# THE CARE OF PREMATURE INFANTS

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Medical literature contains very little of value or interest concerning the care of the premature infant. It has been just the last few years that interest has been aroused. The former philosophy of the survival of the fittest seems to have prevailed in this particular field. When a doctor would look at a premature baby, he would wrap him in a blanket, feed him rum, and pop him into an oven. As the word passed through the neighborhood that the Anderson's new baby was an "incubator baby", the kindly neighbors shook their heads sadly as though all were doomed. If kind fate saw fit to intervene, the child would live; if not, the loss was attributed to God's will. Few instances are recorded of the survival of infants weighing three pounds, but these are rare.

This paper will attempt to deal briefly with the comparisons of the older methods of care with the new, but emphasis will be placed upon causes of prematurity and their prevention, causes of premature mortality and their prevention, and causes of premature morbidity and their prevention.

It has been stated frequently, and the authorities are becoming increasingly aware of the fact, that, in order to reduce further the infant mortality rate, the premature mortality rate must be reduced. There are many causative factors involved in this problem, as well as problems of education, and this paper will try to delve into them and to present some possible solutions.

Obstetricians leave the answers to these questions to the Pediatricians; Pediatricians evade the specific answers and push as much as they can back onto the Obstetricians. It has been very recently that both groups have become keenly aware of the situation and interested in the problem. At present, there are many individual and group experiments in progress. Dr. Ethel Dunham, of the United States Children's Bureau, and Dr. Hess, of Michael Reese Hospital in

Chicago, have done much to pave the way towards a longer and more useful life of the prematurely born infant.

In order to clarify the subject more fully, and to present a standard on which to work, I have chosen the weight factor as my criterion. Henceforth, by premature, I shall mean all those infants weighing between eight hundred grams and twenty-five hundred grams at birth, regardless of the period of gestation. The time factor is so irregular and subject to error, and the weight factor is constant; therefore, the time element is rapidly being discarded by most authorities. About one hundred thousand infants, or five percent of all births, are born prematurely every year in the United States. Approximately thirty-five thousand of these die before they leave the hospital, and it is believed that about fifteen thousand more die soon after. With proper care and more complete knowledge, at least fifty percent of these deaths could be prevented.

Among the papers dealing with the methods of care of premature infants was one in 1887 in which types of incubators used in Russia and France were described. Those in use mainly were the water-jacket type, resembling a bathtub with hollow walls which were filled with warm water. In 1889, literature reveals a discussion pro and con concerning the proper food for the premature. It was generally agreed that mother's milk was ideal, but some believed that the protein content was too high. Methods of administration could not be agreed upon; they varied then, as they do now, from a bottle to a medicine dropper.

It is remarkable that the principles upon which they agreed and to which they adhered were the same as today--mainly those of keeping the infant warm, protecting him from infection, and feeding him properly. Although their methods of obtaining these principles were very often the opposite of those used today, they recognized the needs of the infant.

Prematurity as a syndrome:

In spite of much study and research, the exact causes of prematurity remain a mystery. Recently, there have been some studies in Sweden delving into this, the results of which have been gratifying. It has been found that emotional disturbances in the mother play a very important role. Periods of stress, grief, or great excitement may cause the mother to go into labor. Mothers who have large families with many household duties, and heavy lifting, or those mothers who are employed during their pregnancy, are prone to deliver prematurely. Also, in this same field, it has been found that unmarried mothers frequently deliver prematurely. Whether this is due to attempted abortion, the emotional angle, or employment during pregnancy has not been followed through. Therefore, during the prenatal period, the need for mental relaxation, as well as physical relaxation, should be stressed. The need for an absorbing hobby, or recreation, is even more pressing.

Because of the importance of falls and injuries as a cause of early labor, the mother should be taught not to walk in the dark, nor to hurry up and down steps.

Deformities of the mother, such as a contracted pelvis, or a placenta previa may be a cause of early labor, but these problems are relatively unimportant in the field of public health. Acute diseases, or operations during pregnancy, may cause premature labor and an injured fetus, but these also are comparatively rare.

Syphilis is frequently credited with being the outstanding cause of prematurity, as well as an important factor in the morbidity and mortality rate. With the improved methods of treatment and emphasis upon early prenatal care, syphilis as a cause of prematurity has become of minor importance. Of far more importance are those chronic infections such as nephritis or tuberculosis. Babies of a nephritic mother are generally small and puny, and this, coupled with prematurity, is often a fatal combination.

The prevention of prematurity has gained a good deal of attention in

the last few years, as this seems to be the certain method of reducing premature mortality rates. It is unnecessary to emphasize the importance of the relation between prenatal care and prematurity. It is vital that prenatal care be started early in pregnancy, and that it be available to all mothers. Prematurity may be prevented only by preventing the actual cause of the labor, but if all mothers were being followed closely and routinely, the majority of these causes could be eliminated.

By prenatal care, I mean that program under which all pregnant mothers are supervised closely by a physician, starting at least in the second month of pregnancy. This calls for a visit at least once a month during the first six months, twice a month the next two months, and every week the last month. The first visit should include urinalysis, hematology, serology, and blood pressure reading; also, a thorough physical examination that would include pelvic measurement. Each visit following should include urinalysis and blood pressure readings. By this means, early anemias may be treated, syphilitic babies may be prevented, and incipient toxemias may be stopped.

In the past, it has frequently been the practice of some physicians to induce labor early so that mothers may have small babies, thus be spared the agony of child-birth. Many of the premature infants received in the hospitals are from induced labors. In the developing program of prevention of prematurity, this is being greatly discouraged. It is far wiser and safer for the mother to suffer momentary pain than to deliver a child too small and immature to battle the external elements.

The premature is very aptly described as resembling an old man. His skin is soft, dry and very wrinkled. It is a vivid red and covered freely with lanugo. The weight of these infants is generally from three to five pounds, but frequently they are as low as two pounds; their weight is extremely labile. All newborn infants lose a few ounces in the first week, but these few ounces, to a premature, are vital. Prematurely born infants lose relatively more and regain their birth weight more slowly. Typical of these infants is their

round, well-shaped head with large fontanelles and prominent suture lines. Their cry at first is very feeble and whiny, and they sleep soundly most of the time. If these infants are fed by gavage, they frequently do not even arouse during this procedure.

One of the biggest problems typical of the prematures is that of controlling the temperature. Normally their tempoerature is low, but it fluctuates readily with that of the environment. A good sign and criterion of the progress of the infant is his ability to control his temperature. Other signs considered good are those of a pink color, lusty cry and movement about the bed, good muscle tone and gradual increase in body weight. In opposition to these, those signs which are considered as unfavorable are persistent subnormal temperature, persistent cyanosis, grunting expiration, persistent accumulation of mucous, pronounced somnolence, and persistent edema. Within the last year or two, the problems of premature mortality have been given a great deal of attention. It has been stated repeatedly that in order to reduce the infant mortality rate much more, the premature infant mortality rate must be reduced. The causes are many and uncertain. If the infant can survive his extra-uterine life the first forty-eight hours, his survival is practically a certainty; but these first forty-eight hours are unpredictable.

Outstanding as the cause of mortality in the prematures is that of prematurity itself. Although the weight is sufficient, there frequently exists a certain incompatibility with life. Regardless of the expert care and scientific treatment, these infants do not survive. Birth injuries play a prominent part, due to the softness of the bones and tissues. Although the delivery may appear to be easy, and the trauma received would not be deleterious to a full-term infant, it may result in hemorrhage or injury that will prove fatal or permanently damaging to the prematurely born.

The apparently easy delivery of the premature is responsible also for many deaths, in that the delivery is too rapid, and results in brain injury and hemorrhages.

Prematurity has formerly been considered a pediatric problem, but the failure to reduce the mortality rate more has brought up the question of the obstetrical angle. As a result, a study concerning the different methods of delivery and their effect on the mortality rate was made, the results of which are, as follows:

| Types of Delivery | Number of Births | Deaths | Percent |
|---|---|---|---|
| Forceps | 52 | 17 | 32.6 |
| Spontaneous | 203 | 113 | 55.6 |
| Versions | 23 | 13 | 56.5 |
| Breeches | 51 | 35 | 57.3 |
| Caesarian | | | 80.0 |

In further studies, it was proved that the relation between weight and mortality were directly inverse. That is, the lower the birth weight, the higher the mortality rate. The mortality rate increases as the intrauterine age at birth decreases. The mortality rate for weight and intrauterine age are very nearly parallel.

Of all the criteria for determining prematurity, weight was the most reliable single factor.

The death rate for male infants was 50 percent higher than females.

The length of labor had little effect on mortality.

The use of sedatives and anaesthetics did not show any adverse effect on mortality.

Morbidity was found in 37 percent of the mothers and had a definite effect on mortality; accidents of labor and polyhydramnios most common, and toxemia least.

Other studies have revealed that conditions in the mother, such as multiple pregnancy, toxemias, and placenta previa have little effect on the premature infant who is born alive. Many times it has been stated that the age of the mother influenced the survival of the infant, but this has been found to be untrue, except in mothers over forty. Ether is the safest anaesthetic, and morphine is extremely dangerous; but, next to morphine, the use

of no anaesthetic is associated with the highest mortality rate.

It would seem our best hope of improvement in premature mortality rate still lies in the care of these infants after birth. Any method of obstetrics which tends to bring smaller infants into the world by means of induction, when they might well be carried to term, plays a large part in our mortality rate.

It has frequently been the practice to administer those drugs that, such as quinine, pituitary extract and ergot, tend to hasten labor. The indiscriminant use of these oxytocics has been responsible for many deaths and permanent injuries in these infants.

As in the causes of prematurity itself, the importance of chronic infections such as syphilis, heart disease, nephritis, and obstetrical difficulties play their part toward the premature mortality. All too often they play their subtle role; very often they exist unknown.

The avoidance of all acute infections during pregnancy would do much toward lowering the premature death rate. Measles, lobar pneumonia, influenza often cause early labor with resulting death of the fetus.

Poor nursing care, either lack of knowledge of the principles involved, or inability to improvise the proper equipment, is too often, and unnecessarily so, the cause of death. However, this subject will be dealt with more thoroughly in another chapter.

Much has been done to prevent premature mortality with the establishment of prenatal clinics. The prevention of prematurity itself is the most important factor. With increased interest and opportunity for study, the requirements and needs of these infants should be more fully understood by the parents and those who care for the infants.

Because prematurity accounts for forty-five to sixty-five percent of fatalities in the first few weeks of life, it is time that public health authorities make a concerted effort to remedy this situation.

These infants are especially susceptible to their environment; infections may develop with unbelievable rapidity.

One of the more common complications seen in the premature is that of cyanosis. It develops in varying degrees of severity and from many different causes. It is the most important symptom and is of great diagnostic and prognostic value. If it is continuous, it is generally due to atelectasis. This may be remedied by giving inhalations of a 95 percent oxygen-5 percent Carbon Dioxide mixture at frequent intervals, or continuous oxygen may be

administered through a mask, funnel or nasal catheter. The continuous oxygen has been found to be the more satisfactory method.

If the cyanosis is intermittent, it is most often due to an infratentorial hemorrhage. This usually clears without treatment. But, if the cyanosis is sporadic for some time, it is due to variable causes and the prognosis is grave.

Jaundice almost always occurs, but it, too, generally clears within a few days after administration of fluids. If it persists and increases in severity, it is a sign of impending danger. It may be a result of intracranial hemorrhage with increased pressure, or of a congenital malformation of the bile ducts, or even of a developing infection. All of these are serious and frequently have a fatal outcome.

Vomiting, distention and diarrhea are rarely of primary etiology, but are a warning signal of some hidden infection. They occur in varying intensity, depending upon the causes, but all infections in the premature are of increased severity.

Any upper respiratory infection is to be avoided. These infections rapidly develop into otitis media and pneumonia. Pneumonia is almost always fatal in these infants.

As has been stated before, the prevention of these complications is most easily accomplished through the prevention of prematurity. Next of importance is increased educational facilities for parents and personnel. Included in this would be increased facilities for care of these infants in all districts.

## NURSING CARE

Success or failure with a premature is largely dependent on the nursing care during the early weeks or months of life. Too many nurses are given the care and responsibility of these infants who have had no further training in the care of newborn infants except that which they received in their obstetrical training. This is not enough; all nurses should be taught, at the very least, the necessity for maintaining a stable temperature, minimum handling, adequate feedings and prevention of infection.

Too many infants die as the result of improper methods of resuscitation. The older methods of reviving newborn infants are too violent for a full-term baby, and should never be used to start a premature infant breathing. An infant who is pale, limp, and not breathing is an injured infant and should never be treated with violence. If he is blue, and good muscle tone is present, slightly more vigorous methods may be used. The older ideas of swinging the child by his heels, slapping him and compressing the rib cage are utterly taboo. These serve only to chill, shock and harm him. Frequently, many attempt to revive an asphyxiated infant by immersing him first in hot water, then in cold. This should never be used when reviving a premature. The heat center of his brain is not developed sufficiently to allow for this rapid adjustment. The cold water will only chill him and make it more difficult to regulate his temperature. If need be, he may be put in a tub of warm water. If his trachea seems plugged, this may be freed by inverting him, hyperextending his neck and gently stroking the trachea. If this is unsuccessful, a tracheal catheter may be passed and the substance sucked out. Dr. Hess suggests as a good method of artificial respiration to suspend the infant by his feet, forehead resting lightly on the bed so as to deflect the chin and straighten out the trachea. The chest is compressed between the thumb of the right hand resting on the back and the four fingers of the same hand resting on the anterior wall of the chest. Do this gently sixteen to twenty times a minute.

The desire to keep these infants warm may often be the direct cause of death, as many prematures are killed by overheating as are killed by chilling. Especially in the home, over-anxious parents and friends may keep a hot fire going and repeatedly place hot water bottles in or around the bed.

Because the heat center of the premature infant is not fully developed, he takes his heat from his environment. His normal temperature is always slightly subnormal from that of a full-term infant, but this is rarely realized. The old feeling, "if a little is good, alot is better", prevails. It is of great importance that a stable temperature be reached as early as possible, whether this is 96 degrees or 98 degrees Fahrenheit. It is not the temperature at which it stabilizes that is important--it is the curve of fluctuation and the early stabilization that determines the prognosis.

There is a common feeling within the laity that if an incubator is being used, all within human power is being done to save the infant. Although this is dangerously untrue, many hospitals use them for this reason. From the earliest times, there has existed a controversy as to the advisability of using incubators. In 1914(1) a symposium presented the following viewpoints:

"1. An incubator supplies heat but loses fresh hair; it should be abandoned.

2. A soapbox placed near a radiator works better than an incubator. If the baby is cold, he may be given a warm bath.

3. It is impossible to give baby enough fresh air with an incubator."

Many hospitals and homes use what is known as an incubator bed. It is not an incubator in the true sense of the word, but has proved to be most satisfactory. This consists of the usual nursery crib lined with many thicknesses of newspaper and a layer of cotton. If necessary, this may be supplemented by a small heat cradle. Heat cradles are especially beneficial the first forty-eight hours.

(1) McClanahan, H.M. M.D.- "Care of Delicate and Premature Children in the Home." American Journal of Obstetrics, June, 1914.

The simplest type of warm bed for a premature infant is a small clothes basket lined with cotton or a thin blanket. This basket may then be placed inside a bassinet or a box lined with quilting. Between the sides of the basket and the box, hot water bottles, heated bricks, or bags of heated sand may be placed. One of these may be reheated at a time. In this way, the source of heat will be kept in place and will not be in contact with the infant. The bed should never be warmer than 100 degrees Fahrenheit.

Another type of warmbed can be arranged by using a small box, well padded inside and outside with quilting, into which is fitted a removable platform about four inches above the padded floor. A thin, flat hair pillow or several layers of wool blankets should be used to cover the platform. Beneath the platform, on the floor of the box, two or three hot water bottles may be placed; an opening may be cut in the side of the box so that the water bottles may be refilled.

Another type of improvised bed is an electrically heated wooden box, inverted over the crib and used as a cover. One end should have opening large enough to allow the baby's head to be outside the box. A small, washable curtain may be tacked over this end to be tucked around the baby's neck, thus preventing escape of the warmth. This box is heated by means of electric light bulb covered with a wire guard. The temperature of all these beds should be constantly maintained between 80 and 90 degrees Fahrenheit, and it should be checked every half hour.

Other incubators in use vary from the simplest to the intricate Hess bed. These all serve the same purpose and aid the infant in his adaption to his environment.

Of more recent innovation is the Nobel box. This promises to be one of the most practical types yet, due to its inexpensiveness and usability. It may be made for about $25.00. The box consists of a bed entirely covered with an electrically heated box, and provisions for lowering or raising the humidity. On the side of the box are two covered openings so that the infant may be cared

for without removing him from his bed. This box may be used as a carrying ambulance, also, because it is so constructed, it may be connected to the battery of the automobile.

(2)

Infant deaths due to premature birth and Infants cared for in incubators, Cattaraugus County, New York, 1937-1939.

Solid bars - Premature deaths
Shaded bars - Infants cared for in incubators

From many points of evidence, it is obvious that incubators are beneficial in maintaining a stable body temperature. Because of the paramount importance of this problem of regulation of temperature,(3) Blackfan

(2) Reproduced from Page 26 of 1939 Annual Report of the County Department of Health, Cattaraugus County, New York.

(3) Blackfan, Kenneth; Yaglow, Constantin, "A Study of the Atmospheric Conditions on growth and Development", American Journal of Diseases of Children, November, 1933.

and Yaglow have carried on some valuable experiments which have brought out the following points:

The heat regulatory mechanism of premature infants is not fully developed at the time of birth. If the body temperature is allowed to fall too much, it may never rise.

The premature infants do not perspire, thus they are unable to guard against overheating. Likewise, they do not shiver as a defense mechanism against the cold.

These infants are extremely thermolabile, therefore the temperature of the environment should not be allowed to fluctuate to a marked degree.

The body temperature of prematures can be controlled much better and much more easily in nurseries in which the air temperature, humidity and ventilation rate are automatically controlled. It was also determined that body temperature and fluctuations in body temperature under controlled air conditions are related to body weight - as the weight increases, the body temperature rises and fluctuations decrease. This subnormal temperature is normal to prematures and it is detrimental to growth to attempt to raise it.

The maximum gain of weight occurred under high humidity, although this often causes discomfort in the attendants. A low humidity tends to produce dehydration in the infants. A humidity of 65 proved to be most advantageous.

The temperature of each individual bed should be regulated, using the weight of the infant as the criterion:

| | |
|---|---|
| 2-3 pounds | 80- 87° F |
| 3-5 " | 75- 80° F |
| 5- " | 70- 75° F |
| Smaller | 90-100° F |

In order to keep these infants warm, it has commonly been the practice to overdress them. A sleeveless padded jacket, including a hood, was wrapped snugly about the child. The jackets are made from two squares of cheesecloth, eighteen inches square, with a thick layer of cotton batting stitched between, and a piece of the padded material used as a hood. It is

long enough to cover the feet well, and wide enough to lap over and be pinned in front. Small squares of soft, absorbent cotton covered with gauze are used for diapers.

Other authorities recommend as the ideal way to cloth these infants the following: a flannel band, a flannel undershirt with blind sleeves and drawstrings at the neck, an overshirt, a pinning skirt (to be wrapped snugly around the infant), a woolen bag with a hood, a pair of woolen stockings, diapers and pads.

The common practice of wrapping a premature infant like a mummy may prevent an excessive loss of heat, but it is an effective means of preventing muscular movements which increase heat production. For this reason, more and more the nurseries are dressing their premature infants as any full-term infant, and supplying the needed heat by some other method.

The least amount of handling that is absolutely necessary will aid in conservation of energy and prevent excess heat loss. With the advent of a new baby in a home comes the signal of "seldom-heard-from" friends to stop in and take their turn playing with the child. It is often a delicate situation explaining to grandmother, who raised ten of her own, that she must not pick up the baby. In the hospital, the problem is simpler, but even there, the over-enthusiastic student nurses often need reminders. Only with full explanation why the baby must not be handled, and constant reminders, will this be successful.

Many mothers still gasp in horror at the thoughts of not bathing a new-born baby for ten days; but the premature infants should not be bathed for three weeks, and longer if necessary. They should not be bathed until their temperature is absolutely regulated, for this would only serve to give greater variance. All cleaning that is necessary should be done with small amounts of warm olive oil or mineral oil. Special attention should be given to the axilla, behind the ears, and the genitals. All excess oil should be wiped off with a cotton applicator, and powders with an oil base should be avoided.

Mothers should be taught not to attempt to clean the auditory canals, the nostrils, nor to swab the mouth. This will only traumatize the tissues, leaving them open to infection.

The prevention of infection also presents a major problem. These infants lack any immunity; infections occur with amazing rapidity and are of increased severity. Upper respiratory infections, especially, are common and are frequently fatal. For this reason, extremes in aseptic technique are often used. All attendants should wear gowns and masks, and no attendant should be admitted to the nursery if he has the least sign of a cold. Whether or not all linen used should be sterilized or not is a matter of opinion, but it is agreed that all linen in the nursery should be washed separately from all other linen and kept entirely separate. All enamelware should be autoclaved daily, solutions kept fresh and sterile, and cribs changed at least once daily. Only those nurses who are working in the nursery should be admitted, and they should remain within the nursery at all times.

If these procedures are carried out faithfully and conscientiously, infections should never gain a foothold within the nursery.

The stage of development is the most important factor in determining the nutritional requirements of premature infants. There are many phases of this problem to be considered; namely, kind and quality of food, the amount to be used at one feeding, interval between feedings, and the method to be used in the administration of the feeding.

The basal metabolism is about fifty calories per kilogram per twenty-four hours. The caloric requirement is relatively small in proportion to body weight, because of low basal metabolism and decreased activity. However, his caloric requirement increases rapidly, for the premature triples his birth weight in four to five months, while the full-term infant triples his birth weight in one year. Prematures retain 80 to 94 percent of the calories ingested, while breast-fed infants utilize only 56 percent. Protein requirement is higher than that of the normal infant because of the more rapid rate of

growth; carbohydrate metabolism is at a low ebb, but rises promptly with the administration of dextrose, and fat metabolism of the premature differs from that of the full-term infant in that retention of unsaponifiable material is impaired. Absorption of fat is complete except for olive oil and soy-bean oil. Storage of fat by prematures, however, is actually greater than that of a full-term infant, for fat is formed from ingested carbohydrates. The mineral and vitamin requirements of the premature are high because of lack of available reserves and rapid rate of growth. The water requirement is high, and this should be fulfilled before any other nutrient is started.

All food and fluids are withheld the first ten or twelve hours, to enable the respiratory and circulatory systems to become well established. If the baby appears to be weak, dehydrated, or there are any evidences of bleeding, small transfusions of citrated blood may be given intramuscularly. Amounts varying from 2 cc to 15 cc are given, and may be repeated within several hours, if necessary. Also, small subcutaneous injections of normal saline may be used to combat dehydration. If the infant is sufficiently vigorous, he may be given 2-4 cc 10% lactose, or 5% Karo water.

The feeding of choice is breast milk. The premature should not be put to breast, but should be given mother's milk obtained by manual or mechanical expression. Even those infants who are able to nurse overexert themselves and are unable to obtain sufficient nourishment. Much-needed energy is also wasted in this attempt to nurse.

Nutritive requirements may be fulfilled by breast milk alone after a day or two adjustment to digestive capacity; but many infants are unable to take more than an ounce at one feeding and then regurgitate part of that. If the infants are forced to take more, gastric dilatation and cyanosis develops. For this reason, breast milk may be concentrated with a protein or carbohydrate. Protein may be supplied by the addition 2% powdered milk; carbohydrate is supplied by the addition of 5 to 10 percent Karo or dextrimaltose. Fewer calories of the protein milk are required to produce gains in weight than of the carbohydrate.

If mother's milk is unavailable, or for some reason cannot be used, an artificial feeding must be supplemented. There are many of these in use, different formulas being adjusted to the needs of the different infants. Most of the common milk mixtures have been used at various times with some degree of success. Those high in protein and carbohydrate and low in fat are the most suitable in concentrated formulas. Whole lactic-acid milk with the addition of 7 to 10 percent Karo syrup gives twenty-five calories per ounce. Processed or acid milks are good because of the fine curd they produce.

Probably the most common artifical feedings used are those made from evaporated milk, Karo and water. One of the same caloric value as mother's milk is, as follows:

| | |
|---|---|
| Evaporated milk | 7 oz. |
| Karo (white) | 1 oz. |
| Water | 11 oz. |

If a more concentrated formula is desired, the following may be used:

| | |
|---|---|
| Evaporated milk | 8 oz. |
| Karo (white) | 1 oz. |
| Water | 8 oz. |

The amounts to be fed at each feeding depend upon the age of the infant, size of the infant, and his digestive capacity. The length of the interval between feedings is a subject of debate--many authorities advocate feedings every three hours, and some even suggest that the infants be fed as often as every one or two hours. But, because of the decreased motility of the stomach and the consequent slowness of digestion, the four-hour interval is generally accepted.

The feeding regime used at Multnomah Hospital is, as follows:

First Day: Nothing by mouth unless the baby is quite vigorous, then 10 percent lactose after twelve hours. Clysis, intravenous fluids, or transfusion can be given in amounts not over one ounce per pound of body weight.

Second day: Breast milk is started, giving one ounce per pound, divided into six feedings. Additional fluids in the same amount can be given between feedings, if tolerated. Lactose, Karo water, or normal saline may be used.

Third day: Breast milk, 1½ ounces per pound divided into six feedings. Additional fluids as before.

Fourth day: Breast milk, 1-3/4 ounces divided as before. Additional fluids usually not necessary.

Fifth day: Breast milk, 2 ounces per pound.

Sixth day: Breast milk, 2½ ounces per pound.

Seventh day: Breast milk, 2½ ounces per pound.

Thereafter: Breast milk, 3 ounces per pound. This will generally provide enough nourishment for small babies.

The premature has smaller stores of all nutrients at birth than does the full-term infant. For this reason, vitamin supplements should be started early, especially Vitamins A, C, and D. Vitamins A and D are usually supplied through Cod liver oil, or some concentrate--Oleum percomorphum is being commonly used now. Vitamin C is supplied through tomato juice or orange juice. This is given in varying amounts, from one teaspoonful to three ounces daily, diluted in an equal amount of water. These supplements are started after the second or third week, and should be started about a week apart. It is wise to allow the infant to become used to one before introducing the next. The two should never be mixed.

All prematures have a more or less marked anemia, due to the rapid rate of growth. Many authorities give their infants ferrous sulphate, ferri-ammonium citrate, or feed them egg yolks, in order to combat this. But there is some physiological inability to utilize this. Maintaining good nutrition until the infant is able to manufacture his own red blood cells is the best treatment.

Likewise, all prematures have rickets due to the rapid rate of growth and the laying down of bone cells. The large doses of Vitamin D aid in the treatment, but again, good nutrition is best. The babies always overcome deficiency if they are fed properly.

Because the premature is deficient in hormones normally present in the blood of full-term infants, some authorities suggest the administration of

thyroid, prolan A, corpus luteum, estrogen, insulin, and other endocrine products. Evidence of the good results attained are insufficient as yet to advocate routine usage.

Although it is desirable to have all prematures fed upon breast milk, relatively few prematures are put to breast. They are usually too feeble to suck or swallow without assistance. Some prematures will suck readily from a bottle, some will swallow milk by other means, but the feeble infant should be fed by gavage. In Multnomah Hospital, feedings are gavaged in all babies weighing less than four pounds during the first forty-eight hours; and this is continued on all babies weighing less than three pounds, or those over that weight who show no ability to nurse or who become fatigued on bottle feedings. It is felt that the baby should be allowed to take part of his feedings by bottle as soon as possible in order to develop the sucking reflex.

The medicine dropper enables the infant to receive small amounts of milk ordinarily impossible when allowed to suck from a nipple. The usual nipple is too large for the small premature, and it is necessary for him to exert too much effort. If he can swallow the amounts dropped into his mouth, this is a most satisfactory method of feeding until he can be weaned to a bottle.

The Breck feeder consists of a graduated glass bottle, open at both ends. One end is covered by a rubber bulb, and the other by a small nipple. This type of feeder is generally used while teaching the baby to nurse from a bottle. If he becomes lazy or fatigued, he may be helped along by squeezing the bulb gently.

Gavage is necessary when both sucking and swallowing are difficult, and when feeding produces cyanosis. A small catheter is inserted through the nose or mouth and passed to a point just above the cardiac orifice of the stomach. Before the catheter is passed, the distance from the bridge of the nose to the tip of the ensiform cartilage should be measured and marked on the tube. A barrel of a syringe may be attached to the end of the catheter, held six or seven inches above the infant, and the milk allowed to run in slowly. It should

never be forced in. Tube feeding, properly done, is of minimum disturbance to the infant. Many persons, in objection to the gavage feeding, mention the danger of passing the tube into the trachea. This is done with great difficulty, and may be instantly detected by a regular flow of air bubbles when the end of the tube is placed in milk or water.

The prognosis of prematures is influenced by many factors, of which the outstanding are:

1. The cause of the premature birth.
2. The weight at birth, and consequently the degree of prematurity.
3. The presence or absence of fetal anomalies or birth trauma.
4. The presence or absence of a certain intangible and undefinable compatability with life.
5. The successful inauguration of measures to compensate for the immaturity of vital functions.

The life of the premature is in the hands of the nurse. The greater her understanding of the handling and care, and the more individualized her service in every detail, the greater the probability of a favorable developmental course. The fundamental needs are always the same, but the methods of satisfying them are largely dependent on intelligent nursing.

Follow-up care:

The care of the premature infant demands constant vigilance that should not be relaxed until the end of the sixth month. Whether the infant remains at home or is in the hospital, this watchfulness and the exactness of his care must be maintained.

Of paramount importance in this follow-up care after discharge from the hospital, or after the immediate post-natal period at home, is the instruction given to the mother and the rest of the family. They must realize that this infant is delicate, and must not be treated in the rough and tumble fashion of the full-term infant. He should be kept in a warm room that is well-ventilated and away from drafts. Likewise, this room should be more or less isolated from

the family activity, and all members of the family showing the least sign of infection should be barred. The infant should not be bundled up and taken with the family on Sunday outings, or to a friend's house for the evening. The mother should be taught the preparation of formula, if breast milk has not been maintained, and the importance of extreme cleanliness.

This program of education may be done mainly before discharge from the hospital, but it should not be stopped there. Previous to discharge, the social service department of the hospital, the Visiting Nurse, or the County Nurse may aid in preparation of the home for the arrival of the infant, and the mental preparation of the family.

Attached is the routine used at Multnomah Hospital for discharge of the premature infants.

PROCEDURE FOR DISCHARGE OF PREMATURELY
BORN BABIES FROM MULTNOMAH HOSPITAL

I. Medical:

A. Any baby whose birthweight is less than five pounds shall be considered as prematurely born.

B. Such babies shall remain in the nursery until:

1. The weight is in excess of five pounds.

2. The regime upon which the baby will be handled at home has been in satisfactory operation in the hospital for one week; this shall include a reasonable weight gain with the formula and method of feeding.

II. Refer to Social Service by Dr. Wooley for home investigations.

III. Social Summary placed on medical chart by Social Service covering data requested by Dr. Woolley, as follows:

A. Housing: Adaptability of the home for the care of the infant; adequacy of heat, light and equipment.

B. Mother's competence: An appraisal of the mother's competence to follow orders.

C. Health: Absence of infections and contagious disease in any other member of the family, especially whooping cough and sore throats. An evaluation of the health of each member of the family as related to father's ability to work, mother's ability to care for the family, other children's ability to go to school, or their need of care at home. The same for relatives and others living in the home.

D. Economic competence: Ability of the family to purchase any necessary accessory food stuffs or statement as to the agency responsible for such provisions.

Percomorph oil will be the chief expense in this category, and should not exceed 50 cc in total, approximate cost is $3.00.

E. Appraisal of attitudes and relationships within the family as they affect the baby.

F. The method of follow up and supervision best adapted to the situation, especially the availability of transportation or the necessity for medical follow-up in the home. A telephone number through which the family can be reached and whether it is a neighbor, a store, or the home itself. It is inadvisable to bring infants to the clinic on street

car or bus. Social service worker to notify ward supervisor when the social summary is placed on the chart so that she can call Dr. Woolley's attention to it on his next rounds.

IV. Instructions to the mother:

The floor supervisor nurse will telephone to the mother for an appointment to come to the Multnomah Hospital for instructions to be given the nurse. This is of special importance if the infant is to be nursed, in which case the "ac" and "pc" weight must be obtained in the hospital before the infant is discharged.

V. Notification to Social Service at time when infant leaves the Multnomah Hospital by the floor supervisory nurse.

VI. Notification to Visiting Nurse Association by Social Service that infant is at home and ready for follow-up.

VII. Follow up:

Visiting Nurse to visit home within three days from date of discharge from the hospital and to make two more visits at weekly intervals reporting directly to Dr. Wooley at the conclusion of the third visit.

The mother to communicate with Dr. Woolley or bring the infant to the Medical School Infant Feeding Clinic Thursday at 1:00 p.m., three weeks after discharge from the hospital. Infant to be kept under supervision of Dr. Wooley at the Infant Feeding Clinic for six months after discharge from the hospital. Infant may then be transferred to the Visiting Nurse Well-Baby Clinic in the district in which the family lives.

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August 15, 1940.

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Dr. Robert Franco, Michael Reese Hospital, Chicago

Miss Marie Forman, Obstetrical Supervisor, Harborview Hospital

Appendix

PREMATURE BIRTHS IN MULTNOMAH COUNTY HOSPITAL
January 1937 to January 1941

| | Total deliveries | Premature deliveries | percent |
|---|---|---|---|
| 1937 | 602 | 31 | 5.3 |
| 1938 | 779 | 49 | 6.3 |
| 1939 | 785 | 44 | 5.6 |
| 1940 | 742 | 54 | 7.4 |

| | Stillborn, % | | Neonatal deaths, % | | survived hospital, % | |
|---|---|---|---|---|---|---|
| 1937 | 6 | 19.3 | 7 | 22.5% | 18 | 68.7% |
| 1938 | 9 | 18.3 | 5 | 10.2% | 36 | 73.6% |
| 1939 | 12 | 27.2 | 9 | 20.4% | 23 | 52.4% |
| 1940 | 6 | 11.1 | 12 | 22.2% | 36 | 66.7% |

Neonatal Deaths among Prematures in Multnomah Hospital
From January 1937 to January 1941

| Date | Weight | Prenatal Care | Mother's Wass. | Babe's Wass. | Cause |
|---|---|---|---|---|---|
| 5/20/37 | 1465 | none | neg. | neg. | Placenta Previa |
| 6/10/37 | 1210 | one visit | neg. | neg. | Prematurity |
| 6/17/37 | 1500 | one visit | neg. | neg. | Prematurity(six months) |
| 8/27/37 | 1247 | none | neg. | neg. | Precipitate delivery |
| 9/9/37 | 2500 | OPC | neg. | neg. | Undetermined |
| 11/14/37 | 885 | OPC | neg. | neg. | Prematurity |
| 12/22/37 | 2010 | none | neg. | neg. | Undetermined |
| 4/17/38 | 1790 | ? | two plus | ? | Lues? |
| 5/15/38 | 1720 | one visit | neg. | neg. | Morphine given to stop labor |
| 5/17/38 | 1175 | OPC | neg. | neg. | Multiple abscesses in baby |
| 11/13/38 | 2500 | OPC | three plus | neg. | Difficult extraction of head |
| 11/18/38 | 1400 | none | neg. | neg. | Prematurity |

| Date | Weight | Prenatal Care | Mother's Wass. | Babe's Wass. | Cause |
|---|---|---|---|---|---|
| 1/9/39 | ~~900~~ | OPC | plus | neg. | Prematurity |
| 3/25/39 | 1415 | OPC | neg. | neg. | Premature separation of pl placenta |
| 5/9/39 | 1820 | OPC | -+++ | neg. | No evidence of lues Prematurity |
| 5/19/39 | 1990 | OPC | neg. | neg. | Maternally deformed pelvis Twin |
| 8/16/39 | | OPC | neg. | neg. | Acute pyelitis, cholecystitis |
| 9/2/39 | (six months) | OPC | neg. | neg. | Givn Morphine to stop labor |
| 10/14/39 | 1655 | none | neg. | neg. | Premature rupture of membr. |
| 12/15/39 | 1585 | OPC | neg. | neg. | Polyhydramnious, twin |
| 2/13/40 | 1295 | OPC | neg. | neg. | Prematurity |
| 2/28/40 | 1025 | OPC | neg | neg. | Six months, twins |
| 2/28/40 | 965 | " | " | " | " " " |
| 3/22/40 | 1995 | none | neg. | neg. | Premature ruptrue of membr. |

| Date | Weight | Prenatal Care | Mother's Wass. | Babe's Wass. | Cause |
|---|---|---|---|---|---|
| 4/7/40 | 1735 | OPC | neg. | neg. | Twin, primipara age 36 |
| 5/2/40 | 2162 | OPC | neg. | neg. | Caesarian section |
| 5/25/40 | 1465 | OPC | neg. | neg. | Extensive polio at six weeks pregnancy, total paralysis |
| 7/28/40 7 | 1200 | two visits | neg. | neg. | Severe prenatal bleeding |
| 7/28/40 | 980 | OPC | neg. | neg. | Partial abruptio placenta |
| 9/30/40 | 1550 | OPC | neg. | neg. | Twin |
| 10/29/40 | 1417 | OPC | neg. | neg. | Third postop day for bowel obstruction |
| 12/17/40 | 2583 | OPC | neg. | neg. | Twin, polyhydramnious |

Stillborn Prematures in Multnomah Hospital
January 1937 to January 1941

| Date | weight | Prenatal care | Mother's Wass. | Cause |
|---|---|---|---|---|
| 1/27/37 | 1875 | 2 visits | neg. | unknown, given M.S. gr 1/6 |
| 4/17/37 | 1900 | OPC | neg. | twin, cause of labor unknown |
| 6/28/37 | 1110 | OPC | neg. | toxemia, diabetes |
| 7/23/37 | 2000 | OPC | neg. | toxemia |
| 8/24/37 | 1900 | OPC | neg. | transverse arrest with version |
| 9/15/37 | 920 | OPC | neg. | Premature separation of placenta |
| 2/15/38 | 1650 | OPC | neg. | macerated infant, small placenta |
| 4/15/38 | 2315 | OPC | neg. | chronic nephritis |
| 5/1/38 | 1250 | OPC | neg. | unknown |
| 6/15/38 | 2000 | OPC | neg. | twisted cord |
| 6/21/38 | 1325 | OPC | 4 plus | nephritis, toxemia, lues |
| 8/23/38 | 2450 | none | neg. | abruptio placenta |

| Date | weight | Prenatal Care | Mother's Wass. | Cause |
|---|---|---|---|---|
| 10/5/38 | 2 350 | one visit | neg. | severe pre-eclampsia, abrutio |
| 10/26/38 | 1134 | OPC | neg. | luetic placenta, abruptic placenta |
| 12/8/38 | 2044 | none | neg. | patient entered with head crownin |
| 4/26/39 | (7 months) | OPC | neg. | arm prolapsed, no fetal heart tone, breech |
| 5/22/39 | (7 months) | none | neg. | glomerular nephritis |
| 6/2/39 | | OPC | neg. | hydrocephalis |
| 6/29/39 | 900 | OPC | neg. | prolapsed cord |
| 7/19/39 | | OPC | neg. | abruptio placenta |
| 7/27/39 | 2000 | OPC | neg. | toxemia, HCVD |
| 8/13/39 | (8 months) | one visit | neg. | premature rupture of membranes |
| 10/4/39 | 1770 | OPC | neg. | polyhydramnios and monstrosity |
| 10/8/39 | 1550 | OPC | neg | Prolapsed cord, |

| Date | Weight | Prenatal Care | Mother's Wass. | Cause |
|---|---|---|---|---|
| 11/5/39 | | OPC | neg. | severe eclampsia, maternal death |
| 12/15/39 | 2165 | OPC | neg. | polyhydramnious, edema of infant twin |
| 12/18/39 | 1350 | OPC | neg. | macerated |
| 1/13/40 | 136 | OPC | neg. | fetal death 4 weeks before deliv. |
| 4/7/40 | | OPC | neg. | twins, primipara age 36 |
| 7/4/40 | (6-7months) | OPC | neg. | undetermined (lues???) |
| 7/18/40 | (6-6½months) | one visit | neg. | self-indueed ??? |
| 8-29/4 0 | 6-6½ months | none | neg. | undetermined |
| 12/1/40 | | OPC | neg. | macerated |

January 1937 to January 1941

| Date | Name | Weight | Mother's Wass. | Babe's Wass. | Prenatal Care | Cause of labor | Condition at discharge , present |
|---|---|---|---|---|---|---|---|
| 1/31/37 | Lola Grass | 1990 | neg. | neg. | none | Spontaneous | fair |
| 2/25/37 | Jean McCreery | 1825 | neg. | neg. | OPC | Spontaneous | good |
| 3/4/37 | Isabel Edgett | 2500 | neg. | neg. | OPC | Spontaneous | fairly good |
| 4/3/37 | Grace Guild | 7 months | neg. | neg. | OPC | Spontaneous | fair |
| 4/11/37 | Emma Parke | 1990 | neg. | neg. | OPC | Spontaneous | fair |
| 6/16/37 | Hazel Ousley | 1755 | neg. | neg. | OPC | Spontaneous | good |
| 6/17/37 | Leona Miller | 2385 | neg. | neg. | OPC | Spontaneous | fairly good |
| 6/17/37 | Lola Perry | 1500 | neg. | neg. | none | Spontaneous | fair |
| 8/14/37 | Beatrice Cavan | 2065 | neg. | neg. | OPC | Spontaneous | good |
| 9/8/37 | Hazel Belcher | 2190 | neg. | neg. | OPC | Induced toxemia | fair |
| 9/18/37 | Violet Dittler | 2010 | none | neg. | none | Spontaneous | fair |
| 10/4/37 | Anne Lutek | 2000 | neg. | neg. | OPC | Toxemia | f. good |
| 11/9/37 | Ruby Mayer | 2405 | neg. | neg. | OPC | Spontaneous | good |
| 11/15/37 | Mary Eahen | 2110 | neg. | neg. | OPC | Spontaneous | good |
| 12/8/37 | Jewell Umbreit | 1800 | neg. | neg. | OPC | Induced Toxemia | fair |
| 12/11/37 | Alta Thrus | 2270 | neg. | neg. | OPC | Twins | good |
| 12/11/37 | " " | 2440 | " | " | " | " | " |