic patches generally appear as yellowish, superficial lesions that are often covered by a slimy membranous film which can easily be removed. Removal of this film, however, is followed by small punctate hemorrhages. The lesions are most frequently seen from the second to the fourth day after birth, but with proper care, decrease in intensity and show a tendency to rapid healing. They usually disappear within a week. However, the dangers of secondary infections must not be overlooked.

Etiology. Although the cause may vary, stomatitis is usually due to trauma to the mucous membrane while the mouth is being cleansed. This occurs particularly when the premature infant has been treated for asphyxia or cyanosis, and the stomatitis follows injury due to mechanical removal of mucus from the mouth. More serious lesions, due to more intense trauma of the mucous membrane while cleansing the pharynx, may lead to grave complications. Ulcerations may be found in areas in which a thin mucous membrane is in close proximity to the hard bony structure.

Syphilitic stomatitis is not uncommon in infants born with syphilis. The ulcerations are more frequently seen about the lips and gums.

Treatment. Prophylaxis should consist of the avoidance of all trauma at birth and the prohibition of subsequent mechanical cleansing of the mouth, unless indications for it are specific. Cleansing of the mouth is superfluous, when proper care is taken in the preparation and administration of the infant's food. Infants with ulcerative stomatitis should be isolated to impress the attendants with the dangers of spreading the infection by careless handling.

The curative treatment is the same as that recommended for thrush, and even greater care should be taken in the application of local therapy. If other methods are unsuccessful, the deeper ulcerations in the mouth may be treated with the application of a 1 per cent silver-nitrate solution. However, the nurse must not become overzealous in the administration of local treatment to the premature infant, because of the dangers of further traumatizing the sensitive mucous membrane. The feeding offers the same difficulties as in the more severe cases of thrush, and dropper feeding or gavage may become necessary.

The local therapy for syphilitic stomatitis is the same as that suggested for the other forms. The general care for this condition is, of course, treatment of the underlying congenital syphilis (see Chap. 26).

Cancrum Oris
(Noma)

Etiology. No single micro-organism has been isolated as the cause of noma. Spirilla and fusiform bacilli have been observed not only in the necrotic tissue, but in the surrounding healthy parts. Whether these organisms represent the primary cause of the lesion or only secondary invaders is unknown. In some instances, the diphtheria bacillus alone has been found.

Symptoms. The site of the disease is usually the inner side of one or both cheeks. The gangrenous process generally begins as a small inflamed, infiltrated area in the mucous membrane. Localized destruction of tissue follows, and this process extends with great rapidity until the tissue sloughs away in masses.

Prognosis. If the disease occurs in weak, marantic infants, they usually die from exhaustion and sepsis within 10 days or two weeks from the onset of the disease.

Treatment. Treatment in many instances will be unsatisfactory. Chemotherapy with one of the preparations of sulfanilamide or of arsenic, together with transfusion of blood or human serum, offers the greatest hope.

DISORDERS OF THE STOMACH AND INTESTINES

A consideration of the diseases of the stomach and intestines, as related to the premature infant, recognizes:

1. The possibility of congenital malformations and other prenatal factors which might be of significance in the function of the digestive organs.
2. The lack of proper physiologic development in the prematurely born infant, the degree of which varies inversely with the fetal age.
3. Postnatal pathologic conditions which may develop in the gastrointestinal tract.
4. The importance of the influence of systemic infections on the processes of metabolism.

The term "nutritional disturbances" rather than "digestive disturbances" is undoubtedly more generally applicable to the premature than to any other period of life, since these infants always develop general nutritional disorders rapidly following even moderate causes. The exceedingly important relationship between the fetal age of the infant and the quality of the food and the method of its administration are emphasized in the chapter on "Feeding."

It cannot be too strongly stressed that the immediate institution of the proper hygiene and prophylaxis to prevent nutritional disturbance and the early administration of human milk whenever possible are of utmost importance to avoid disaster. A great number of premature infants die, not because their organs lack that degree of maturity necessary to independent function, but because of early neglect, due either to lack of adequate facilities or to ignorance of exact methods of feeding and care.

Functional inadequacies of the gastro-intestinal tract that are wholly or in part dependent on lack of development are difficult nursing, anorexia, inanition fever, vomiting, gastric and intestinal distention, diarrhea and constipation.

Difficult Nursing

The causes of difficult nursing are to be found either in the infant, the mother or in both.

Various factors may make nursing for the infant difficult or even impossible. Some of these have been discussed in the chapter on "Feeding." The malformations that offer the greatest difficulty are cleft palate, harelip and nasal deformities due to lack of cartilaginous development. The child's tendency to sleep constantly is often perplexing. General weakness and the incomplete muscular development in the premature infant are not infrequently sufficient to make nursing impossible. Infections of the mouth that produce thrush, stomatitis and ulcerative processes are always serious. Any condition that interferes with proper respiratory function, whether it is lack of physical development, such as atelectasis, or pulmonary infection, also interferes with satisfactory feeding on the part of the infant. These are but a few of the many complications which may impede proper nursing.

Pathologic conditions of the nipples and of the mother's breasts must also be given consideration when feeding problems arise.

Anorexia

The premature infant born in the seventh or eighth month rarely shows a disposition to feed spontaneously during the first days of life, and, in a great many instances, the food must be administered without any active participation of the infant. An interesting fact noted in premature infants weighing less than 1,500 grams, and occasionally even in larger infants, is a tendency to attempt to nurse spontaneously during the first two or three days of life, during which time, of course, they receive little food. After about three days, this period is usually followed by a definite somnolence, during which the infant shows little, if any, inclination to nurse. The anorexia is almost always associated with a rather rapid loss in body weight. Regardless of the stage of the infant's development, anorexia must always be given the most serious consideration and every attempt must be made to administer sufficient food to meet the demands of the organism. Gavage must be employed if the less drastic methods of feeding are unavailing. It has been our experience that occasionally the omission of one or two feedings, with the administration by mouth of a one-half strength physiologic salt solution, will further stimulate the appetite by producing thirst.

During this period, enough fluids should be given to meet the infant's needs, that is, about one-sixth to one-eighth of the body weight daily. The addition of three to ten drops of brandy is often a beneficial stimulant. Addition of vitamins B_1, B_2 and C may be advisable.

Inanition Fever

Hyperpyrexia, as seen in the first days of life and during the time when the infant is receiving a minimum of food, is not necessarily due to inanition. Instability of the heat-regulating center in the brain and overheating are the most common causes. Occasionally, however, hyperpyrexia occurs in a premature infant or in a newborn, in which the high temperature cannot be due to the surrounding artificial heat. Moreover, the infant will make a rapid recovery without any after-effect, as soon as the fluid intake of milk or water is increased. Some cases are undoubtedly caused by infection or toxic products which enter the circulation through the gastro-intestinal tract.

Treatment. Treatment for hyperpyrexia requires that fluids equal to at least one-eighth to one-sixth of the body weight be given to the infant in 24 hours and that the baby be fed according to the regular schedule for infants in the first 10 days of life. When the causative factor in so-called "inanition fever" is doubtful, a colonic flushing with a saline solution should be given and external heat discontinued temporarily. At the Sarah Morris Hospital, it is a rule that milk should not be fed to the infant until it has passed its first meconium stool.

If the baby's temperature registers over 101° F., immediate steps should be taken to lower the body temperature.

1. Remove excessive clothing.
2. Give the infant a tepid sponge.

3. Administer a small tap-water enema. The temperature of the water should be 90° F.

The temperature of the baby will drop rapidly after these procedures. It is advisable to have a stimulant and oxygen ready for emergency use if the baby should show symptoms of shock.

Vomiting

The intensity of vomiting and the result that it has on the general state of nutrition of the premature infant usually determine its importance. Vomiting must not be considered primarily as a disease; it is only a symptom, and one which can be influenced by many factors peculiar to the premature infant.

About 75 per cent of all premature infants regurgitate some food during their first three days of life. The relatively vertical position of the stomach in the seventh and eighth months of fetal life, the poorly developed cardiac sphincter and the strong pyloric sphincter, all predispose to regurgitation.

Frequent causes of vomiting other than the physiologic ones described are:

1. Congenital anomalies.
2. Improper feeding technic.
3. Errors in feeding.
4. Excessive handling.
5. Pressure from clothes.
6. Toxemia in the mother.
7. Abdominal distention.
8. Intracranial hemorrhage.
9. Infections.

Regurgitation of all of the first and subsequent feedings, together with dribbling of mucus through the mouth and nose, suggest congenital tracheo-esophageal fistula. X-rays are indicated to determine the diagnosis.

Vomiting of an excessive amount of bile may be caused by duodenal atresia.

When vomiting continues, x-rays of the gastro-intestinal tract is usually advised. However, a premature infant may vomit profusely when it has an intracranial hemorrhage or if the mother had a severe toxemia.

Among the dangers of uncontrolled vomiting are:

1. That it may cause aspiration pneumonia.
2. That fluid and food will be lost to the infant.
3. That it may become habitual.

In the prevention of vomiting, proper feeding technic is the first requisite. The nurse should observe the following precautions.

1. Feed small amounts to the baby.
2. Increase feedings gradually, by not more than 2 cc. at a feeding.
3. If baby vomits, divide the feedings; give one-third or one-half of the food at a time, waiting five to ten minutes between the first and second portions.
4. Have feeding warm. Food that is either too hot or too cold will often cause regurgitation.
5. If the infant is fed by bottle, be sure that the hole in the nipple is neither too large nor too small. If the hole is too small, the baby becomes exhausted; if it is too large, the baby will feed too rapidly. Vomiting may result from either.
6. Belching after feeding is often helpful to the baby.

Treatment.

1. Elevate head of bed. Place a thick pad under head of mattress.
2. Decrease feeding to the amount that the baby will retain.
3. Relieve any abdominal distention that may be present. If vomiting is severe, it may be necessary to:
4. Stop all feeding by mouth for six hours.
5. Lavage the stomach with 1 per cent bicarbonate of soda solution.

When feedings are again started, give an amount as small as 4 cc. (one teaspoonful) at the first feeding.

Discontinue water between feedings when the baby vomits excessively, and give Ringer's or normal saline solution subcutaneously two or three times daily, until vomiting is checked.

Medication. One-sixteenth or one-eighth grain of phenobarbital or one of the other barbiturates at six-hour intervals is sometimes effective. The administration four times daily of atropine sulfate, 1/1500 or 1/1000 of a grain, is often effective. If necessary, further information should be secured from x-rays.

Gastric and Intestinal Distention

Abdominal distention may be of grave consequence in the premature infant through interference with respiratory and cardiac functions and possible consequent cyanosis. Although overfeeding is frequently the cause of distention, it is not the only source. Most of the factors which induce vomiting also predispose to indigestion and distention. The tendency to abdominal distention in the premature infant induces danger of underfeeding because of the low food tolerance that exists in such cases.

Abdominal distention is exceedingly troublesome in the premature infant, but does not necessarily imply that indigestion is present. However, excessive external heat may cause impaired digestion, and secondarily abdominal distention.

Intestinal and systemic infections, and more especially pneumonia and peritonitis, are almost invariably complicated by abdominal distention.

Treatment. To avoid early distention, a small tap-water enema should be given to the infant if it has not had a meconium stool by the second day of life.

When gastric distention is present, the outline of the stomach can usually be seen through the thin, abdominal wall. Gastric distention can often be relieved simply by permitting the baby to belch. If the distention is persistent, however, a catheter should be passed into the stomach and the infant held in an upright position while the nurse exerts slight pressure over the stomach. Gastric lavage may become necessary.

Feeding should be discontinued until gastric and intestinal distention is relieved. In the treatment, correction of dietetic errors is essential, especially in the artificially fed premature infant. The correction of mild forms of indigestion is life-saving. Every attempt should be made to obtain human milk for the artificially fed infant. When breast milk cannot be obtained, the best results have been attained by feeding milk in which the curd has been finely precipitated, and in which the carbohydrate and fat content is low. (See "Artificial Feeding," Chap. 13.)

In all cases of abdominal distention, the nurse should check and ascertain the time of the infant's last stool. If there has not been a stool for 24 to 36 hours, therapy should be instituted to evacuate the bowel. A glycerin suppository (one-half the regular infant size) can be inserted into the rectum. If this does not bring relief, an enema may be given, containing

Water	2 ounces
Glycerin	1 teaspoonful
Peppermint water	10 drops

Depending on the size of the infant, one-half to two ounces of such an enema should be injected under low pressure, with a soft rubber catheter, No. 10, 12 or 14. At the Premature Station of the Sarah Morris Hospital, the instruction sheet for nurses on this procedure is:

PROCEDURE FOR ADMINISTRATION OF ENEMA

Aim.

To relieve distention with a minimum amount of handling and exposure.

Requirements.

Funnel.

Rubber French catheter, No. 10 or No. 12 or No. 14.

Lubricant.

Enamel measuring cup containing solution to be used.

Procedure.

1. Larger infants can be removed to a heated table. It is safer to irrigate the small infants without removing them from their incubators.
2. Place blanket over chest of baby.
3. Turn shirt up in back to prevent soiling.
4. Be sure rubber pad and diaper are under buttocks and lower back.
5. Lubricate tube.
6. Expel air from tube by allowing some of the enema solution to flow through it.
7. Carefully insert catheter one or two inches into rectum.
8. Allow fluid to flow in slowly at low pressure.
9. When distention is relieved, cleanse baby carefully.
10. Wrap warm diaper around baby.
11. Chart results.
12. Clean and boil equipment used.

Diarrhea

Moderate frequency of bowel movements, especially in the breast-fed infant, may be entirely physiologic and unassociated with fever, vomiting or other evidences of gastro-intestinal disturbances. However, such diarrhea may be due to overfeeding, contaminated food or intestinal infection; every case should therefore be carefully studied. *A gastro-intestinal infection is not always associated with fever and may, therefore, go unrecognized and be of serious consequence.*

The colostrum almost invariably causes frequent bowel movements in the infant nursed by its mother. This is one of the chief reasons for the selection of wet nurses who have passed at least two or more weeks of their puerparium. The first milk also has a tendency to be high in carbohydrate and fat content, either of which may be a factor in the causation of frequent stools.

The average mother of a full-term infant can be permitted to select her own diet during the nursing period and be trusted to eliminate such foods as may cause colic, abdominal distention and diarrhea. However, such freedom of selection must under no circumstances be given to the mother or wet-nurse who nurses a premature infant. An indiscretion may cause cyanosis in the small infant or death due to abdominal disturbances. Therefore, every wet-nurse or nursing mother should be required to adhere strictly to the limitations of diet as prescribed under "Breast Milk," Chap. 12.

As long as the infant is passing yellow stools of normal odor, has no symptoms of indigestion, and is gaining in weight, the diet should be maintained. The number of stools per day for a premature infant who is progressing satisfactorily may be as high as six. The change in color of the yellow stool to green, shortly after passage, is the normal process of oxidation. However, the green, frothy stool containing small white curds and much mucus should always be considered abnormal. Such stools usually lose their normal acid odor and cause excoriation of the buttocks. This condition is frequently found in the breast-fed premature infant. Therefore, although the care of the infant is of paramount importance, yet no less essential is the prudent regulation of the mother's surroundings, her mode of living and diet as well as her psychic state, such as freedom from anxiety.

The nurse should keep an accurate record of the premature infant's stools. As soon as a baby is diapered, if it has had a stool, the nurse should immediately record the stool as to size, color and consistency. The consistency of the stool is most important. Two watery stools are far more serious to the infant than four pasty ones. If, at the end of 24 hours, any baby has had more than four stools, this fact should promptly be reported to the physician so that immediate treatment can be started. Negligence to report early evidence of diarrhea may result in mortality.

Tarry stools are always due to the presence of blood, which may be coming from abrasions of the intestinal mucous membrane. Such lesions are likely to lead to fatal infections, and therefore must always be given prompt and serious consideration.

Treatment. The nurse can aid in the prevention of diarrhea by:

1. Practicing aseptic technic.
2. Feeding the infant.
   a. Breast milk, or
   b. Carefully selected artificial food.
3. Avoiding overfeeding.
4. Early recognition and prompt treatment.

Every precaution must be taken in reducing the infant's diet. Dietetic measures similar to those recommended for the treatment of indigestion apply to every case of diarrhea with abnormal stools, since they are almost invariably attendant on an intestinal indigestion or infection.

The excessive water losses and the consequent dehydration of the body tissues that follow diarrhea must be met with the administration of sufficient water. In all cases of diarrhea, therefore, at least one-sixth of the body weight in water is given daily. The normal infant's stool forms a water margin about the semisolid mass, approximately one-half to three-quarters of an inch in diameter. When more water than this is lost with each stool, the infant must be carefully weighed, and its water losses noted, so that they may be compensated.

A mild case of diarrhea can be treated by:

1. Feeding breast milk (with or without added lactic-acid milk or 2 per cent of calcium caseinate).

2. If artificial feeding is unavoidable, feeding mixture of low fat and carbohydrate content, such as skimmed lactic-acid milk or other weak milk mixtures.

3. Weak tea or one-half strength Ringer's solution between feedings.

If improvement is not seen within 24 hours, treat as a severe case.

1. Stop all feeding by mouth for 24 hours, or give only weak tea (one-third to one-sixth of body weight in 24 hours), fed at two-hour intervals.

2. Administration of fluids subcutaneously at 6- or 8-hour intervals, if fluids are not well taken by mouth.

3. Start with small feedings to re-establish food tolerance.

Breast milk, or

Breast milk and skimmed lactic-acid milk in equal parts, or

Breast milk plus 2 per cent calcium caseinate, or

Weak artificial food mixtures.

4. Increase milk as tolerated. Usually it will take two or three days to attain amount of previous feedings.

5. Medication has only a limited value.

Tinctura Opii Camphorata (Paregoric), 2 to 5 drops.

Brandy, 3 to 10 drops.

Constipation

A sluggish lower bowel is common in the premature infant. In fact, the lack of power of the muscular wall and the minimal reaction of the mucous membrane to mechanical and chemical stimulation are both important etiologic factors and are often associated with intestinal distention. The first evidence of such hypo-irritability of the colon is often noted in the inability of the premature infant to evacuate the meconium which has accumulated in the lower bowel. If the infant has not had an evacuation of meconium by the end of the first 24 hours, a small saline enema is given under low pressure. This procedure will also help to ascertain whether or not there is a congenital obstruction of the lower bowel. Atresias in various parts of the intestinal tract or an imperforate anus must be considered among the possible causes of constipation.

The next stage of the infant's existence which is associated with constipation is in the first few days of life when food ingestion is insufficient and below the caloric requirements of the infant. In the absence of other causes, constipation may be considered a symptom of underfeeding, as it always is when "hunger stools" are present. Increasing the quantity of the food judiciously removes the trouble. However, the nurse should be aware of the fact that diarrhea is of graver consequence to the infant than is constipation.

As the infant's digestive function improves, and it utilizes its food to the fullest advantage, constipation may result from the minimal amount of food residue. The best evidence of such a causative factor, when sufficient food is being given to the infant, is the improvement in its general condition and gain in weight. In fact, when the infant utilizes all of its food, a tendency to constipation exists so long as the food intake is not in excess of its required caloric needs. Therefore, feeding such an infant moderately in excess of its normal caloric needs usually overcomes the constipation. In treating constipation in an infant whose ability to digest food is minimal, increase in the water intake is frequently beneficial.

Even the premature infant is a creature of habit. When it is necessary to assist the infant in the evacuation of its bowels, this should be practiced at a stated hour, once or twice daily, either by inserting a thermometer, the tip of a well-oiled catheter or a small suppository. Drugs administered directly to the infant are dangerous agents and should be avoided whenever possible. Five to 10 minims of milk of magnesia may be administered occasionally, but only after attempts at correction with mechanical irritation.

Epidemic Diarrhea of the Newborn

Recently, there has been an increasing number of reports of epidemics of severe diarrhea with a high mortality rate among newborn nurseries. The etiology and subsequent course of such outbreaks clearly point to the conclusion that "epidemic diarrhea of the newborn" must be classed as an acute infectious and communicable disease.

Etiology. To date no one specific etiologic agent has been accepted as the cause of epidemic diarrhea of the newborn. Bacteriologic studies of secretions from the nose, throat and feces that have been taken both early and late in the course of the infant's illness have failed to produce uniform findings. Neither from infants in a single epidemic nor from epidemics in different institutions can sufficiently related findings be obtained to satisfy the requirements for designating a single causative factor. In all of the more recent epidemics, at least, the flora taken from the nasopharynx and stools of the mothers, nurses and physicians have also given inconclusive results.

While there is a great similarity in the symptomatology and course of the various outbreaks that have occurred throughout the country, the cultural and pathologic studies indicate that the condition may be due to one or more organisms or a virus or a combination of these in symbiosis, for whose identification our present bacteriologic technics seem inadequate.

There have been two small outbreaks of epidemic diarrhea of the newborn in the newborn nursery of the Michael Reese Hospital. In the first of these, the cause was believed to be a *Streptococcus mucosis* which was isolated from the stools of a number of the infants, as well as found in great number in the stools of one of the infant nurses. In the second epidemic, a virulent hemolytic streptococcus was isolated from the throat of one of the attendants.

In two Chicago hospitals in which there were serious epidemics with a high mortality, the only factor found which might have been the cause was the feeding of a solution of 5 per cent glucose to all of the infants. Since these last two epidemics, at the Michael Reese Hospital no carbohydrate feedings are given to newborn infants during the first three days of life.

Concerning the contributory factors, symptomatology and treatment, we quote from the excellent discussion of epidemic diarrhea by Frant and Abramson:[24]

> **Contributory Factors.** In order to understand the clinical aspects of the disease it is necessary at the outset to bear in mind those factors contributing toward the inception and spread of outbreaks. The increasing number of deliveries of expectant mothers in hospitals has made unforeseen demands on these institutions, but the facilities for the care of the babies have not kept pace with these demands. Newborn babies, whether full-term, premature

or congenitally diseased or malformed, are being cared for collectively in open nurseries. In addition, these babies are often attended in their daily routine by an understaffed nursing personnel, often unacquainted with and untrained in the details of aseptic nursing technic, and are continually transported for feeding from the open nurseries to their mothers in the open maternity ward. Add to this routine the constant manipulation of the babies for dressing, diapering, bathing and administration of treatments, and one is confronted with the characteristic picture of chaos and disorderliness which occurs daily in any newborn nursery. Inadequacies likewise exist with respect to proper nursery, formula room, utility room and laundry equipment, and facilities for the segregated care of premature infants and of infected infants.

All these defects, taken in conjunction with the notorious susceptibility of newborn babies to infection and the remarkable rapidity of spread of infection from baby to baby in nurseries of this type, comprise in brief the typical setting and situation in which outbreaks of epidemic diarrhea of the newborn characteristically occur.

Symptomatology. Period of Incubation. The median period of incubation of the disorder is six days. However, manifest signs of the disease may occur as early as one day.

Stage of Invasion. Early in the course of an outbreak the acute symptoms may be preceded for one or two days by preliminary signs indicative of a gastro-intestinal disturbance, such as lack of appetite, drowsiness, arrested weight accretion or loss in weight, occasional vomiting, distention, and change in the character and increase in the frequency of stools. The body temperature is normal and physical examination shows nothing unusual. At the height of the outbreak the prodromal symptoms are less evident and the onset of illness becomes more acute, merging rapidly with the stage of intoxication.

Toxic Stage. In this stage of the disease the well-known symptom train of progressive intestinal intoxication rapidly unfolds in all its phases. The general appearance of the baby soon changes from that of a previously healthy nursling to that of an intensely dehydrated and toxic infant in shock. The acid stools, expelled forcibly, increase considerably in frequency and are characteristically very watery and yellow, less often greenish or brownish. Blood and pus are conspicuously absent, and little or no mucus or curds are seen. With the marked depletion of body fluids considerable loss in weight occurs, amounting to as much as a pound or more in a day. Signs of severe dehydration and acidosis ensue. Drowsiness deepens into coma and the cry is feeble and short. Vasomotor collapse is indicated by ashen gray color and cherry-red lips. The skin and mucous membranes are dry and tissue turgor is lost. The eyeballs and fontanels are sunken and the breathing is hyperpneic. The urine is scanty, vomiting may increase; abdominal distention is more marked. Except when complications occur, the temperature remains between 99 and 100° F. (37.2 and 37.8° C.), seldom rising higher than 101° F. (38.3° C.). It is interesting to note that convulsions are rare. In other respects physical examination, except perhaps for questionable redness of the throat, reveals little of note to account for the severity of the symptoms. In very severe cases death occurs rapidly.

Stage of Recovery. In mild or moderate cases and in those babies fortunate enough to weather the severe form of disease, recovery is manifested by the usual signs of decrease in the frequency of stools, arrested weight loss, improved tissue turgor and return of appetite.

Complications. The complications of the disease are, in the main, late otitis media and terminal bronchopneumonia and are heralded by abrupt temperature rises. At times, secondary invasion by pyogenic organisms may cause a terminal septic phase in which foci of suppuration appear.

Duration of Illness. In fatal cases death occurs in from one to 25 days; the median is seven days. The duration of illness in recovered cases ranges from three to 26 days, the median being nine days.

Prognosis. In general the prognosis in cases of epidemic diarrhea of the newborn is very poor. Among the babies exposed, just under 15 per cent are attacked. The mortality rate is 7 per cent and the case fatality rate about 50 per cent. Thus one half of all babies infected usually die. The prognosis in premature infants is even graver. Of course, this mortality in individual outbreaks is influenced greatly by the severity of the infection, the type of baby involved, and the time when disease is recognized and treatment begun.

Treatment. The treatment of the disorder is highly unsatisfactory. In part these poor results may be due to the lack of acquaintance with the clinical picture of the disorder and, therefore, to delay in diagnosis, and in part to the failure to institute early, complete and intensive therapy. It cannot be emphasized too strongly that the success of therapeutic procedures depends on early recognition and prompt treatment of the disease.

Essentially, therapy should be directed toward combating impending or existing acidosis and dehydration, and toward the replacement of depleted body fluid. Total restriction of food for periods as long as 12 to 24 hours is of importance. Prompt steps should then be taken to counteract the acidosis and dehydration, to restore blood volume and kidney function, and to replace lost body fluids and mineral salts. To that end, either subcutaneous or intravenous administration of measured amounts of physiologic fluids should be used, such as normal saline, or Hartmann's or Ringer's solutions with or without the addition of dextrose. The continuous method of intravenous injection is probably the most effective and the method of choice.

When the fluid content of the blood and the normal protein level are approximated, transfusions either of whole blood or of serum are indicated. The addition of food should be begun with extreme caution and only in small amounts, stepped up slowly, depending upon the severity of the diarrhea, the depth of the intoxication and the general condition of the baby.

To date, no known drugs, serums or vaccines are available to counteract the infection. Various drugs of the sulfanilamide group have been tried, but the cases so treated are too few to justify any conclusions.

The essentials in the control of epidemic diarrhea of the newborn are:

1. Recognition of the possible causes.
2. Immediate reporting of suspected infants to the Board of Health.
3. Closing of obstetric services and newborn nurseries to new patients on the slightest suspicion of the presence of epidemic diarrhea.
4. Isolation and quarantine of all sick infants.
5. Close observation of all exposed infants.
6. Follow-up of all infants recently discharged from the hospital by both the physicians responsible for their care and the Board of Health.
7. Readmission to the same hospital of babies found ill. If they have already been admitted to another hospital, it should be notified of the infant's exposure.

22

The Liver and Bile Passages

PHYSIOLOGIC JAUNDICE

Jaundice in the newborn is regarded as normal, since all infants have some elevation of serum bilirubin (bile pigment) during the first weeks of life. Only when it reaches an excessive level, is there sufficient discoloration of the skin to make the jaundice evident on inspection. Examination for jaundice should be made by daylight, as it is difficult to observe by artificial light. Jaundice is more frequently present and is usually more prolonged in the premature infant than in the full-term child.

Hyperbilirubinemia is the result of the increased destruction of blood cells after birth, which is followed by the formation of bile pigment. The degree of icterus is dependent on the ability of the liver to excrete the bilirubin. The greater tendency to hyperbilirubinemia in the premature infant is due in part to the high red blood cell content of the blood, the higher percentage of immature cells in the circulation and the immaturity of the liver. It is usually most intense toward the end of the first week of life, following which it gradually decreases. It may be present for as long as four to six weeks.

Examination of the blood for serum bilirubin and icterus index are the two laboratory means used to determine the presence of an increase in bilirubin content. Both serve the same purpose.

Jaundice can sometimes be detected when the bilirubin is more than 2 to 3 mg. per 100 cc. of blood (adult level, 0.6 to 0.9 mg.). More often, however, it is not noted until the level reaches 4 to 5 mg., or higher. Normal blood serum has an icterus index which is ordinarily between 4 and 6 mg. Clinically, recognizable jaundice usually occurs when the index lies between 8 and 15. In the newborn infant, it may reach 15 to 20 or more by the seventh day. The indirect van den Bergh test is considered more accurate than the colorimetric method used for determining the icterus index of the blood.

Symptoms. Icterus of milder types is most readily detected in the sclera. Later it becomes manifest in the skin of the face and chest, and is usually less evident on the extremities. In races other than the white, it is more easily determined by examination of the mucous membranes.

Bile pigment may be found in the stools of all infants who are free from obstruction of the bile passages. If the bile ducts are obstructed, the stools become white and chalk-like in appearance. The urine, in physiologic jaundice, may contain bilirubin, although again it may be free of bilirubin even in the presence of severe icterus.

Diagnosis. Jaundice usually appears first between the second and seventh day of life. When it is present at birth, or is seen on the first day, the condition described as icterus gravis should be suspected. When the jaundice increases in severity during the second week, a septic infection, congenital syphilis, obstruction of the bile ducts or icterus gravis should be suspected.

Physiologic jaundice disappears without treatment and does not require special attention.

CONGENITAL OBLITERATION OF THE BILE DUCTS

Congenital obliteration of the bile ducts may be due to atresia at the point where the common duct opens into the duodenum, or it may be the result of failure in the development of the common duct, the hepatic or cystic duct or in all of them. When the cystic duct is affected, the gallbladder itself is usually involved also. In place of atresia or nondevelopment in any one of the ducts, a stenosis or obstruction alone may be present at some point. In the cases with localized obstruction, surgical interference may give a favorable result. Again, the obstruction may be postnatal and due to inspissated bile in the ducts. In such instances, the obstruction is often transient. If the obstruction is permanent or organized, the infant becomes deeply jaundiced, the liver is enlarged and deeply pigmented and biliary cirrhosis develops.

The pancreas usually undergoes cirrhotic changes with cystic degeneration of the ducts. The islands of Langerhans may escape either completely or partially. The spleen is usually enlarged and fibrotic, and the skin assumes an olive-green color. The stools are gray or chalky, and if obstruction is complete, may be entirely free of bile pigment. The urine becomes dark brown in color, and the van den Bergh reaction is of the direct type as compared with that in physiologic jaundice. The blood-sugar level is usually low.

The general condition of the patient may be good early in the condition, but gradually becomes worse, and death is frequently due to secondary infection. All of the appearances of inanition are more evident when obstruction of the common duct is present, since the pancreatic juice does not reach the intestinal tract in such cases. An infant with obstruction of the biliary passages may live for several months, but sooner or later it will develop a cholemic state of intoxication.

Treatment. Exploratory laparotomy should be undertaken in the larger premature infant as well as in the full-term child, when there is an obstruction because of congenital malformation. The operation may be temporarily postponed, if the condition is thought to be due to a "temporary" obstruction from inspissated bile. The delay, however, should never be prolonged.

Before operation is undertaken, the prothrombin level of the blood should be raised by the subcutaneous administration of vitamin K. Supportive measures by the giving of vitamins A, B, C and D, as well as injection of saline and glucose and transfusion with human serum or blood, are indicated. The best results following surgery are obtained when only the common duct is involved.

ICTERUS GRAVIS

Under the heading of icterus gravis, a number of different conditions have been described, all of which are associated with severe icterus, and most of which have nearly always been fatal. One condition of this type is a severe icterus associated with infection. It has long been recognized that such a severe infection may be a complication of sepsis, probably as a result of destructive processes which occur in the liver. In this group may also be included the cases of icterus which are to be seen in cases of florid fetal syphilis.

The second group is the condition designated as erythroblastosis neonatorum.

The third group is concerned with the so-called nuclear icterus. This condition is evidently familial in nature and consists essentially of severe jaundice associated with involvement of the basal ganglia. Prematurity itself is not directly responsible as far as is known. Clinically, jaundice is an outstanding feature. It usually appears in intense form on the first or second day of life. In some instances, spasticity and convulsive seizures may be noted, but these conditions do not differ in any way from neurologic symptoms that develop in other forms of icterus. The blood shows a definite indirect van den Bergh reaction and the icteric index is high.

Generally, the infants die early—in most instances on the second or third day. Pathologically, the condition is manifested by definite icteric staining of the basal ganglia of the brain. At times, parts of the cerebellar cortex and anterior and posterior horns of the spinal cord are involved. Most of those who have written on the subject believe that the condition is primarily due to pathology of the nerve cells with secondary deposit of biliary pigment.

No treatment has been suggested for this condition.

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Hernia

UMBILICAL HERNIA

More than 70 per cent of premature infants develop umbilical hernia of sufficient size to require early attention. Treatment should be started as soon as the umbilicus is dry and cicatrized. The umbilicus should be inverted, using the abdominal skin and subcutaneous tissue to form a supporting pillar on each side. Zinc oxide adhesive plaster is then applied. The plaster should be changed as soon as there is evidence of moisture leaking beneath the tape. Two-inch plaster is preferable, and the old type, not the dry-back variety, has the better adhesive quality. In removing the plaster, the edge should be elevated, and a clothes-cleaning fluid should be applied to the under-surface in order to avoid irritation of the skin. The infant can be tub-bathed if the plaster is well adherent.

INGUINAL HERNIA

Rambar and Goldberg,[25] in their study of 830 premature infants discharged from the premature station of the Sarah Morris Hospital, found 38 who had developed inguinal hernias, an incidence of 4.8 per cent.

Thirty-one of these hernias were in males and seven in females. Six of those occurring in the males were bilateral. Since the peritoneal process formed by the descent of the testicles is normally not closed until term, this in all probability was the potential factor in some of the cases. More important were conditions producing increased intra-abdominal tension on the immaturely developed musculature of the abdominal wall. Such contributing factors in these infants were phimosis in 12, anal stricture in one, constipation in six, diarrhea in seven, cough in eight, excessive crying in three and pylorospasm in three. The age of onset is shown in Table XII.

Table XII

AGE AT ONSET OF HERNIA IN CASES STUDIED

AGE IN MONTHS	NO. OF CASES
1	2
2	16
3	14
4	2
5	2
15	1
24	1

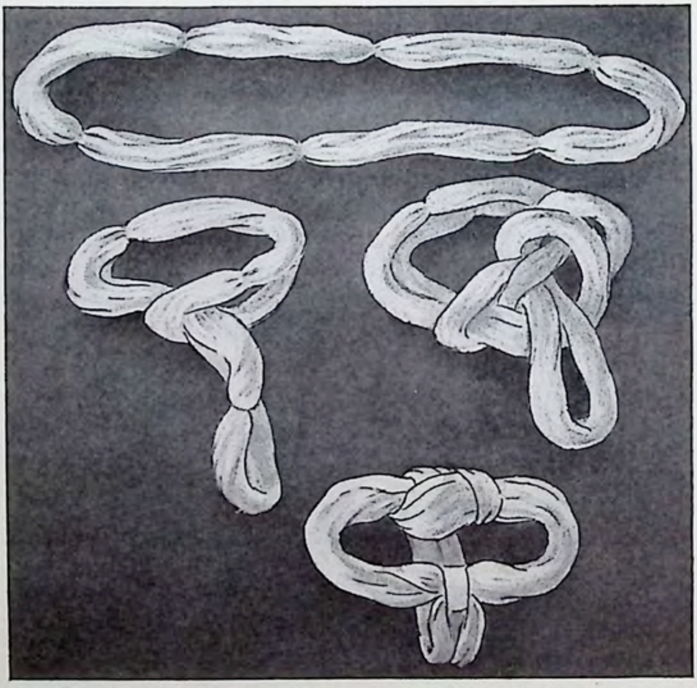

Fig. 54. Truss made with skein of medium-weight wool yarn.

True strangulation occurred in six of the 38 infants (16 per cent). Of these, four were males and two were females. This complication occurred immediately after the original appearance of the hernia in four infants, six days later in one, and six weeks later in the remaining one. Fortunately, in five of the six infants the complication was recog-

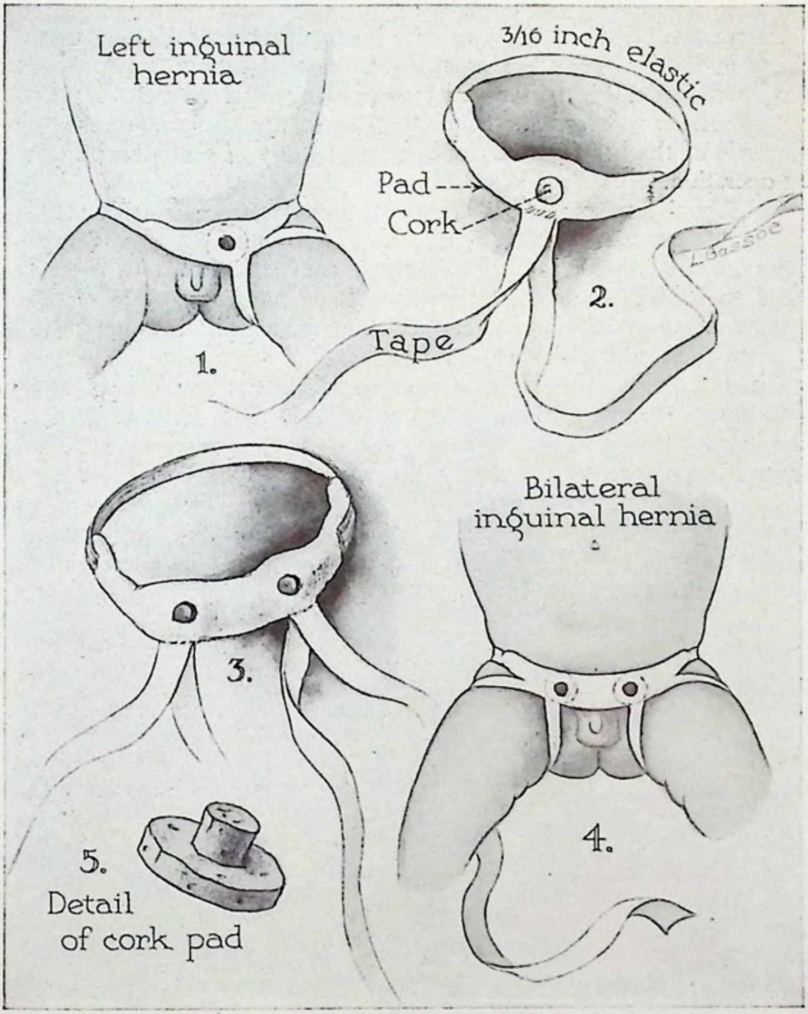

Fig. 55. Cork pad trusses for single and double inguinal hernia.

nized early by the parents, and operation was followed by recovery. The other infant was greatly dehydrated and moribund when first seen and died from shock five hours following operation.

Preoperative and postoperative care is very important. Treatment of shock and dehydration are paramount. External heat, subcutaneous fluids, oxygen and intramuscular blood have proved valuable adjuncts. These infants recovered in remarkably short time. Symptoms of recurrence of the hernia have not occurred in any of the babies treated by operation.

Conservative treatment has been used for all uncomplicated cases of hernia. Yarn trusses (Fig. 54) as devised by Fielder, the cork-pad truss described by Hess (Fig. 55) or soft rubber trusses have been applied to all infants, except those who have had immediate circumcisions. Every male infant should be examined for phimosis, and when present, the foreskin should be dilated.

Circumcision was performed on eight infants when the hernia was first noted. In five of these there was an immediate disappearance of the hernia; two disappeared within a few days, and one infant with large bilateral irreducible hernias improved so well that the masses became smaller and were easily retained by a truss. The greater rapidity with which the hernias disappeared after circumcision was striking.

The average time of disappearance of the hernia in those infants treated with trusses was 2½ months.

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Anemia in the Premature Infant

Before discussing the blood of the newborn premature infant and the changes that occur during its first years of life, the changes that occur in the blood of the normal full-term infant will be considered for comparative purposes.

FULL-TERM INFANT

In the great majority of instances, the high hemoglobin level present at birth in the full-term infant tends to fall early in neonatal life, and eventually we see the so-called "physiologic anemia"[26] of the young infant. Simultaneously, there is a rapid reduction in the number of red cells and a fall in the number of reticulocytes. However, the red-cell count rarely drops below 3,500,000 per cu. mm. and the maximum fall is almost always seen by the sixth to the tenth week. An increase in the number of reticulocytes usually appears during the third month, and coincident with this, there is an increase in the number of red cells and the amount of hemoglobin. However, the red cells tend to increase more rapidly than the hemoglobin content. As a result, the color index usually falls below unity, especially after the first three months, and maintains a value generally not above 0.8 to 0.9 for the remainder of the first year.

The number of white cells may vary from 6,000 to as high as 30,000 per cubic millimeter at birth, although more often they vary between 12,000 and 18,000. The count gradually diminishes during the first week or ten days. Myelocytes are frequently seen at birth. As the total number of white blood cells falls, that of the lymphocytes rises until, at the end of the first week, they may constitute more than 50 per cent of the total.

The number of platelets is somewhat lower in the first week than later, but it rarely goes below 100,000. It is questionable whether or not the small number of platelets is of much significance in relation to hemorrhage. Clotting time is ordinarily not prolonged. Bleeding time is usually within regular limits, but is at times increased in some normal infants without tendency to hemorrhage.

PREMATURE INFANT

In general, the effect of prematurity is seen in an exaggeration of many of the characteristics found in the blood of the full-term infant. Starting from the same or a higher point, the red cells and hemoglobin decrease for about six or eight weeks and reach a level somewhat below that of the full-term infant of the same age. The spontaneous rise seen in the normal baby at the end of the second month is less apt to develop. While these conditions are not shared by all premature babies, the lower the birth weight, the more likely are they to be present. Full-term twins and infants of low birth weight may behave in a similar manner.

The number of reticulocytes in the premature infant tends to be higher at birth, followed by a period in which they are reduced. An increase then occurs at two months or later, usually at the time when the hemoglobin is at a low level. Nucleated red cells are more frequently seen and persist somewhat longer, but are not ordinarily encountered after the first week. Although the white cell count is, in general, no higher than in the full-term infant, the shift toward immaturity of cell form is often more pronounced.

Little is known concerning the agents regulating the formation and destruction of blood cells and the extent to which these processes in the fetus are influenced by factors derived from the mother. The make-up of the fetal blood is so different from that of the mother that a largely independent mechanism must be assumed. Moreover, anemia in the mother is only rarely coincident with anemia in the newborn baby. In the premature infant there is evidence that the rate of blood destruction is relatively greater and more prolonged than in the full-term. However, indication of true "hypoplasia" does not exist, since reticulocytosis occurs when the hemoglobin falls to the anemic level.

As the premature infant becomes older, it becomes subject to the usual extrinsic factors, the effect of which appears to be more destructive to the red blood cells than in the full-term infant. Two phases of the anemia occurring in premature infants are conspicuous.

The first is the early *physiologic anemia* which does not differ in any way, except quantitatively, from that which affects the full-term baby. There is little evidence to indicate that the iron deposits in the liver, marrow and tissues of the premature infant are insufficient to meet its earliest requirements. During the first weeks of life, when the anemia is developing, failure or partial failure of the blood-forming organs to react to hematopoietic stimulants, such as iron and copper, is apparent. However, normally after the sixth week of life, when iron or liver is administered, there is a rise in the number of reticulocytes, and subsequently, an increase in the red-cell count and in the amount of hemoglobin. Ample evidence proving that iron fed during the earliest weeks is stored in part for future use indicates that iron should be added to the infant's diet by the third or fourth week. Iron is distinctly a bone marrow stimulant.

The second phase is the period characterized by increased red cells with a diminished formation of hemoglobin and a resultant hypochromic anemia, usually perceptible by the third or fourth month. Recovery from this phase is rather slow for the premature infant and often is not completed until the second year of life. Nevertheless, reaction to hematopoietic stimuli, such as iron and liver, is almost always good. Extrinsic factors, such as infections or a poorly balanced diet, are important agents in exaggerating the condition.

As has been stated, the iron deposits in the liver and in the vascular system of the premature are manifest in most premature infants in quantities ample to meet its requirements in the first few months. According to Wallgrem's [27] studies, 30 to 40 milligrams of iron are present at birth in the average premature infant, while 70 to 100 milligrams are the average in the full-term infant. These amounts of iron are sufficient for the formation of double that number of cubic centimeters of blood. However, the body weight of the full-term infant is doubled in the first six months of life, while that of the premature infant is often quadrupled in the same period. The relatively greater demand on the supply of iron and on the function of the bone marrow in the premature infant, as compared with that in the full-term baby, can readily be appreciated. It seems probable, therefore, that these factors bear an important relationship to anemia in the premature infant.

During recent years, the decrease in the number of severe cases of anemia seen in premature infants may be related largely to the improved knowledge of the requirements of diet for the formation of blood cells and of the prevention of injurious exposure to infection.

Therefore, the anemias seen in premature infants will be considered in relation to two groups of factors:

1. Those cases in which the anemia is primarily dependent on the state and degree of prematurity.

2. Those cases following inadequate feeding or trauma or other external influences and infections. Among the acute infections, those of the upper respiratory tract, pulmonary, intestinal and genito-urinary are important, while among the chronic infections, syphilis is of great significance.

Symptoms. The severe forms are marked by intense pallor, and the skin has a waxy or white appearance with the superficial veins prominently in evidence. The mucous membranes and nail beds are extremely pale. The liver and spleen may be moderately enlarged, and the spleen, in many infants, is distinctly palpable through the thin abdominal wall.

Treatment. In the treatment of anemia, consideration must be given to:

1. Diet.
   a. Routine feedings.
   b. Additions of vitamins and minerals.
2. General hygiene.
3. Blood transfusions.

DIET. When it is realized that a relative functional insufficiency exists, not only of the blood-forming organs, but of the gastro-intestinal system as well, the importance of proper nutrition of the infant is evident. The diet of necessity must consist largely of milk amplified by vitamins and minerals. The latter become increasingly important when considered in terms of requirements for rapid growth and development.

For details on routine feedings, see Chaps. 11 and 13.

VITAMINS. Since anemia must in greater part be considered as a deficiency disease, it is easily apparent that the diet should be well supplied with vitamins A, B complex, C and D. (See "Vitamins," Chap. 14.)

Whether the infant is being fed on breast milk or cow's milk, it should have an abundance of vitamins added, since milk in the quantity which the premature infant can take cannot contain sufficient amounts of vitamins and iron to meet its full requirements.

We believe that at least thiamin and riboflavin can be considered as valuable therapy. They can be added singly or as powdered yeast or as wheat germ. Several good preparations are available, containing thiamin and riboflavin combined with ferric or ferrous iron salts.

Raw egg yolk in quantities of one yolk added to a quart of milk, human or cow's, furnishes the infant with iron, vitamins and fats in an easily assimilable form during the first weeks. We have never noted any undesirable reaction from the egg-yolk-milk mixture in the premature infant.

The time at which foods other than milk can be added is dependent on the fetal age, weight and physical condition of the infant. Therefore hard and fast rules cannot be prescribed for the addition of cereals, vegetables, liver and other foods.

MINERALS. The addition of iron is a necessary adjuvant to all other measures recommended in the treatment of anemia. Iron is essential for the formation of hemoglobin and it stimulates the blood-forming tissues. The iron is especially valuable in the hypochromic anemias seen in the premature infant and which are in large part due to a deficiency of iron and immature blood-forming organs. The added iron may be latent in its effect during the first weeks or months of life, but, at least in part, is stored for future use. Even in the older premature infant there may be one or more weeks of latency before an increase of reticulocytes, hemoglobin and red cells can be noted.

Copper, when given in conjunction with iron, may accelerate hemoglobin formation. Apparently, if fed alone, it is ineffective. The iron preparations recommended and the doses prescribed contain a considerable, and probably sufficient, amount of copper to meet the infant's requirements, at least until foods containing an increased amount of copper, such as eggs, vegetables, etc., will be added to the diet.

A liver extract may be of distinct benefit in the various types of anemias. Whether the effect is due to the fraction giving the specific effect to pernicious anemia or whether the effect is nonspecific and largely due to the iron and copper content, together with the so-called extrinsic factor, is still a question. Several good liquid and dry liver preparations in which iron has been combined with the liver are available. Older infants may be fed puréed liver in amounts of 5 grams per kilogram of body weight per day. Parenteral liver therapy may be indicated in the exceptional case.

PREPARATIONS CONTAINING IRON AND DOSAGES. Ferric ammonium citrate is the preparation most commonly used in the Premature Infant Station of the Sarah Morris Hospital. It is conveniently administered in milk. A 10 per cent solution is prescribed, and at first, amounts of 0.5 cc., and later up to 2 cc., per kilogram of body weight (0.25 to 1 cc. per pound) may be given daily. The infant receives from ¾ to 3 grains per kilo, or ⅜ to 1½ grains per pound of the iron salt daily. Ferrous sulfate is also recommended as a source of iron. A comparable dose is 2½ grains of hydrated salt per kilogram of body weight (1½ grains per pound). We have found, however, that such large doses are often not well tolerated by these small infants, and therefore much smaller doses should be recommended. We prefer the ferric ammonium citrate which has been better tolerated, especially when used over long periods. The iron preparations should be given between feeding periods, rather than in milk. The presence of hydrochloric acid enhances the absorption.

Several excellent liver and iron preparations are also available. In each level teaspoonful of Lilly's compound there is approximately 58

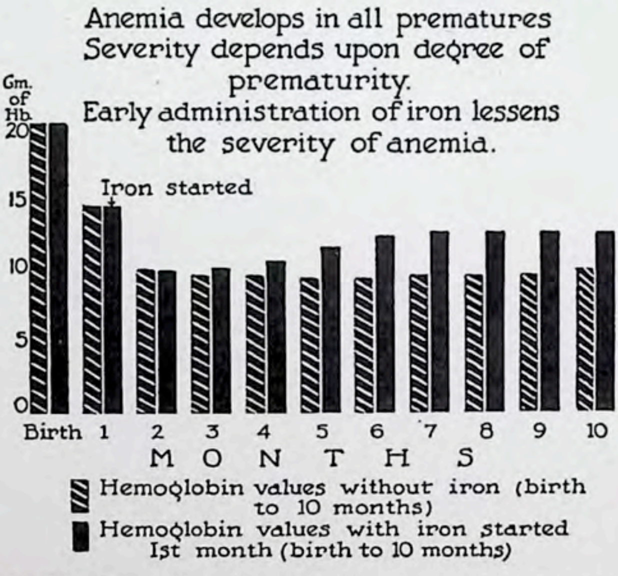

FIG. 56. Comparative hemoglobin values with and without iron.

grains (3.75 grams) of liver fraction and 10 grains (0.65 gram) of ferric ammonium citrate. The initial amount should be four grains (one-fourth gram) daily, which can be increased up to one dram (four grams) each day for the older infant.

VENTRIX (desiccated hog's stomach) in combination with iron is also obtainable. This preparation has been chiefly recommended in the treatment of pernicious anemia. We have used it with good results in hypochromic anemias. The ventriculin when given alone does not have the desired effect. The exact function of ventriculin in combination with iron in the anemias of the premature infant is not definitely understood.

OTHER FACTORS. In addition to the vitamins and minerals in the diet, sunlight and fresh air are of the utmost significance to the infant, and these should be provided as soon as the infant's condition permits.

Sanford [28] has shown that ultraviolet irradiation in minimal doses two or three times a week causes at least a transient rise in erythrocyte and hemoglobin values.

TRANSFUSION. In extreme instances, transfusion of whole blood or human serum may be considered as imperative and a life-saving measure.

The immediate and most obvious action of a transfusion of whole blood is to raise the level of red cells and hemoglobin. In raising the hemoglobin values, whole blood has the same effect as iron medication but acts more quickly. Its action appears to be that of a bone-marrow stimulant with a resulting early increase in the reticulocytes. Transfusion of whole blood also increases the infant's ability to resist infection. With the added antibody content, it may have a direct effect in overcoming infection, or indirectly improve the condition of the infant so that the baby is better able to withstand infections.

Recently, human serum has become available. When the problem is one of raising the blood volume and supplying antibodies, the serum alone can be used with great benefit. Serum has an added advantage in that it can be given without preliminary laboratory typing and compatibility tests. At the Premature Station of the Sarah Morris Hospital, we have used it repeatedly without incurring reactions, taking for granted that meticulous care must be given to its preparation.

For further discussion of the value of transfusion and procedures, see Chap. 15.

INTRAMUSCULAR AND SUBCUTANEOUS INJECTIONS of whole blood can be used in place of a transfusion when an immediate need for increase in red cells and hemoglobin is not indicated. Such an injection also supplies the infant with antibodies and, in addition, has a further nutritional value. It can be repeated at regular intervals.

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Rickets, Tetany and Scurvy

RICKETS

Premature infants develop rickets early, if they are not properly protected by a diet which has been supplemented by vitamin D. However, etiologic factors other than a deficiency of vitamin D are also important. The mineral content of the infant's body is proportionately low, since it is dependent on the fetal age. Birk [29] found that at four months, the body of the fetus contains 14 grams of ash, at six months 30 grams, and at term the body has 100 grams. Two-thirds of the mineral content is apparently deposited during the last three months of fetal life. In the newborn infant, approximately 75 per cent of the mineral content is in the form of calcium and phosphate, which are the chief constituents of bone.

The situation is further complicated by the proportionate rapidity of growth in the premature as compared to the full-term infant. While the full-term infant multiplies its body weight three times in the first year of life, the small premature infant may increase its weight by seven times in the first year (see Fig. 4). The effect on the initially low supply of minerals can readily be understood.

The minimal feedings which the premature baby can take is another factor in the development of rickets. Since the calcium content of human milk is low, the infant has difficulty in metabolizing this food in sufficient quantity to prevent the withdrawal of some part of the inherited supply. Artificially fed infants are even more prone to develop severe forms of rickets.

The importance of vitamins in calcium metabolism can be seen from the fact that even a diet containing an abundance of calcium will not prevent rickets when an avitaminosis is present. A diminished calcium retention exists in the florid stage of rickets, although the intake is high. The avitaminosis has been found to be not only that of vitamin D, but of vitamins A, B complex and C also.

Craniotabes, megacephalus, beading of the ribs and chest deformities are early manifestations of neglected infants. Great epiphyseal enlargement and bowing of the long bones are, generally, not conspicuously present during the early months of the premature infant's life. In all probability, this is partly due to the fact that these infants use their extremities so little. For this reason, unless the infant is carefully watched for signs other than those which affect the extremities,

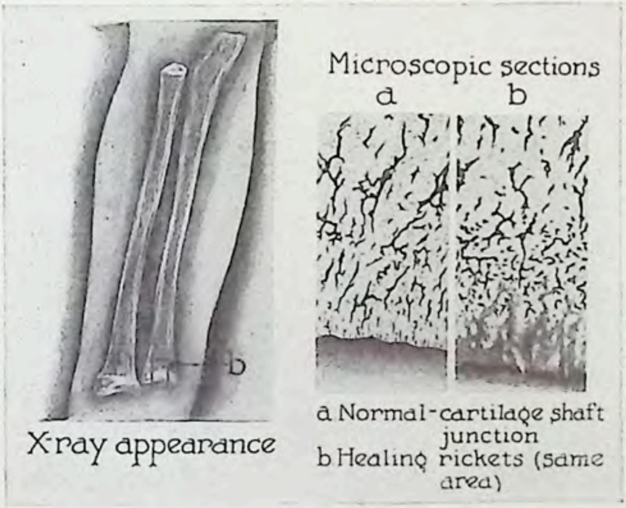

Fig. 57. Rickets. Rickets is dependent upon rate of bone development. Prematures are predisposed because of rapid growth. Histologic changes are present in bones before clinical signs.

the presence of rickets may be overlooked until the condition is well advanced.

Treatment. The prophylactic therapy for rickets is the same as that recommended for the full-term infant. Feeding of human milk is considered a preventive measure. Two to four times as much vitamin D as is given to the full-term infant, proportionate to its weight, is given to the premature infant. The vitamin D concentrates are more easily assimilated than the amount of cod liver oil that would be necessary to supply the infant's needs.

Vitamin C (ascorbic acid) is next in importance in prophylaxis. Orange and tomato juice, while high in vitamin C content, may not be as well received during the first weeks as ascorbic acid. As soon as the infant is able to take the quantities of orange or tomato juice recommended in "Prophylactic Feeding," it is well to substitute these for the ascorbic acid. Vitamin B_1 (thiamin) can also be advantageously added to the infant's diet. By the third month, cooked cereals should be included, and by the fifth month the infant should receive vegetables, either in soups or in finely puréed form.

Once rickets has developed, the food additions recommended for prophylaxis should be stressed as imperative requirements.

TETANY

Tetany is evidenced primarily by a hyperirritability of the nervous system. The same harmful factors that damage the activity of the blood-forming organs in the first month of life and interfere with normal calcification of the bones, in some unknown manner may also produce changes in the nervous system. In our experience, we have found a definite tendency on the part of the infant to develop signs of tetany during the active healing stage of rickets. This tendency may be due to the withdrawal of calcium from the circulation.

The signs of tetany may be divided into latent and active. The latent signs become manifest through the stimulation of various nerves. Chvostek's facial sign is produced by tapping lightly with a finger along the facial nerve, and is seen in the contraction of the alae of the nostrils, angle of the mouth and the eyelids. Trousseau's sign is elicited by moderately compressing the nerves and vessels of the arm, midway between the elbow and the shoulder, and results in the development of a carpal spasm, or so-called "obstetrical hand."

Active signs of tetany are seen as tonic spasms of the hands and feet. The fingers are flexed at the metacarpophalangeal joints with extension of the fingers. At the same time, the thumb is adducted and the wrist is flexed. The pedal spasm is evidenced by flexion of the toes and extension of the feet. Edema of the dorsal surfaces of both hands and feet is often present.

These clonic contractions may persist for hours, or even days, and are exceedingly painful. Convulsions are frequent. More commonly, they are mild with quick recovery from the individual attack, so that they may resemble petit mal. At times, however, they may be severe and prolonged. Laryngismus stridulus results in an inspiratory laryngeal spasm and usually follows crying. It is heard as an inspiratory crow, due to spasmodic closure of the larynx. Spastic apnea is usually described as a breath-holding spell. While these attacks are usually mild and transitory, they may result in cardiac death. Bronchotetany is a complex of pulmonary-bronchial symptoms simulating asthma.

Active tetany with classic, clinical manifestations rarely occurs in the breast-fed infant. It is more frequently seen in the artificially fed baby. The clinical manifestations are most frequently precipitated in the presence of infections, and therefore may be seen shortly after birth, if the mother has been ill or has been on a poorly balanced or otherwise inadequate diet. Such an instance was seen at the Sarah Morris Hospital in October, 1940. An infant, five days of age, had been born of a diabetic mother, who herself had been sugar-free during the last weeks of pregnancy. This infant had the classic signs of Chvostek,

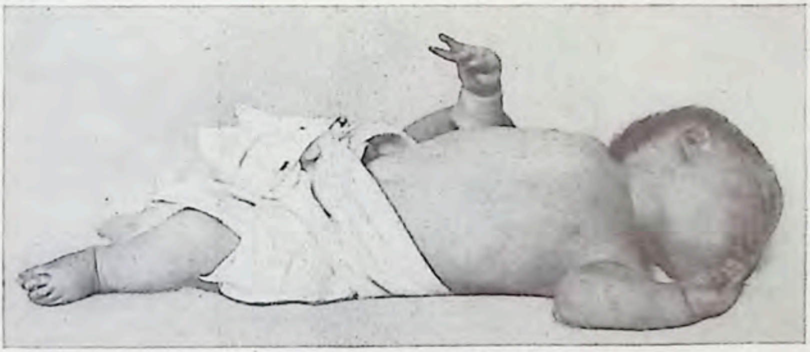

FIG. 58. Tetany. Tonic carpal and pedal spasm.

Trousseau and the carpopedal spasm. In the majority of infants, this spasmophilic tendency disappears with treatment of the anemia and rickets, which may be considered as predisposing factors.

Treatment. Latent tetany should be treated prophylactically by dietary measures to prevent the development of manifest symptoms. Breast milk, lactic-acid or hydrochloric-acid milk can be used temporarily as both dietetic and therapeutic measures. A cereal and vegetable diet should be instituted as soon as the infant's diet permits. Fruit juices are also essential.

Medicinal therapy must be considered, first, from the point of view of the symptomatic treatment of acute manifestations and, second, on ability to accomplish a permanent cure through the removal of the underlying causes. Calcium salts are best for combating the acute symptoms. Calcium chloride is the most active and best salt, and amounts of 10 to 20 grains may be administered daily for a few days. Calcium lactate in similar doses or calcium bromide in one-fourth such amounts can be used in place of the chloride. These drugs are best administered in the food mixtures. Full doses of cod-liver oil or the vitamin D concentrates should be given. Five drops of diluted hydrochloric acid U.S.P. may be given three times a day.

In the absence of pronounced gastro-intestinal irritation, when convulsions are present, an initial dose of castor oil, 15 drops (1 cc.), or

FIG. 59. Tetany. Pathologic fractures of radius and ulna due to carpal spasm.

magma magnesia, one-half teaspoonful (2 cc.) is a valuable adjunct to further treatment. A short period with starvation diet, consisting of tea and saccharine, should be followed by human milk when possible. In the treatment of repeated convulsions, excellent results have been frequently obtained with the administration of 0.5 to 1 cc. of a 25 per cent solution of magnesium sulfate, given subcutaneously daily for one or two days.

The injection of parathyroid hormone is indicated as a therapeutic measure in the presence of convulsions and acute manifestations, but is less effective than magnesium sulfate. In infantile tetany, a dose of 10 units, given subcutaneously, is advocated; such a dose is repeated after one hour, if the spasms are not relieved.

The use of ultraviolet rays has been found to be of great value as an adjuvant to cod-liver oil and calcium therapy.

Further measures should include the treatment of the secondary anemia. Efforts should be directed toward the prevention of all respiratory infections, more especially during the winter and spring months.

SCURVY

Acute florid cases of scurvy, with all of the classic appearances, such as malnutrition, secondary anemia and hyperasthesia, together with subperiosteal hemorrhages and hematuria; are seen only occasionally. Rare, too, are hemorrhages in the mouth and gums. Far more common among premature infants are the subacute or latent manifestations, characterized by insidious onset, including lack of gain in weight, anorexia, irritability and progressive anemia. Such latent cases are often overlooked. General improvement following the introduction of antiscorbutic dietetic measures usually confirms the diagnosis.

Treatment. Prophylactic feeding is the best preventive and must be instituted early to be effective. Human milk is the ideal food. For other dietetic measures, consult "Feeding," Chap. 11, and "Vitamins," Chap. 14.

Infants who are dependent on boiled, dried, evaporated, condensed or reconstructed milk foods must, necessarily, be given some antiscorbutic food in the first weeks. Vitamin C, in some form, should be started when the infant is two weeks old. Ascorbic acid may be indicated in these first weeks in the amount of 25 mg. per day. If the infant is sufficiently developed to take orange juice, it should be given, starting with one teaspoonful daily, and the amount increased to the juice of one orange as soon as digestion will permit. In the premature infant, the minimum protective dose, in all probability, is two or three teaspoonfuls a day. Fresh or canned tomato juice in doses twice as large as those advised for orange juice can be used. In some infants, however, such large quantities will result in diarrheal stools. Cooked, green vegetables and potatoes containing vitamin C, but in relatively smaller amounts, can be fed to older infants.

Once scurvy has developed, double the quantities of fruit juices or ascorbic acid recommended as preventive will be required. With some infants who have loose stools, the orange juice may have a beneficial therapeutic effect. When orange juice is not well received, ascorbic acid in doses as large as 50 to 100 mg. may be given during the acute

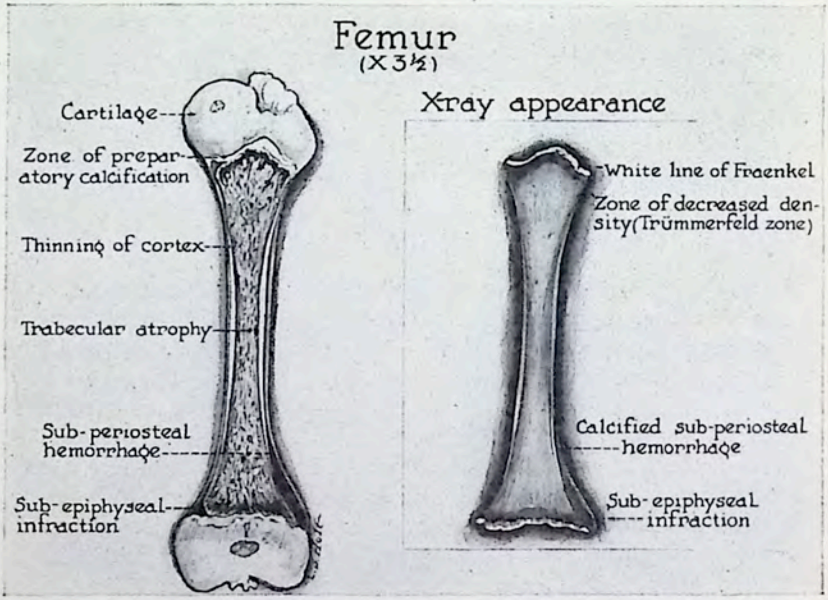

FIG. 60. Scurvy. Subclinical scurvy is common in premature infants (failure to gain, anorexia, irritability and anemia). Bone changes are demonstrable only in advanced cases.

stage. Later, it may be reduced, or fruit and vegetable juices substituted. Temporarily, ascorbic acid, intramuscularly or intravenously, can be injected in the presence of vomiting.

With sufficient vitamin C in the diet, if the other foods meet the infant's dietetic requirements, recovery is usually rapid and relapses are exceptional, unless the infant has acute intestinal disturbances or infection.

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Syphilis

Syphilis is one of the more frequent causes of premature birth. It is, however, even more often, the cause of intra-uterine death of the fetus, with resulting miscarriage. Congenital syphilis results from the intra-uterine infection of the fetus by *Treponema pallidum* (*Spirochaeta pallida*). The severity of the disease in the offspring of an infected mother, in whom the disease is active, is dependent on the stage of the disease in the mother, the amount of therapy she has received during pregnancy, and the time at which the treatment was initiated.

Infants who show signs of syphilis at birth have a high mortality rate. This is especially true of those born prematurely. The prognosis is much better for those who develop clinical symptoms several or more weeks after birth, because the disease is not so virulent in these infants. Fortunately, likewise, the disease does not seem so severe in a majority of the infants born near full term. The more active infections often cause fetal death during the later months of pregnancy.

It is generally assumed that the fetus is not infected until the latter half of pregnancy. This belief is based on the failure to find lesions and spirochetes in the tissues of the infant, even when treatment has been instituted late in the pregnancy. This opinion, however, must be accepted with reservation.

In the majority of instances, if the infant is not born until late in the last month or so of pregnancy, it may appear healthy at birth and continue so for several weeks, unless the infection in the mother herself has been active. Moreover, it is possible that the infant may escape, if the mother acquires her infection late in pregnancy. The less active the disease in the mother, the more likely is the infant to escape or develop the infection only in a mild form. If the mother is untreated or receives inadequate treatment, the history may be one of early miscarriages, followed by stillbirths. Later, viable infants with severe lesions may be born, and still later, infants who, to all appearances, have escaped the infection. Furthermore, the disease may become more active in the mother after she has given birth to a normal infant and may be manifested by active syphilis in a following pregnancy.

Two groups of organic changes in infants infected with syphilis deserve special consideration:

FIG. 61. Mask-like expression due to infiltration and rhagades about mouth.

1. Organic changes that are carried over from the fetal to the extra-uterine period, especially involvement of the viscera and osseous system.

2. Organic changes that appear after a period of latency in infants, apparently free from syphilis at birth, especially lesions of the skin and mucous membranes. Characteristic late manifestations, which may not appear for several years, are corneal opacities, optic atrophy, nerve deafness, vascular disease and the parenchymatous type of neurosyphilis. In addition, late changes in bone and tooth structures occur, the latter resulting in so-called Hutchinson's teeth. (Fig. 65.)

EARLY SYMPTOMS

Early symptoms of syphilis in the young infant are usually both constitutional and local. In the premature infant, the constitutional symptoms such as cachexia, emaciation with an "old age" appearance, and severe anemia are characteristic of the more severe types of infection. The symptoms become progressively worse if the disease is not diagnosed and early treatment is not started. The ultimate result must necessarily depend on the response to therapy.

The more apparent local symptoms are rhinitis, skin eruptions, mucocutaneous lesions, swelling of the extremities of the long bones, pseudoparalysis or restricted movement of the extremities and onychia. Infants born with syphilitic eruptions usually exhibit some degree of visceral change. Unfortunately, also, in these babies, the disease runs a much more serious course and the prognosis is less favorable than for those infants born without such visible symptoms.

MUCOUS MEMBRANES

Coryza is usually the first evident symptom. In its onset it resembles an ordinary cold but is soon characterized by its severity and chronicity. The discharge is profuse, becomes mucopurulent and is often tinged with blood. Obstruction of the nasal passages results from the formation of crusts, and mouth breathing follows and nursing becomes difficult. Pharyngitis and laryngitis are generally associated with the subsequent characteristic hoarseness and aphonia.

SKIN ERUPTIONS

If the skin eruptions are not present at birth, they usually follow the development of the coryza, but the eruptions are not necessarily preceded by the coryza.

The most common lesions, ones which are rarely seen at birth, are of two types. The first is marked by a diffuse, generalized skin infiltration. The skin becomes thickened, edematous, loses its elasticity, and, after a short period, the superficial layers often crack. Much of the skin has a waxy appearance with scattered inflamed areas, especially at the points of fissuring. This characteristic change of the skin may involve the entire body or appear only in isolated areas. The face and extremities, and particularly the hands and feet, are likely to be affected, although the region of the mouth, nose and eyelids is most commonly implicated, frequently with ensuing rhagades. A massive involvement of the face will cause a mask-like appearance. With fissuring, an exudate frequently occurs, followed later by crust formation. When the scalp is affected, alopecia usually results, or the lashes may drop out. In most instances, the soles of the feet and the palms of the hands present a diffuse edema and appear firm and shiny, sometimes red or blue-red, at other times a copper-red or brown. A true paronychia, often accompanied by complete destruction of the nails, generally complicates this type of skin lesion. The surface may be smooth, or it may show fissures in the uppermost horny layers of

FIG. 62. Generalized eruptions of mixed types of skin lesions.

the epidermis, which occasionally slough off in large, lamellous scales.

In the second type of rash, more circumscript lesions may be observed. These eruptions assume more nearly the characteristics of the skin manifestations in acquired syphilis. Usually, the lesions are macules which are circular and slightly elevated, averaging 2 to 5 mm. in size. The face and the extensor surfaces of the upper and lower extremities, and more especially the hands and feet, are commonly involved. The macules may cover the entire body, but often the chest and abdomen escape. At first red in color, they soon become darker and assume a coppery hue. More elevated papules, similar in character and without an inflammatory base, may be scattered among the macules. A squamous eruption is frequently seen on the palms and soles, and small masses of scales may appear on the surface of the macules. A circinate eruption is not uncommon, particularly in Negroes (Fig. 63). The eruption may develop abruptly, but more frequently, it increases progressively during a period of from one to three weeks. Under vigorous treatment, it disappears rapidly, except for the remaining pigmentation.

In the severe cases, the bullous, or pemphigoid lesions may be superimposed on the macular squamous syphilides, or they may be primary. They may lead to deeper ulcerations of the skin with secondary infection, and are always a source of danger to other persons, because of the likely presence of spirochetes in the lesions. Confusion of these lesions with nonspecific pemphigoid lesions, which frequently occur in obstetric wards, is possible, as the latter are especially prone to affect

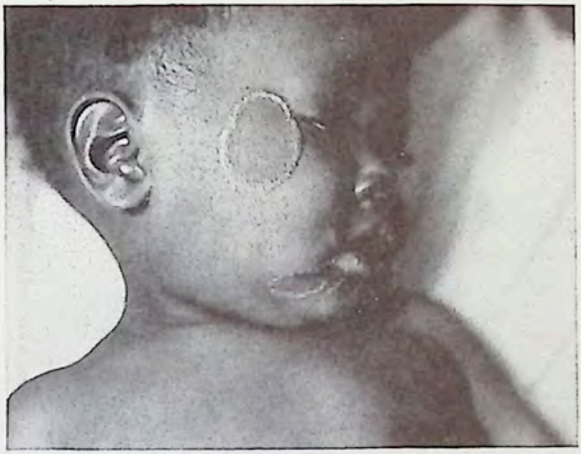

Fig. 63. Circinate lesions in the negro infant.

the premature infant. This type of pemphigus neonatorum is usually a staphylococcus infection. Linear fissures and mucous patches are among the most characteristic features. Because of the fragility of the skin, such rhagades occur easily, especially on the lips, nose, about the anus, and sometimes about the eyelids. In healing, these lesions generally cause radiating cicatrices which result in characteristic "purse-string" deformities.

UMBILICAL CORD

The umbilical cord often heals slowly and the stump has a tendency to become purulent. There is also a tendency toward infiltration about the umbilicus.

THE LIVER

The liver is the organ most frequently affected. It is usually enlarged and firm, due chiefly to involvement of the interstitial tissues and thickening of the capsule.

THE SPLEEN

The spleen may be the seat of interstitial changes with adhesions to other organs. Gummatous lesions may also be present. The spleen itself is enlarged and is usually easy to palpate.

THE LYMPH GLANDS

The lymph glands show less evident changes. General hyperplasia may be present, but the glands seldom become extremely enlarged until later, when they may respond to local secondary infection from neighboring structures.

BONES

The most consistent, and often the only lesions which can be demonstrated, are those found in the long bones. These are of great diagnostic value in the premature infant, since they frequently develop to such a degree that they can be identified in x-rays taken at birth. In the milder, untreated forms of syphilis, such lesions frequently may not be apparent until the infant is several weeks or months old.

The two chief lesions are osteochondritis and periostitis. Osteochondritis (epiphysitis) attacks the cartilage-shaft junction. Involvement of the cells of the proliferating cartilage results in an irregular arrangement at this point, with formation of a dense and irregular, lattice-like epiphyseal line, in the milder type. In more severe forms, only a few calcified remnants may be seen, in place of the regular columnar formation of proliferating cartilage and calcified bone. These islands are surrounded by irregularly growing connective tissue which, on section, resembles granulation tissue. Microscopic examination reveals that the blood vessels are thick and surrounded by small, round cells. The process may involve the joints, with secondary suppuration in extreme instances. Usually, however, osteochondritis has a tendency to disappear after the third month, even without treatment.

X-rays offer one of the best diagnostic mediums for syphilis in the fetus and newborn. The beginning of the process, as shown by the x-rays, is an intensification of the shadow cast by the bone at the epiphyseal line. In bones, in which osteochondritis is well advanced, a band-like area may be seen, which gives the appearance of diminished density to the region of the epiphyseal line, where the shadow is not so intense.

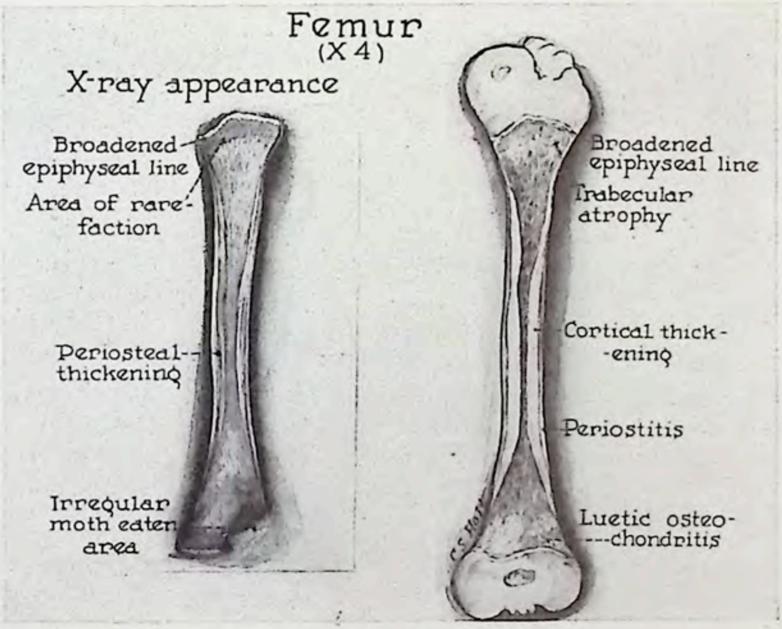

FIG. 64. Bone lesions due to syphilis.

Bones may also be seen in which the dense shadows at the epiphyseal end are broken by small areas of rarefaction, to give an appearance of irregular density to the end of the bone.

Sometimes the bone seems to end in a double line, so that two lines of heavily calcified tissue are visible, separated each from the other by a zone in which lime salts are less heavily deposited. Histologic preparations indicate that this region contains a great amount of delicate granulation tissue. This picture becomes more intensified as growth continues. During the course of the disease, the calcification of the infected areas is not only abnormally heavy, but also quite irregular, so that the epiphyseal border of the shadow cast by the bone develops a notched, saw-toothed or serrated appearance.

When periostitis occurs near term, in severe cases of syphilis, it may be present throughout the length of the bone, or only in the extremities. It is revealed in x-rays by a wide, almost homogeneous shadow, or with longitudinal striations separated from the external surface of the cortex by a narrow clear area which surrounds the bone.

The x-ray appearances of three other conditions which are encountered in early infancy may cause confusion in the diagnosis of syphilis unless the case-history is carefully considered.

1. Osteogenesis imperfecta is a congenital condition in which the x-rays reveal bones of diminished density and often severe deformity with intraperiosteal fractures, but without significant disturbance of

Fig. 65. Congenital syphilis, permanent (Hutchinson's) teeth.

epiphyseal development. Growth in length is not impaired, although there may be shortening as a consequence of fractures. Growth in girth, however, is often greatly impaired, so that extremely slender bones result.

2. Scurvy may be present at a much earlier time in the life of the premature infant than is usually seen in the full-term infant. Nevertheless, x-ray appearances are rarely discernible before the third or fourth month of life.

3. Rickets, in the healing stage, may be confused with the bone lesions of syphilis, if the history and age of the infant are not given careful consideration.

Occasionally, the thymus gland is the focus of small abscesses which consist of leukocytes and spirochetes. These were first described by Dubois.

The pancreas may manifest diffuse fibrosis, while the kidneys reveal perivascular, round-cell infiltration, especially involving the cortex, and immature development of the glomeruli and tubules.

Changes in the nervous system may affect the meninges, the blood vessels or the brain itself. Later in childhood, lesions may develop due chiefly to vascular changes, with eventual localized or diffuse sclerosis and atrophy of the convolutions. Sufficient and proper treatment may prevent juvenile paresis and tabes.

Although all organs and tissues of the body are involved in congenital syphilis, the lesions described are those most manifest.

DIAGNOSIS

Typical clinical manifestations in florid early syphilis are cachexia, persistent coryza, lesions of the skin, thickening and fissures around the mouth and anus, and condyloma about the anus and genitalia. The characteristic facies (Fig. 61) is of the greatest diagnostic importance. Added to those signs already enumerated, are frequently a broad forehead, prominent eyes, a flat nose and often scanty hair and eyebrows. X-rays reveal pathognomic changes. Spirochetes can usually be demonstrated in scrapings from the mucous membranes and external lesions by dark field examination; at delivery they can be found in placental tissue, and at times in the umbilical vein.

Serologic Tests. Infants with congenital syphilis rarely develop sufficient antibodies of their own during the first month of life to yield a positive reaction to a Wassermann or Kahn test. Such a result in the first month may indicate that only the reacting substances and not the spirochetes have been transmitted from the mother to the fetus. If this is true, the infant's blood will react negatively by the second to the sixth month. The untreated, syphilitic infant may also give a positive reaction at birth due to the reacting substances received through the placental circulation. Later, the reaction may be negative, but it will again become positive to the Wassermann and Kahn tests by the time the infant is three months old or sooner.

PROGNOSIS

Prognosis is dependent on:

1. Stage and severity of the condition in the mother.
2. Whether or not the mother has received treatment and the thoroughness with which it was executed.
3. The month of pregnancy in which treatment was begun.

Most of the deaths among syphilitic infants occur in those with florid syphilis. Prematurity, respiratory and nutritional disturbances are the most frequent contributory factors predisposing to early death. Infants with syphilis who survive the first weeks of life have a low mortality rate and, with thorough treatment, may be expected to make a complete recovery in a high percentage of instances. The ultimate prognosis of the cases which go untreated will necessarily depend on the severity of the infection, but unquestionably, some will overcome the disease spontaneously. Others will develop late nervous manifestations and visceral and bone lesions. It has been found that most of the children appearing for treatment in late stages of the disease, and with active manifestations of syphilis, have not received any treatment in infancy. Moreover, even a small moderate amount of medication administered early in life has proved effective in modifying the disease so that many of the children who disappear temporarily from observation and return later because of other conditions are found to have remained free of the disease. Therefore, it is imperative that all infants suspected of harboring active syphilis receive treatment.

Prognosis should be considered from the standpoint of the disappearance of clinical signs and from biologic evidence. Since the serologic tests are not necessarily evidence of active infection, it is impossible to know whether or not spirochetes are still present in the various organs and tissues. In those children who have been competently treated, the Wassermann reaction may remain positive; this is known as Wassermann "fastness," and may be indicative of a permanent, immune response in the absence of live organisms. A negative Wassermann or Kahn test obtained in the course of the disease may be considered a favorable prognostic sign. It must be remembered, however, that the tests may again become positive in both treated and untreated cases. In all probability, the earlier the treatment is started, the more likely will it be that permanent negative serologic tests will be obtained.

TREATMENT

As previously stated, a considerable reduction in the number of cases of congenital syphilis has been found of late among the premature infants admitted to the Sarah Morris Hospital Station. Furthermore, as indicated, this decline is no doubt attributable, at least in part, to the rigid enforcement of the recent marriage laws of Illinois, and to the even more recent legislation making it compulsory for physicians to obtain serologic tests of pregnant women. Positive reactions naturally lead to the initiation of treatment of the infected mother, thereby saving the infant from the ravages of the disease in a high percentage of instances.

The question arises as to whether or not therapy should be undertaken early in the infant whose mother has been observed and who has received treatment in the prenatal clinic over a period of weeks or months, or whether or not it is advisable to delay treatment until serologic or clinical signs are evident in the infant. In our Station, every infant born of an actively syphilitic mother, who has either not been treated or has been indifferently treated, is considered a potential syphilitic and is subjected to an early course of treatment. Other clinics assume that nonsyphilitic children should not be subjected to antisyphilitic treatment. As a result, such institutions do not begin treatment unless there is clinical, serologic or x-ray evidence of activity. The decision as to whether or not therapy should be started early or delayed should perhaps best be based on the amount of treatment that the mother has received during the later months of pregnancy. In 943 pregnancies in syphilitic women with varying amounts of treatment observed in the Johns Hopkins Hospital obstetric service, McKelvey and Turner [30] obtained the following results:

TREATMENT DURING PREGNANCY (NONE PREVIOUSLY)	INCIDENCE OF SYPHILIS IN OFFSPRING PER CENT
No treatment	64.5
Less than 1 Gm. arsphenamine	27.0
1-2 Gm. arsphenamine	20.2
2-3 Gm. arsphenamine	16.1
3-4 Gm. arsphenamine	12.5
4-6 Gm. arsphenamine	0

All children who are syphilitic suspects, and in whom the institution of treatment is to be delayed because of negative or doubtful evidence in the first weeks of life, must be kept under close observation for at least one year and should have blood tests every month. This does not imply that the child should be free from observation during early childhood, but rather, on the contrary, that serologic tests should be continued, although at less frequent intervals, during the first few years.

Intramuscular Therapy. During the early years of our work with premature infants, we were dependent in treatment on mercury. The drug, in the form of mercury and chalk, was given by mouth and inunctions, and occasionally by hypodermic administration. Recently, arsenic and bismuth are the drugs of choice. The arsenical preparations, sulfarsphenamine and mapharsen, are given by intramuscular therapy. Mapharsen has recently been used in the short-term (five days) treatment for infants, children and adults with what appear to be promising results for a cure from a single course of treatment. This drug is administered intravenously. Nevertheless, at least at present, we feel that this method does not have a place in the treatment of the premature infant.

Daily mercurial inunctions are given to the infant for a period of seven days. One-half gram of a 50 per cent mercurial ointment is used. The inunction is applied to a different part of the body of the baby each day. After seven days of therapy, a rest period of seven days is desirable. The nurse must wear rubber gloves in carrying out this procedure. In addition to the inunctions, mercury with chalk is given orally. One-sixteenth of a grain is given for four days, and then the dosage is increased to 1/8 gr. If diarrhea does not develop, the dosage is increased to 1/4 gr. daily, and this amount is continued for a period of six weeks. Following this treatment, the baby is given acetarsone by mouth and bismuth salicylate intramuscularly. The dosage of the latter two drugs is:

Start with course of acetarsone by mouth

1st week	0.005 Gm. (1/10 gr.) per kilogram daily
2d week	0.010 Gm. (1/6 gr.) per kilogram daily
3d week	0.015 Gm. (1/4 gr.) per kilogram daily
4th week	0.02 Gm. (1/3 gr.) per kilogram daily

We recommend the same dosage for five more weeks, then a course of bismuth salicylate in oil, 0.01 to 0.02 gram per kilogram (1/12 to 1/6 grain per pound) once a week for 10 weeks (intramuscularly in the buttocks).

Continue alternate courses constantly during first year. A Wassermann or Kahn test is made at least every six months. If the patient reacts negatively at the end of the first year, a two months' vacation is given. A course of acetarsone, again followed by bismuth, is instituted and then, after two more months of vacation, the courses are repeated

The minimum amount of treatment given is 70 weeks in the first two years.

The generally accepted dosage for intramuscular hypodermic administration of the drugs is:

Neoarsphenamine	0.015 Gm. per kilogram of body weight
Sulfarsphenamine	0.02 Gm. per kilogram of body weight
Mapharsen	0.001 Gm. per kilogram of body weight

Bismuth tartrate, bismarsen and salicylate in oil are prescribed by many clinicians at alternate intervals with the arsenical preparation. These drugs are usually prescribed for young infants in the amount of 0.001 gram per kilogram. For the premature infant we have used larger doses, 0.01 to 0.02 gram per kilogram at intervals of one week.

Oral Administration. Acetarsone (stovarsol) has the advantage that it can be used as oral medication. During the past eight years we have depended largely on this drug in the treatment of the less seriously infected babies. The results have been most gratifying, and the infants show little toxic effect. This form of drug has the further advantage in that the number of tablets which the infant is to receive between professional calls can be prescribed. However, the mother must be impressed with the responsibility of returning with her infant for further observation as soon as the medication is consumed.

The routine treatment in the Sarah Morris Hospital Station is as follows:

Wassermann tests are made on both mother and father. If either parent has a positive Wassermann reaction, x-rays of the long bones of the infant are taken. If the mother has had sufficient antisyphilitic treatment, and the x-rays of the long bones of the baby are negative for syphilis, treatment is not given to the infant. If the mother has not had treatment, the baby is given antisyphilitic therapy, regardless of the x-ray appearances.

27

City- and State-Wide Plans for the Care of the Premature Infant

While very satisfactory progress has been noted in the lowering of infant mortality rates throughout the United States, especially in the last five years, there is still room for improvement. The results noted in the past few years are attributable to a closer understanding and co-operation between the practicing physician and public health officials. As stated, there has been a steady decline in the number of total deaths during the first year of life. On the whole, however, there has not been a satisfactory decrease in the death rate in the first month of life which accounts for nearly one-half of the total loss of life in the first year. The situation as pertains to the first day and first week after birth has, until recently, shown only a minimum decrease in the mortality rate. In the past, approximately one-half of the deaths during the first month have been among the premature infants. We may therefore state that the fields in which the least has been accomplished lie in the saving of infant lives in the first days and month, and also in those cases in which there was complicating pathology during pregnancy.

The most significant steps taken to achieve a decrease in these difficult groups has been the establishment of city- and state-wide programs for the care of the premature infant, in which both the practicing physician and public-health official have co-operated. Since, as has been indicated, a successful premature program necessitates first that the nursery for all newborn infants conform to rigid requirements, the successful carrying out of the city- and state-wide programs has been reflected in the reduced mortality and morbidity rates among all infants, during the first year of life. The mortality rate among all newborn infants per 1,000 live births in the United States registration area dropped from 64.6 in 1930 to 48.0 in 1939. In Illinois, the mortality rate was 55.8 in 1930 but only 37.4 in 1939. There has, therefore, been a saving in Illinois of more than 18 infants among every 1,000 live births, or approximately 33 per cent in less than ten years.

In 1938, the mortality rate in 45 states throughout the United States ranged from 36.0 to as high as 69.0 per 1,000 live births, and in 1939 the range was from 35.4 to 66.9. In three states in 1938, South Carolina, Arizona and New Mexico, the rates were 80.0, 99.0 and 109.0 respectively, and in 1939 they were 66.4, 95.5 and 109.3. We make special reference to these three states because of the tendency of lay publications often to present only the unfortunate side of the picture without analyzing the results or appreciation of some of the underlying factors, such as type and nationality of the population affected and the relation of high mortality rates to the attendant at delivery. In these three states, as well as in others in which there is a low income white, Negro and Mexican population, many deliveries are conducted by nonmedical attendants.

City-, county- and state-wide programs for the care of premature infants seem to be the order of the day in efforts throughout the United States to reduce infant mortality rates.

THE CHICAGO PLAN

The Chicago City-wide Plan was the first to attempt to fulfill all the requirements for the care of the premature infant, and was more especially aimed at meeting the needs of the low-wage class of a large metropolitan city. The Chicago Plan was designed to place at the disposal of the medical profession of Chicago all of the special features provided for the care of the premature infant by the Premature Infant Station of the Sarah Morris Hospital, which had been established in 1922. The Chicago Plan came into effect in 1934, twelve years later. All of the Sarah Morris features are now incorporated in the city-wide plan, namely:

1. A 24-hour ambulance service for the conveyance of the premature infant to a hospital station when that is considered necessary.

2. Premature-ward care where oxygen and other types of emergency therapy are available. While all general hospitals should be so equipped to care for the infants born in their own wards, only a few institutions can sacrifice the necessary nursing personnel and space for receiving such patients from the outside. No maternity nursery is willing to receive infants born outside of the institution into its clean nurseries. The Sarah Morris Station receives about 75 per cent of its infants from very modest homes, and these infants are received either free of cost or for a minimum fee. For those who can afford to pay,

a moderate hospital rate is charged. It is, therefore, one of the essentials to the success of the project that there be a sliding scale which meets the possibilities for payment for all who are sent in. The majority of the infants come through the boards of health of Chicago and neighboring towns. The Sarah Morris Hospital averages approximately 25 infants. In the Cook County Hospital of Chicago, as many

Table XIII

CITY OF CHICAGO
MORTALITY AMONG ALL INFANTS—1934-1940

YEAR	UNDER 1 YEAR OF AGE RATE PER 1,000	UNDER 1 MONTH OF AGE RATE PER 1,000
1934	47.7	30.9
1935	40.1	27.5
1936	38.5	25.3
1937	37.8	25.2
1938	33.7	22.4
1939	31.3	21.9
1940	28.8	20.3

Table XIV

CITY OF CHICAGO
MORTALITY AMONG PREMATURE INFANTS—1935-1940

YEAR	REPORTED AS PREMATURE	DEATHS	MORTALITY PER CENT
1935	1,862	690	42.6
1936	2,031	518	25.5
1937	1,938	521	26.9
1938	1,962	437	22.3
1939	2,120	463	21.8
1940	2,274	473	20.8

as 68 premature infants have been in the station at one time. At the Cook County Hospital all services are rendered without cost.

3. The nursing service, both in the field and in the hospital, is rendered by a personnel with special training in the care of the premature infant. This is essential to any successful program.

4. Breast milk is available to all when required. The breast milk is supplied free of charge to the premature infants of both the Cook County Hospital and the Sarah Morris Hospital.

5. A visiting nurse service. The field nursing is of inestimable value in cutting down hospital days, and this in turn spells economy for service and an increase in the number of infants who can be handled

by any one institution. The promotion of breast-milk secretion in the home through the field nursing service usually means that an infant who is going home to receive breast milk from its mother can be discharged from the hospital at least one to three weeks sooner than the infant who is going home on an artificial feeding. The education of the mother through the early visits of the field nurse to the home during the child's stay in the hospital, and the visit made immediately preceding its return to the home, are of great educational value to the family.

6. A simple type of heated bed that can be loaned to the family. This can be supplied for use in the home when the baby is to be kept at home, or is often advisable even after the baby is discharged from the hospital. Such heated beds will aid in preventing morbidity among the infants, especially respiratory-tract infections which formerly filled our wards and which are always of grave consequence in these young infants.

7. An outpatient clinic maintained for instruction of mothers and the care and supervision of graduates not having private physicians.

The success of the Chicago City-wide Plan is well illustrated by the tables on page 248 showing the decrease in mortality rates among all infants and premature infants since 1934.

STATE PROGRAMS

According to reports received by the Children's Bureau,[9] 28 states, Hawaii and the District of Columbia have already made or have submitted plans for making special provisions for the care of premature infants as part of their maternal and child health programs under the Social Security Act. Usually, the first step taken by the states has been to study, often in co-operation with the state medical associations, the influence of prematurity on the infant mortality rate of the state and to make a survey of existing provisions for the care of prematurely born infants in various parts of the state. Since the state programs have been concerned chiefly with problems in rural areas and areas in special need, most states have found existing provisions for premature infants in these areas inadequate. In general, the programs developed by the states to deal with the problem contain three main divisions, an educational program, the provision of field nursing services and the provision of equipment in the form of incubators.

The educational programs have included the encouragement of special training in the care of premature infants for members of health department staffs at such centers as the Sarah Morris Hospital and the

Cook County Hospital in Chicago and the Boston Lying-In Hospital. The member receiving the training, usually a supervising nurse, is thus in a position to teach modern methods of care to the staff public health nurses and also to advise hospital nursing staffs in this field. Pediatricians on state staffs have carried on educational programs for local health officers and have secured the interest and co-operation of practicing physicians in providing improved care for premature infants. The care of the premature infant has been discussed in postgraduate courses for physicians in a number of states.

In addition to these educational efforts which are basic, the health departments have provided the services of public health nurses to assist practicing physicians to care for these infants in their homes when necessary, and particularly to teach members of the family the special methods of caring for them. Members of the state staff have given assistance to the administrators of hospitals in planning for better facilities for the care of premature infants and in teaching their nurses modern technics in this field. A few states have made provision for pediatric consultant services for rural physicians.

THE MASSACHUSETTS PROGRAM

The most complete plan is that now being carried on by Massachusetts. During 1937 the Commonwealth of Massachusetts initiated its state-wide program for the care of premature infants. Its objective was to reduce the death rate among premature infants and to improve the standards for their care.

The hospital center part of the program is state-wide outside of Boston. Hospital maintenance is provided free for indigents by the local boards of public welfare. Forty-eight centers have been established. The hospitals are selected with a view toward strategic location and the grade of service given by the hospital.

When an infant weighing five pounds or less is born at home, and cannot be adequately cared for there, it is taken to the nearest hospital equipped for the care of premature infants. Transportation is provided by the local board of health. However, in Massachusetts about three-fourths of all births occur in hospitals.

The nursery supervisors of the hospitals which have been accepted as premature centers are given a two weeks' course at the Boston Lying-In Hospital. The Department of Public Health pays the tuition of the nurse and also her traveling and living expenses during this course. A nurse from the Department of Public Health is available for consultation services to nursery supervisors in the hospital centers.

THE NEW YORK PROGRAM

The New York State Department of Health is also inaugurating a state-wide program. Fourteen New York nurses have been in attendance at the Sarah Morris Hospital Station. Special centers have been in operation in Albany and Syracuse since the first part of 1938. Schenectady, Utica, Troy and other cities have followed a similar program. In other areas, portable heated beds have been made available for loan purposes for use in the home in rural districts. Transportation is provided for taking the infants to nearby hospitals.

28

Later Physical and Mental Development

George J. Mohr and Phyllis F. Bartelme were engaged during the five-year period from 1928 to 1933 in a study [31] of the physical and mental growth of premature infants graduated from the Station at Sarah Morris Hospital. This group included 250 prematurely born white children—104 boys and 146 girls. Included in the study were also 152 of their full-term siblings who served as a control group.

The estimated mean period of gestation for the prematurely born infants was 33 weeks. All of these children weighed less than 2,500 grams at birth. The mean birth weight for the boys was 1,877 grams, and for the girls 1,786 grams.

The age of prematurely born children may be given in two ways—statutory or chronologic age (CA), and corrected chronologic age (CCA). Corrected chronologic age is statutory age minus the degree of prematurity; both were used in the evaluation of their findings. The chronologic ages of the prematurely born children included in the study ranged from six months to 132 months; the age range of the full-term siblings was six months to 135 months. Following the initial study, the children were seen annually on their birthdays. The results were based on 487 individual examinations.

The families of the prematurely born group studied represent a slightly inferior socio-economic group on the basis of standardized socio-economic ratings, amount of serious social maladjustment, and incidence of free hospital care.

PHYSICAL DEVELOPMENT

Physical growth was studied by recording several physical measurements and indices. Standard technics were used in taking measurements. The prematurely born children were compared with full-term, like-sexed siblings, and with the Woodbury norms of height and weight for children under six years of age.[32]

Weight. The prematurely born boys weighed less than their full-term brothers until the age of four to five years was attained, at which time their weight curve approximated that of the full-term boys. They attained the Woodbury norms at approximately three years of age. Prematurely born girls attained the Woodbury norms for weight somewhat earlier than did the boys. They tended to weigh slightly less than their full-term sisters, but the difference was not a statistically reliable one, though it persisted through all of the age levels studied.

Stature. In growth in stature, again differences were observed between the prematurely born boys and girls, and the full-term siblings of like sex. The boys were somewhat more variable than the girls and the siblings tended to exceed them in stature until approximately three years of age. The prematurely born boys reached the Woodbury norms somewhat earlier than this.

Differences in height and weight between the total group of prematurely born children and the control groups, as well as deviations from the norms, were thus temporary or minimal. However, striking differences were revealed when the birth weight was considered. Prematurely born children weighing 1,500 grams or less at birth gained less well in height and weight than did the prematurely born children weighing 2,000 grams or more at birth. The differences were more marked in relation to weight than to stature and were more pronounced among the boys than among the girls.

Sitting-Height/Stature. The index sitting-height/stature did not distinguish the prematurely born group from the full-term sibling group. The rate at which the trunk became shorter in proportion to stature was approximately the same for both groups.

Head Circumference. Megacephaly was noted among 10 of the 250 prematurely born children. The prematurely born group were considerably younger at the time of examination than the sibling group. In only four instances among the children designated as megacephalic was there a persistent deviation.

Hydrocephalus was noted in eight instances among the premature group and oxycephaly (tower skull) in four instances. These conditions were not observed among the siblings. The less marked observations pertaining to the cranial bones (that is, enlargement of parietal or frontal bones) were similar in incidence among both groups.

Of the eight children who were hydrocephalic, seven were included among the 69 children diagnosed as having had an intracranial hemorrhage. Two of these showed no later evidence of central-nervous-system damage. A third presented slightly exaggerated tendon reflexes but no other disturbances. A fourth showed hypotonia involving the lower extremities, and a moderate strabismus. Three presented evidence of severe injury. One hydrocephalic child was among those with a birth weight of less than 1,000 grams.

Chest. Definite deformities of the chest were rare among both groups, although mild flaring and grooving of the ribs were more common among the younger premature group than among the siblings. Because of a lack of suitable technic for estimating measurements for comparative purposes, no reliable statements as to any specific effects of prematurity on chest development can be made.

Teeth. Allowing for corrected chronologic age, there was no marked evidence of disturbance in dentition attributable to prematurity. Later inspection of the mouths of these children indicated that they compare favorably with their siblings in the occurrence of dental caries. It must be noted that graduates of the Premature Station of the Sarah Morris Hospital have been supervised carefully with respect to nutritional requirements, and rules of hygiene favorable to development of good tooth structure have been emphasized.

Abdomen. Among the prematurely born children, the abdominal wall presented common evidences of muscular weakness and lack of tone more frequently than among the sibling group. Greater tendency to occurrence of "potbelly" was noted. Furthermore, there was a distinctly greater frequency of umbilical hernia. This condition was present in 70 per cent of the children. It has been believed that inguinal hernia is also more frequently observed among prematurely born children. However, as has been noted (see Chap. 23) in a special study made by Rambar and Goldberg, 38 instances of inguinal hernia were found among 830 graduates of the Station. This incidence approximates the average expected among full-term infants.

Cardiovascular System. Congenital cardiac conditions were diagnosed in eight of the 250 children. Theoretically, prematurity would tend to favor the occurrence of persistent foramen ovale and patent ductus arteriosus, and physical and postmortem observations would seem to be consistent with such a theory. Endocarditis, with or without rheumatic complications, was diagnosed in four instances.

Endocrine Glands. Evidence of endocrine gland disturbances was infrequent among the 250 children. Six had enlarged thymus glands. A few showed symptoms suggestive of hypothyroidism.

Skin Conditions. Hemangiomata and nevi were more common among the prematurely born than among their siblings. (See "'Skin," Chap. 19.) Eczematous disturbances were infrequent. Of the latter, only five were present among the 250 and in four of these the condition disappeared at an early age.

Rachitis. Evidence of severe rickets was rare among the premature group. Knock knee was observed with greater frequency among the prematurely born group than among their siblings. Whether this should be described as being related to rickets is questionable.

Physique. Any attempt to classify children as to "physical type" at once brings one into a highly controversial field. Examiners designated habitus as "linear," "stocky" or "unclassified."

Children in the sibling group were more frequently designated "linear" than were children of the prematurely born group. It is probable that the difference noted was not related to prematurity but was dependent upon the age factor. The siblings were older than the prematurely born group. With rapid growth in stature, the subjective impression of a more linear build among the older premature infants was obtained.

MENTAL DEVELOPMENT

The mental development of children born prematurely has had very limited study. Psychologic studies reported have been few and offer widely divergent opinions.

Therefore, Phyllis Bartelme, the psychologist, undertook a comparative study of the mental development of the 250 graduates and 152 siblings. All of the oldest graduates who could be located were included. In the group tested were 72 twins, consisting of 25 pairs and 22 singles. Each child was given from one to four psychologic examinations. A total of 487 examinations was made.

The primary purpose of this investigation was to determine whether the mental growth of prematurely born children differed from that of children born at term. Two intelligence tests were employed: the Gesell Developmental Schedule and the Binet Scale. The former was used for examinations of all children under six years of age; the latter for all the other children included in the study. The performances of the prematurely born children on these tests were compared with those of full-term children, siblings and standardization groups. Comparisons were also made within the premature group itself in an effort to determine whether such variables as fetal age and birth weight, sex and existence of pathology in the mother affected the mental development materially.

Premature Infants Compared with Siblings. If the intelligence ratings of the graduates of the Premature Station of the Sarah Morris Hospital were computed on a chronologic-age basis, there appeared to be a tendency toward retarded mental development during the first two years, as compared to that of siblings. However, if the scores were computed on a corrected chronologic-age basis, subtracting the amount of prematurity from the chronologic age, there was no statistically reliable difference. When the total group of 250 prematurely born children was compared with the Gesell and also with the Kuhlmann standardization groups, the curves of mental growth were comparable in both rate and amount of mental development. These results indicate that, in our group, premature birth, unassociated with intracranial injury, does not affect mental development. In evaluating this finding it is to be remembered that these children had the benefit of the special care offered by the Premature Station, together with home and outpatient follow-up. It is believed that such special observation and guidance are conducive to optimal conditions for the infant's satisfactory development, both mental and physical, and also tend to improve the character of the home environment and care.

Fetal Age and Weight. Correlation between weight at birth and general intelligence, as measured by the Gesell and Binet scales, indicated no demonstrable relationship between these two factors. Those children whose birth weight was low apparently developed mentally equally as well as those of heavier birth weight. Similar negative results are obtained when the period of gestation and general intelligence are correlated. Comparison was made between two groups of contrasting birth weights, those children who weighed 1,500 grams or less at birth, and those who weighed between 2,000 and 2,500 grams. In contrast with the differences between curves of physical measurements of these two groups is the striking similarity in curves of mental growth. We may conclude that for surviving children, if weight at birth and duration of the period of gestation are used as criteria of fetal age, prematurity itself and the degree of prematurity are not related to mental development according to the mental tests that were employed and within the age range tested.

Sex Differences. As has been noted, the physical development of boys with low birth weight was more retarded than that of the girls. Therefore, if there were any difference in the mental development of the boys as against that of the girls, it would be logical to assume that such a sex difference in intelligence would be apparent in children of low birth weight. However, the slight tendency shown on the part of the girls studied to be more advanced than the boys in mental development is in keeping with the relative precocity of girls usually found at the earlier ages.

Pathology in the Mother. The general intelligence of children born of mothers who suffered from toxemia, kidney complications or syphilis during the period of pregnancy was determined. There were 30 instances of toxemia in the mother, four of kidney complications and 28 instances of mothers who had positive Wassermann tests. Only a very few of the children of mothers in this latter group ever showed clinical manifestations of syphilis. The general intelligence of the children in these groups did not show reliable differences in mental development when compared with the group as a whole. From these facts it may be deduced that the infants who survived for the most part showed only minor or transitory effects from the various conditions enumerated as complicating pregnancy.

HABIT FORMATION AND SOCIAL ADAPTATION

Two sources of information about the developmental progress of the prematurely born children and the sibling control group were utilized. These were:

1. Accounts of the mothers together with notations on clinical records of the children as they returned to the follow-up clinic.
2. The direct observations at the formal psychometric examination.

Sphincter Control. The prematurely born infants are slightly delayed in the development of bladder and bowel control. This is more especially true of the boys.

In contrast to their full-term siblings the prematurely born children also showed a greater tendency to manifest intestinal irregularities; constipation and diarrhea were noted with greater frequency. These latter disturbances, however, were usually moderate and transient and responded readily to dietary measures of control.

Personality Traits. Prematurely born children are more frequently observed to evidence dependency reactions in relation to their mothers. Temper display occurred with distinctly greater frequency among the prematurely born children than among the sibling group. The full-term children were reported by their mothers to be somewhat more adequate in their earliest social responses; that is, they were more frequently on good terms with their own siblings than were the prematurely born children. The full-term group was described as more self-reliant than the corresponding prematurely born group.

Conclusion

The tentative conclusion reached by Mohr and Bartelme was that neither in rate nor amount of mental development—insofar as this was measured by the tests employed—do surviving premature infants, who were normal for their fetal age, and who did not show congenital disease or birth trauma, differ significantly from their siblings, or from unselected groups of a comparable socio-economic status.

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Supplementary Materials

Table XV

GRAM EQUIVALENTS OF POUNDS AND OUNCES

POUNDS

OUNCES	0	1	2	3	4	5	6	7	8	9	10	
0		454	907	1,361	1,814	2,268	2,722	3,175	3,629	4,082	4,536	0
1	28	482	936	1,389	1,843	2,296	2,750	3,203	3,657	4,111	4,564	1
2	57	510	964	1,417	1,871	2,325	2,778	3,232	3,685	4,139	4,593	2
3	85	539	992	1,446	1,899	2,353	2,807	3,260	3,714	4,167	4,621	3
4	113	567	1,021	1,474	1,928	2,381	2,835	3,289	3,742	4,196	4,649	4
5	142	595	1,049	1,503	1,956	2,410	2,863	3,317	3,770	4,224	4,678	5
6	170	624	1,077	1,531	1,984	2,438	2,892	3,345	3,799	4,252	4,706	6
7	198	652	1,106	1,559	2,013	2,466	2,920	3,374	3,827	4,281	4,734	7
8	227	680	1,134	1,588	2,041	2,495	2,948	3,402	3,856	4,309	4,763	8
9	255	709	1,162	1,616	2,070	2,523	2,977	3,430	3,884	4,338	4,791	9
10	284	737	1,191	1,644	2,098	2,551	3,005	3,459	3,912	4,366	4,819	10
11	312	765	1,219	1,673	2,126	2,580	3,033	3,487	3,941	4,394	4,848	11
12	340	794	1,247	1,701	2,155	2,608	3,062	3,515	3,969	4,423	4,876	12
13	369	822	1,276	1,729	2,183	2,637	3,090	3,544	3,997	4,451	4,904	13
14	397	850	1,304	1,758	2,211	2,665	3,118	3,572	4,026	4,479	4,933	14
15	425	879	1,332	1,786	2,240	2,693	3,147	3,600	4,054	4,508	4,961	15
	0	1	2	3	4	5	6	7	8	9	10	

To calculate the gram equivalent of any number of pounds over ten, add the necessary amounts as, for example, to find the gram equivalent of 15 pounds, 5 ounces:

10 pounds = 4,536 grams
5 pounds = 2,268 grams
5 ounces = 142 grams
15 pounds, 5 ounces = 6,946 grams

Table XVI

STATISTICS OF THE SARAH MORRIS HOSPITAL PREMATURE STATION

PERCENTAGE OF INFANTS GRADUATED FROM PREMATURE STATION OF THE 3,883 ADMITTED BETWEEN YEARS 1922 TO 1940

	1922-24	1925-27	1928-30	1931-33	1934-36	1937-39	1940
Admissions	94	310	555	664	832	1,088	343
Per Cent Graduated	44.9	57.4	73.9	77.2	74.8	74.5	77.0

Table XVII

MORTALITIES OF THE PREMATURE STATION OF THE SARAH MORRIS HOSPITAL

	1935-37	1938	1939	1940
Admissions	921	380	392	343
Total Deaths, %	25.38	26.8	20.9	23.0
Excluding 24-Hour Deaths, %	9.6	12.3	6.9	9.9
Excluding 48-Hour Deaths, %		5.03	3.31	6.7

Table XVIII

MORTALITY RATES OF PREMATURE INFANTS OF THE SARAH MORRIS HOSPITAL BETWEEN YEARS 1922 TO 1940 BASED ON WEIGHT AND TIME OF DEATH

BIRTH WEIGHT IN GRAMS	TOTAL ADMISSIONS	NUMBER GRADUATED	DECEASED FIRST 24 HOURS	DECEASED 24-48 HOURS	DECEASED AFTER 48 HOURS	SURVIVED PER CENT
Less than 1,000	247	32	136	28	51	12.95
1,001 to 1,250	286	110	89	34	53	38.46
1,251 to 1,500	465	266	97	28	74	57.20
1,501 to 2,000	1,391	1,090	113	37	151	78.36
2,001 to 2,500	1,359	1,209	53	22	75	88.96
Over 2,500	135	123	5	1	6	91.11
Total	3,883	2,830	493	150	410	72.88

Table XIX

PREMATURE OUTPATIENT CLINIC MICHAEL REESE HOSPITAL

AGE AT WHICH OTHER FOODS ARE ADDED TO DIET

MONTHS

1 .... Cod liver oil, ½ teaspoonful; orange juice, 2 teaspoonfuls
1½ .... Cod liver oil, 1 teaspoonful; orange juice, 4 teaspoonfuls
2 .... Cod liver oil, 2 teaspoonfuls; orange juice, 6 teaspoonfuls

After 2 months, the cod liver oil is gradually increased until the child is receiving 3 teaspoonfuls. The orange juice is increased by a teaspoon each week until the child is receiving two ounces.

Fish liver oil concentrates may be used in place of cod liver oil, and ascorbic acid in place of orange juice during the first weeks or months.

4 .... Cereal—10 A.M. and 6 P.M.
5 .... Vegetable soup—2 P.M.
6 .... Mashed banana, gelatin.
7 .... Junket, applesauce.
8 .... Strained peaches, pears, prunes, apricots, bacon, toast or zwieback, egg yolk.
9 .... Scraped liver, vegetable mixture.
10 .... Scraped beef.
11 .... Cottage cheese.
12 .... Suggestions for the day:

7 or 8 A.M. Cereal, toast, bacon, milk.
10 A.M. Cod liver oil, 3 teaspoonfuls; orange juice, 2 ounces.
12 M. Vegetable soup or vegetables, scraped liver or beef, fish, sweetbreads, lamb bone, minced chicken. Mashed banana, rice or tapioca pudding, egg custard. Milk.
3 P.M. Graham cracker or bread with jelly or honey.
5 P.M. Macaroni, spaghetti, noodles, baked potato, egg. Strained peaches, pears, prunes, apricots, applesauce, gelatin. Cottage cheese. Milk.
8 P.M. Milk.

FORMULA-ROOM TECHNIC *

Aim.

Thorough and efficient method of preparation and sterilization of milk, water, and sugar solutions to help prevent infections among infants.

Formula room is closed to all except those directly connected with preparation of formulas.

The formula nurse may prepare formulas for other departments in the hospital, providing the nursing bottles and rubber caps are sterilized by boiling after use, and are transported directly to the formula room (in a clean receptacle) by a clean nurse.

Equipment for Formula Room.

Kitchen sink.
Gas range.
Autoclave.
Nursing bottles.
Rubber caps and nipples.
Gauze squares (10-fold) 4 by 4 inches and 6 by 6 inches.
Water sterilizer.
Utensils for mixing feedings—
- Enamel graduates.
- Pans, equipped with covers.
- Funnels.
- Standard measuring spoons, table knives, stirring spoons, egg beater.
- Fine-mesh sieves.
- Rubber bands.
- Sterile pouring pack.
- Sterile table drapes.
- Name tags (not necessary where system of numbers painted on bottles is used).
- Supply of unpunctured and punctured rubber caps.
- Dressing forceps in alcohol (70%).
- Sterile nipples.
- Rubber gloves.
- Gowns, caps and masks.

Nurses' Routine Preceding the Preparation of Formula.

Wipe off all sinks, tables and ledges with damp cloth.

* Board of Health of Chicago.

Formula-room nurse scrubs and dresses in clean cap, gown and mask.

Use surgical hand-scrubbing technic upon entering formula room.

Scrub hands after adjusting mask or using handkerchief, or if they become contaminated in any other way.

To Sterilize Water.

Cleanse water container inside and out once daily. Rinse well under running water.

Fill water sterilizers.

When water starts to boil, mark container with exact time sterilization was started to insure correct sterilization time.

Boil for 20 minutes.

How to Prepare Raw Feedings to be Autoclaved.

Start autoclave.

Arrange ingredients for formulas and utensils on work table. Measure and pour into individual, marked pans for each infant. If several infants are on identical feedings, these feedings may be prepared together in one pan and labeled for those infants.

(Lactic acid, protein milk, barley water, buttermilk and breast milk require special methods of preparation.)

Pour unsterile raw feedings and sterilized water into sterilized bottles; cap with punctured rubber caps (make 3 holes in rubber cap with heated needle); cover cap with 10-fold gauze, and fasten on with rubber band.

Arrange formulas in racks or wire baskets; tag each rack with infant's name or number (if bottles are not identified in other manner).

Autoclave at 15 pounds of pressure for 5 minutes. Be sure gauge registers 15 pounds before sterilization time is noted. Care must be taken on removing feedings from autoclave to reduce pressure slowly lest the bottles burst.

If heat-tempered bottles are used, the racks may be placed in cold water immediately after being removed from autoclave; otherwise allow the formula and bottles to cool thoroughly. Mark each bottle with wax pencil if bottles are not otherwise labeled, and arrange in icebox.

It is important to place formula in icebox as soon as sufficiently cool, therefore it is advisable to use heat-tempered bottles.

Preparation of Boiled Feedings.

1. Sterile equipment:

FORMULA SET-UP	GOWN PACK
Enamel graduates.	Gown.
Funnels.	Towel.
Fine-mesh sieves.	GLOVE PACK
Standard measuring spoons.	Gloves.
Table knives.	Powder.
Stirring spoons.	BOTTLE PACK
Pans.	Number of bottles needed.
Towels or sheets.	Rubber caps.

The number of utensils in the formula set-up and the bottle pack will depend on the number of special formulas to be prepared. A separate graduate and sieve should be used for each formula.

2. How to prepare boiled feedings:

Open sterile gown pack and formula set-up.

Scrub, using surgical hand-scrubbing technic.

Dry hands and arms with sterile towel and put on sterile gown.

Drape area to be used on work table with sterile towels or sheet.

Open set-up in such a way that the inside of the sterile cover does not become contaminated.

Using sterile graduate, measure specified amount of sterilized water and pour into a sterile pan.

Using the same graduate, measure the specified amount of milk and add to the sterilized water.

Using sterile measuring spoon, measure the amount of specified carbohydrate. Be sure to level off the spoonfuls with a sterile knife. Add carbohydrate to the sterilized water and milk.

Stir with a sterile stirring spoon and slowly heat the mixture to the boiling point. Continue stirring and boil for three minutes after boiling has started.

3. How to pour boiled feedings:

Open glove pack and bottle pack. Open packs in such a way that the inside of the sterile cover does not become contaminated.

Using sterile forceps, stand sterile graduates upright; place a sieve on the top of each graduate and pour the formula through the sieve.

Scrub and dry hands thoroughly with sterile towel.

Put on sterile gloves.

Using sterile bottles, funnels and unpunctured rubber caps, pour and cap all the special formulas.

Be sure bottles are labeled.
Place them in refrigerator.

Preparation of Orange Juice.

1. Sterile equipment:

Squeezer.	Funnel.
Sieve.	Bottles.
Spoons.	Unpunctured rubber caps.

2. How to prepare orange juice:
   Place oranges in container. Pour scalding water over oranges and allow them to remain in water for a few minutes.
   Remove from container and place on sterile towel.
   Scrub (wear sterile rubber gloves), using sterile set-up.
   Squeeze, strain juice, pour into bottles and cap.

Preparation of Fluids.

Boil water for 20 minutes; add to carbohydrate, if any is desired. Bottle the solution in individual bottles, and cap with a punctured rubber cap covered with 10-fold gauze. Autoclave for 5 minutes at 15 pounds' pressure.

Sterile water or sterile carbohydrate solutions may be autoclaved in two- and three-ounce quantities and kept in nursery, to be used as needed, for 24 hours.

SUGGESTED TEACHING OUTLINE FOR CLASS ON NURSING OF PREMATURE INFANTS

(Time Allotment: Total 3 hours class instruction)

First Hour—The Premature Infant

1. Definition of Premature Infant.
2. Characteristics.
3. Causes of Prematurity.
4. Maintenance of Heat.
   a. Clothing.
   b. Incubators.
      Commercial.
      Improvised.
5. Temperature of Room.
6. Temperature of Incubator.
7. Immediate Care After Birth.

Second Hour—Feedings

1. Methods.
2. Importance of Breast Milk.
3. Artificial Feeding.
4. Feeding Normal Premature Infant
5. Feeding Small and Weak Premature Infant.
6. Caloric Calculations.
7. Vitamin Requirements.

Third Hour—Therapeutics

1. Aseptic Nursing Technic.
2. Administration of
   a. Oxygen.
   b. Blood.
   c. Fluids.
3. Pathologic Manifestations.
   a. Symptoms.
   b. Medical Treatment.
   c. Nursing Care.
4. Follow-up Care.

Ward Teaching

All demonstrations are given in the Station. Nurses are not permitted to carry out any procedure without at least one demonstration. They are supervised the first two, three or more times if necessary.

Routine ward teaching includes:

Bathing (tub and sponge baths).
Skin care.
Dressing.
Handling.
Treating cyanosis.
Administration of oxygen.
Quartz lamp therapy.
Regulation of incubators.
Feeding.
  Dropper.
  Small bottle.
  Regular-sized bottle.
  Gavage.
Technic (stressed constantly).
Administration of blood and fluids.
Pathologic conditions.

When students are in the Station for more than two weeks, they are taught:

1. Caloric calculation of feedings.
2. Regulation of baby feedings and vitamin intake.
3. Follow-up care which includes
   a. Clinic care.
   b. Home care.

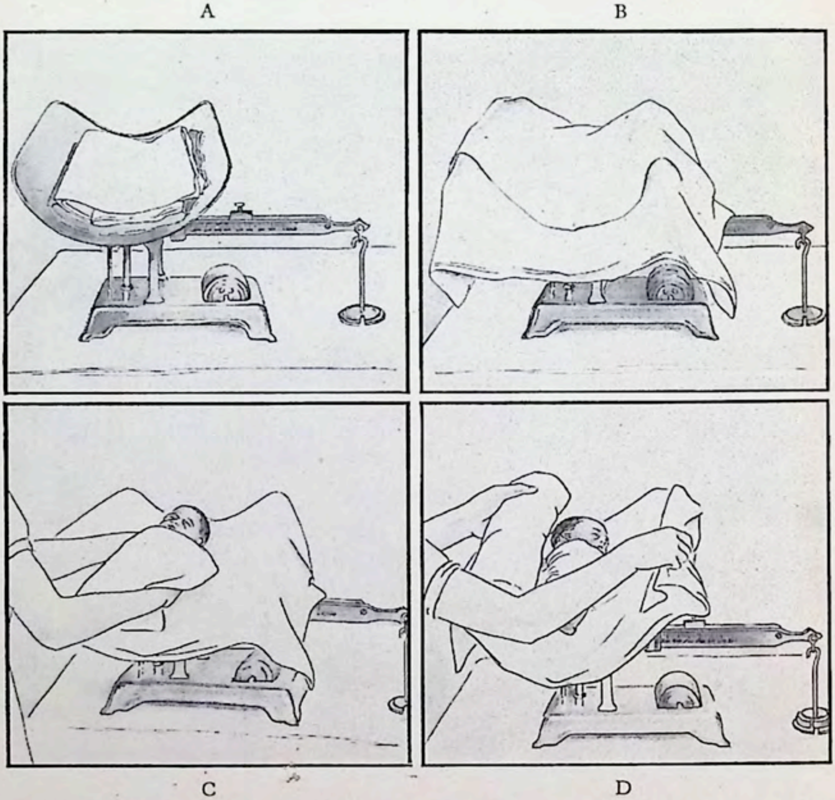

FIG. 66. Placing baby on scale. A. Balance sheet on scale. B. Open sheet so that scale is completely covered. C. Undress baby in crib and cover with blanket. Place baby on scale. D. While removing blanket with left hand, use right hand to cover infant with sheet.

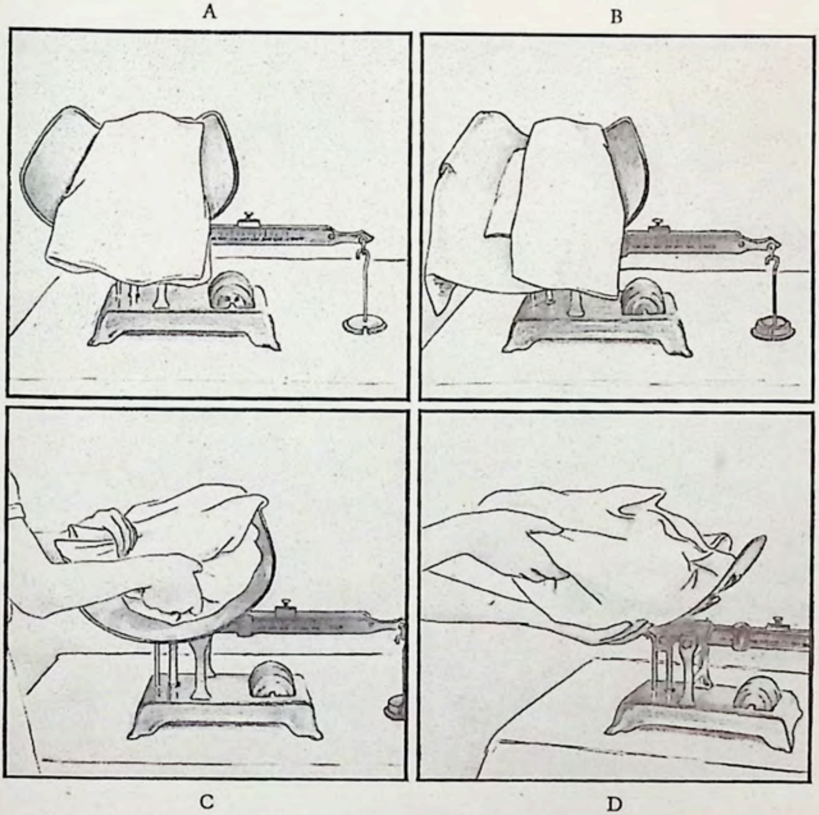

Fig. 67. Weighing the baby. A. Be sure that baby is completely covered with sheet while it is being weighed. B. Cover baby with blanket again before reading scale. Do not let blanket touch external surface of scoop. C. Lift the lower part of the body with left hand while grasping the legs with right. D. Pull baby toward you and grasp head and shoulders with left hand.

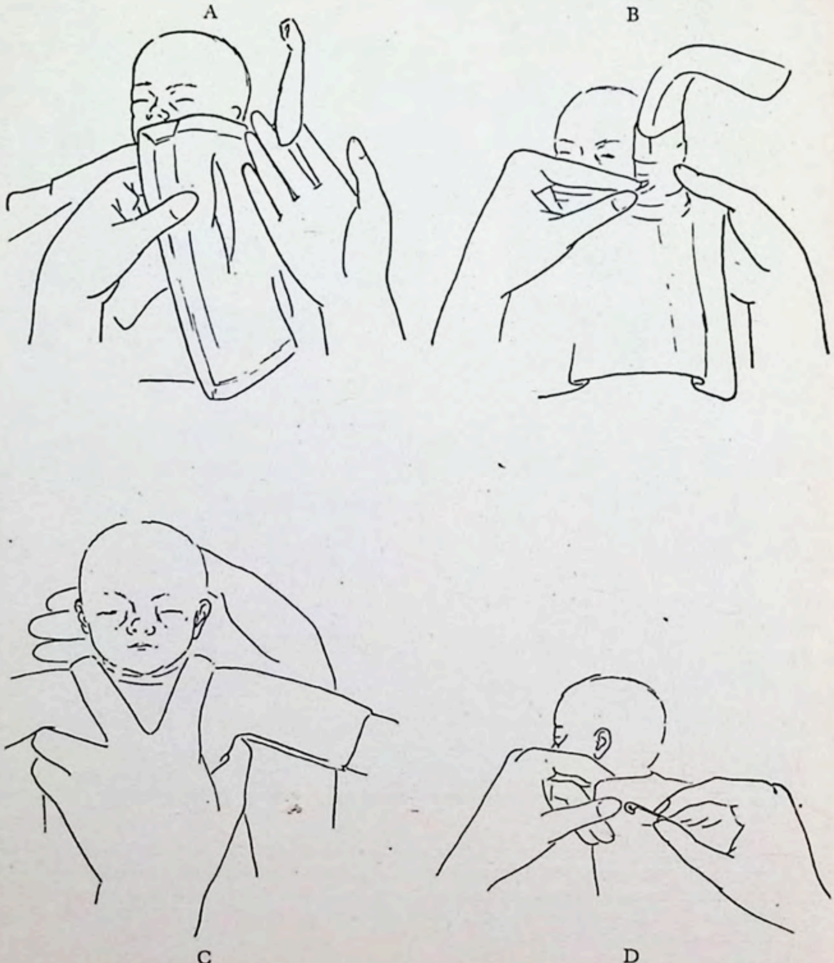

Fig. 63. Dressing the baby. A. With the second and third finger of right hand, grasp infant's arm just above the elbow. B. Grasp infant's arm in back of its elbow with the second and third finger of right hand. C. Turn infant as illustrated. D. Pin the shirt together in the back with a small safety pin. Place the pin about one inch from the top. The shirts are pulled together in the back to prevent exposure.

Directions

THE HESS BABY AMBULANCE FOR PREMATURE INFANTS

This improved Hess Infant Ambulance contains three separate heating units, for operation on 110-volt, 60 cycle, alternating current, 110-volt direct current, or 6-volt current from a standard automobile battery.

Two separate plug-in connections, one for the 6-volt current and one for the 110-volt current, are built into the end of the cabinet, each one clearly marked with a metal plate.

Also supplied are three line cords: one for the 110-volt line; a second for the 6-volt battery circuit, which has a connection to fit the interior outlet in any automobile; and the third cord, also for the 6-volt battery, with clamps for direct connection to the battery.

There are two pilot lights, one beside each of the two plug connections, which glow all the time the heating units are in action. (On the 110-volt line, of course, the pilot light goes out each time the automatic thermostat cuts off the heating unit.)

IMPORTANT!

For quick warm-up when the ambulance is first plugged in on the 110-volt line, two heating units go into action. Together, these heaters raise the temperature within the ambulance to 100° F. within ten to fifteen minutes, <u>at which point one heater must be turned off.</u> A switch on the lower right of the cabinet, below the thermometer dial, is for this purpose. <u>This switch must be operated manually.</u> Turn "On" for quick warm-up at the beginning; turn "Off" when temperature becomes 100°, as shown on the thermometer dial.

Once this auxiliary heater is switched off, the second heating unit, which is automatically controlled by a thermostat, will maintain the 100° F. temperature within the ambulance for an indefinite period—as long as it is connected to the 110-volt current.

On the battery circuit, the 6-volt current is not thermostatically controlled. The heating unit, however, is so co-ordinated with the battery output that the heat will remain at the same level until the battery output is completely exhausted.

Note: To save and extend the strength of the 6-volt battery as much as possible, the ambulance should be heated to 100° F. on the 110-volt house line, if this is practical, before attaching to the automobile current for transportation.

Circulation of fresh air is accomplished by means of the wire mesh opening at the bottom of the cabinet and the little sliding shutter at the top. This shutter, of course, must be open while the ambulance is in use. The holes of the shutter accommodate a tube from the oxygen supply, when oxygen is necessary.

SHEET I

PREMATURE RECORD

MICHAEL REESE HOSPITAL

Name ______________________ Date ______________________ No. __________

Address ______________________

Telephone __________ House Flat Front Rear Floor ______________________

Guardian's Name ______________________ Relationship __________

Referred by ______________________

Clinician ______________________ Born in hospital, home __________

WHY IS INFANT BROUGHT TO THE HOSPITAL? (Mother's answer) ______________________

Condition on arrival ______________________ Temperature __________

Method by which body temperature has been maintained ______________________

HISTORY OF PREGNANCY (Onset, duration and progress of illnesses, injuries and operations):

Last Menstruation (first day of) __________ Duration __________ Quickening __________

HISTORY OF LABOR (Length __________ hours, Spontaneous, Induced, Operative) ______________________

FAMILY HISTORY

	Name	Birthplace	Living	Dead	Age	Condition of Health	Cause of Death
Father							
Mother							

Children No.	Premature or Full Term	Condition of Health	Age	Age at Death	Cause of Death

Miscarriages

No.	Order of Pregnancies	Months	Cause

PERSONAL HISTORY

Date of birth ______________________ Present age __________ days. Sex __________

Condition at birth ______________________

Single, Twins, Triplets (Order of birth, weight of each and number surviving) ______________________

Calculated Fetal Age. By History __________ weeks. By measurements __________ weeks.

By Radiograms ______________________

Congenital Diseases and Abnormalities ______________________

Birth Injuries ______________________

Fig. 69a. History Sheet Used in Premature Station. (Page 1.)

PHYSICAL EXAMINATION (Continued)

TONGUE: Moist, dry, injected ______

THROAT: Normal, injected, membrane (type) ______

GLANDS: Normal Enlarged Ant.-cervical Post. cerv. Epitoclear Inguinal
Others ______

EARS: Normal perforation right, left. Discharge right, left, character ______

NECK: Thyroid ______
Thymus ______

CHEST: Normal barrel flat funnel pigeon rosary Harrison's groove.

LUNGS: Primary respiration, (spontaneous, induced.) Degree of asphyxia ______
Cyanosis ______ Respiration, thoracic, abdominal). Evidence of atelectasis ______

______

______

HEART: Area of dullness ______ cm. to left of mid-sternal line.
______ cm. to right of mid-sternal line.
Apex 4th 5th 6th space in mid-clavicular line.
______ cm. outside, inside, mid-clavicular line.
Action: Number ______ regular irregular Sounds: Clear impure ______
Murmurs ______
______ Blood Pressure ______

ABDOMEN: Normal large distended

______

Hernia umbilical inguinal right left Other (seat) ______
Cord (condition of)

LIVER: Palpable Enlarged ______ Boundaries in Mid Cl. L. ______

SPLEEN: Palpable Yes no Size ______

KIDNEYS: Palpable Yes no Size ______

GENITALS: Phimosis Circumsized Undescended testicle Rt. Lt.
Hydrocele Rt. Lt. Vaginitis Anus (normal abnormal) ______

EXTREMITIES: Normal Deformity (acquired, congenital) ______ Fractures ______
Paralysis Rickets

FEET: Deformities Acquired Congenital

SPINE: Normal Deformities

REFLEXES: Patellar Brudzinski Oppenheim Trousseau
Kernig Babinski Chvostek

WEIGHT: Birth ______ Present ______ Initial loss ______ B. W. regained ______
Doubled ______ Trebled ______ Average daily gain ______

LENGTH: Date ______ Age ______ days ______ cm. ______
Ant. sup. spine to vertex ______ to sole ______
Location center of body ______
Date ______ Age ______ days ______ cm. ______
Ant. sup. spine to vertex ______ to sole ______
Location center of body ______

CIRCUMFERENCE: Heat (occipito-frontal) ______ Chest ______ Shoulders ______
Birth ______
1 month ______
3 months ______
6 months ______
1 year ______

FIG. 69b. History Sheet. (Page 2.)

SHEET II

PREMATURE RECORD

PRESENT AND PAST ILLNESSES:

Asphyxia	Vomiting	Pemphigus	Cerebral Hemorrhages
Cyanosis	Meteorism	Furunculosis	Encephalitis
Hemorrhages	Diarrhea	Adenitis	Otitis
Stridor	Constipation	Cord (Condition of)	Pyelitis
Rhinitis	Atelectasis	Sepsis	Rachitis
Icterus	Bronchitis	Megacephalus	Spasmophilia
Convulsions (Early, Late)	Pneumonia	Hydrocephalus	Anemia
Difficult Nursing	Edema	Meningitis	Scurvy

Lues (Evidence of) ______________________________

Congenital Deformities ______________________________

Operations ______________________________

Important details of diseases______________ During first week______________

Later ______________________________

FEEDING HISTORY:

Before entering hospital—Breast, bottle, mixed______________________________

First ten days (Breast, bottle, mixed). Number______________, Interval______________hours.

Amount______________cm. Administered (Breast, dropper, bottle, catheter)______________

Subsequent feedings. Kind______________ Method ______________ Number______________

Interval______________hours. Amount______________ ccm. ______________

Other details ______________________________

Present Feeding (Able to nurse—Yes, No)______________________________

MOTHER'S general health:______________ Is she available? (Yes, No)______________

Quality of breasts (Good, fair, poor)______________ Nipple, (Good, Bad, Inverted)______________

Is she pumping, expressing, other methods______________________________

Why was nursing discontinued?______________________________

Does the baby take all of its feedings?______________________________

Does the baby vomit?______________ How much?______________

Does the baby have colic?______________ When?______________

How many times a day do the bowels move (average)? Well, sick ______________

Color______________ Consistency______________ Mucus______________ Curds______________ Blood______________

PHYSICAL EXAMINATION

Temperature______________ Pulse______________ Respiration. (Underline each word describing condition)

INSPECTION: Bright Apathetic Cyanotic Anemic Icteric

GENERAL CONDITION: Fat Thin Good Fair Poor

SKIN:

Normal Prickly Heat Pemphigus Furunculosis Nails

Tissue turgor Seborrlea Impetigo Edema Lues

MUSCLES: Biceps and thighs Firm Flabby

HEAD: Normal______________ Deformities______________ Fontanelles ______________

Craniotabes ______________ Megacephalus ______________ Hydrocephalus ______________

EYES: Pupils, equal, unequal______________ React to light ______________ Nystagmus______________

Blepharitis ______________ Conjunctivitis______________

NARES: Clear Crusted Discharge Character______________

MOUTH: Normal______________ Stomatitis (type) ______________

Deformities, hair lip, cleft palate, etc.______________

Fig. 69c. History Sheet. (Page 3.)

RECOMMENDATIONS:

FEEDING ____

____

____

____

____

EXTERNAL HEAT ____

____

MEDICAL ____

____

SURGICAL ____

SUMMARY OF HISTORY AND EXAMINATION: Born in hospital, home______________________

Father's History ____

Mother's History. Para______________________

Diseases ____

Miscarriages ____

Pathology of Pregnancy ____

Pathology of labor. Length______________________hours. Character ______________________

____

Infant. Single, Twins, Triplets, No. Living______________________ Which______________________

Length of gestation ______________________days. Age when received______________________days.

Temperature when received______________________°F. Condition when received______________________

Congenital disease (Lues) (Evidence)____

Other ____

Congenital deformities ____

Birth injuries ____

Post natal diseases. First week____

Later ____

Previous care. (Artificial heat, etc.)____

Previous feeding. Kind______________________Amount______________________ How Given ______________

Birth weight______________Initial loss of weight______________________Present weight______________

Age when B. W. regained______________________Age when B. W. doubled______________Trebled______________

Anemia ______________________Rachitis______________ Spasmophilia ______________

Other pathological finding ____

____

____

Condition on discharge. Age, etc.____

____

____

____

Apparent cause of Prematurity____

Cross Index ____

____

____

Future Development (Mental, Physical) ____

____

____

____

____

____

FIG. 69d. History Sheet. (Page 4.)

Temperature Chart for Heated Bed

Name ______________________________ Dr. ______________________________

Day of Entrance ______________________________ Age ______________ Temperature ______________

Birth weight ______________ Present weight ______________ Case No. ______________

DATE	6 a. m.				12 a. m				6 p. m.				12 p. m.			
	ROOM		BED		ROOM		BED		ROOM		BED		ROOM		BED	
	Humid	Temp.	Contact	Temp.	Hum'd	Temp.	Contact	Temp.	Humid.	Temp.	Contact	Temp.	Humid.	Temp.	Contact	Temp.

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Fig. 70. Premature Infant Temperature Chart Used While Infant Is in Heated Bed.

PREMATURE INFANT STATION

FEEDING ORDERS

DATE	NAME	AGE	WEIGHT	BREAST MILK	NUMBER	AMOUNT	WATER	OTHER FOOD

357A

FIG. 71. This blank is used to show the doctor's orders for the day's feedings for all the babies in the Station.

PREMATURE INFANT STATION

FOOD REQUIREMENTS FROM MILK STATIONS

DATE	NAME	AGE	WEIGHT	BREAST MILK	NUMBER	AMOUNT	WATER	OTHER FOOD

358A

FIG. 72. This blank is sent to the milk laboratory as the day's requirements for ward feedings.

Case No.____________

Name ____________

Present Weight ____________

TIME	FOOD	AMOUNT	WATER	Describe stools and special findings here, on figures corresponding with hour.
1				1
2				2
3				3
4				4
5				5
6				6
7				7
8				8
9				9
10				10
11				11
12				12
TOTAL				
1				1
2				2
3				3
4				4
5				5
6				6
7				7
8				8
9				9
10				10
11				11
12				12
TOTAL				

355a

FIG. 73. Daily Record of Individual Patient.

Dr.______ Name______________ Diagnosis ______________

Case No.______ Address______________ Complications ______________

ENTRANCE { Date______ Age______ Weight______ Condition______

DISCHARGE { Date______ Age______ Weight______ Condition______

Weight	Temp.	Date	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.
—	108°	MEDICATION 10 9																												
Lb. Oz.	107°	8 7																												
—	106°	6 5																												
Lb. Oz.	105°	4 3 Milliamperes																												
—	104°	2 1																												
Lb. Oz.	103°																													
—	102°																													
Lb. Oz.	101°																													
—	100°	SYMPTOMS																												
Lb. Oz.	99°																													
—	98°																													
Lb. Oz.	97°																													
—	96°																													
	95°																													

FEEDING ORDERS															
FOOD CONSUMED															
TOTAL CALORIES CONSUMED															
PERCENTAGE COMPOSITION of FOOD															
Stools Number Quality															
VOMITING															

FIG. 74. Graphic record sheet. A brief description of the clinical sheet used in our wards may be of value, as it answers both the need of a history sheet and of a daily chart as well. The points illustrated by it are: A graphic relationship between the temperature, weight, quality and quantity of food taken, and the end-results on the stools and urine. Also separate spaces are provided for complications which may influence the preceding under the heading of symptoms, together with spaces for treatment other than dietetic, energy value of foods, vomiting, blood examinations, tuberculin reactions, etc. The small figures 1 to 10 are used to make an electrical reaction curve in cases showing a spasmophilic diathesis. (Courtesy, Lea and Febiger.)

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(Bold face page numbers indicate pages upon which a Procedure is detailed.)

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