

The historic origin of Prematurity/Low birth weight: Lessons from the past

Introduction by: Hamisu M. Salihu, MD, PhD. Department of Epidemiology and Biostatistics, College of Public Health, University of South Florida

Low birth weight (defined as birth weight < 2,500 grams) is the most important determinant of infant morbidity and mortality¹, making it a target index for evaluation of public health initiatives and interventions. Low birth weight and preterm births are well-established precursors for subsequent death in infancy and childhood^{2,3,4}. In addition, preterm infants that survive suffer disproportionately from severe morbidity (e.g., cerebral palsy) in later life leading to poor quality of life and enormous cost burden to affected families and the society in general^{5,6}. However, recent controversy regarding the utility and appropriateness of using low birth weight as a comprehensive perinatal health index has come to the forefront³ with well-supported assertion that low birth weight is too heterogeneous to be a precise measure of morbidity burden and risk for mortality⁷. This controversy makes it pertinent to examine the origin of the use of low birth weight or prematurity (the original word used) in the scientific and clinical literature and the genesis of its utilization in instituting public health policy.

To this end, we provide the reader with two “classic” articles; the first one is a seminal work of **Arvo Ylppö**⁸. By way of introduction, Arvo Ylppö was a Finnish pediatrician who worked and conducted a lot of perinatal research in Germany. He was born premature and remained small in stature throughout his 104 years of life. In his seminal article titled “Anatomic and pathological analysis of preterm births”, he used the cut-off 2,500 grams thus: “we define as preterm those neonates born with a birth weight less than 2,500 grams.” This groundbreaking study by Ylppö encompassed 2,168 births at the Charlottenberg’s Empress Auguste Victoria Center for the Prevention of Infant Mortality in Germany. The study was conducted from June 1909 to May 1918 with the original aim of delineating clinical course and autopsy findings among neonates born preterm. Out of the 2,168 births at the Center, 114 were identified as preterm using the original definition of birth weight < 2,500 grams (5.3%), a figure that was much lower than the national German average at that time. Close to that period, a study in Berlin had found 12% of all German birth to be of low birth weight.

Of interest to Public Health in the article are not the anatomic and pathological findings that were at the core of the work (and no doubt, Ylppö was apparently more excited by the autopsy results among demised “preterm” infants) rather the definition of a term that would subsequently influence public health policy decision-making for the entire planet. Although Ylppö did not provide any justification as to why of all equally feasible numbers, 2,500 grams seemed the most reasonable, this single decision has nonetheless, influenced public health and public health practice in substantial ways till today, and most likely for years to come.

The second article is a detailed and important series of discussions that took place at the American Academy of Pediatrics fifth annual meeting in New York on June 7, 1935⁹. The proceedings highlight the acceptance and spread of Ylppö’s definition of prematurity (< 2,500 grams) and the high level of early mortality in the first year of life among this group of infants. Noteworthy is that 2,500 grams is the equivalence of 5.5 pounds, which made it easier to remember for the American Academy of Pediatrics members. Throughout the discussions, the repeated reference to Ylppö’s work was apparent, strong and convincing to the audience. There was now a sound (albeit untested) framework to launch a public health intervention strategy or initiative in the United States in order to dwindle the US infant mortality rate by focusing on “premature” babies. Noticeable in the national debate was the promotion and acceptance of an “ecological model” as a reasonable strategy. This ecological model had at its core the “premature” infant that was the target of the intervention, with three concentric circles representing environmental settings that needed to be addressed: the hospital environment, the home environmental (post-discharge home visit) and finally, the community environment with the district nurse serving as the pivot of surveillance and monitoring of community-based care offered to these premature infants at home. Hence, one could claim that the beauty of Ylppö’s definition of prematurity (< 2,500 grams) is its connection with subsequent mobilization of public health resources to solve a very important public health issue that had now been defined and quantified in terms that made meaning to care-providers, public health practitioners and decision-makers.

References:

1. Kramer MS. Determinants of low birth weight: methodological assessment and meta-analysis. *Bull World Health Organ.* 1987;65(5):663-737. Review
2. Kramer MS, Demissie K, Yang H, Platt RW, Sauvé R, Liston R. The contribution of mild and moderate preterm birth to infant mortality. *Fetal and Infant Health Study Group of the Canadian Perinatal Surveillance System. JAMA* 2000;284:843-9.
3. Wilcox AJ, Russell IT. Birthweight and perinatal mortality: II. On weight specific mortality. *Int J Epidemiol* 1983;12:319-25.
4. Barker DJ, Osmond C, Simmonds SJ, Wield GA. The relation of small head circumference and thinness at birth to death from cardiovascular disease in adult life. *BMJ* 1993;306:422-6.
5. Vincer MJ, Allen AC, Joseph KS, Stinson DA, Scott H, Wood E. Increasing prevalence of cerebral palsy among very preterm infants: A population-based study. *Pediatrics* 2006;118:e1621-e1626
6. Russell RB, Green NS, Steiner CA, Meikle S, Howse JL, Poschman K, et al. Cost of hospitalization for preterm and low birth weight infants in the United States. *Pediatrics* 2007;120:e1-9
7. Salihu HM, Mbah AK, Jeffers DF, Alio AP, Berry L. Healthy Start Program and feto-infant morbidity outcomes: Evaluation of program effectiveness. *Maternal and Child Health J* DOI 10.1007/s10995-008-0400-y.
8. Ylppö A. Pathologisch-anatomische Studien bei Frühgeborenen Makroskopische und mikroskopische Untersuchungen mit Hinweisen auf die Klinik und mit besonderer Berücksichtigung der Hämorrhagien. *European Journal of Pediatrics* 1919;20(1):212-431
9. Fifth Annual meeting of the American Academy of Pediatrics roundtable discussion on prematurity 1936;8(1):104-121

American Academy of Pediatrics

Proceedings

FIFTH ANNUAL MEETING OF THE AMERICAN ACADEMY OF PEDIATRICS

NEW YORK CITY, June 7, 1935

Round Table Discussion on Prematurity

The meeting was called to order at 2:00 P.M. in the Hotel Waldorf Astoria, by the chairman, Dr. Julius H. Hess, Chicago, Ill.

A City-Wide Plan for the Reduction of Deaths Associated With and Due to Prematurity

Julius H. Hess, M.D., Chicago

Infant death rates in many large cities have remained at practically the same percentages with relation to the total of births during the past five or more years. In Chicago the deaths per thousand live births (under one year of age) were 1930, 53.4; 1931, 56.4; 1932, 48.2; 1933, 48.8; 1934, 47.7.

A study of the reported causes of death led us to believe that efforts to reduce those death rates further must be directed toward those conditions associated particularly with early infancy, such as birth injuries, premature birth, and congenital malformations. Obstetricians have been directing their attention more recently to a study of comparative results following the institution of the various operative procedures. More recent reports from the Massachusetts General Hospital by Clifford and from Minneapolis by Huenekens emphasize the disadvantages of cesarian section. Further, Clifford and Sisson, in cooperation with their obstetrical staffs, have given much thought to the relationship of the size of the fetus to the chances of survival of the infant and, of equal importance, its relationship to intracranial hemorrhage and other injuries. There still remains much to be accomplished in these fields.

Prematurity was stated as being the cause of death in 749 infants during 1934 in Chicago. A reduction in morbidity and mortality rate among prematurely born infants in our hospitals, therefore, seemingly offered a promising field for lowering the death rate among newborns. It was felt that, if the same principles established in conducting the premature station at Sarah Morris Hospital could be applied in a Chicago-wide program, many premature infants now lost might be saved.

The Sarah Morris Station offers:

1. Ambulance service by the hospital
2. Premature ward care—with special equipment for oxygen therapy and other types of emergency therapy.
3. Nursing service by a trained personnel.
4. Breast milk obtained from wet-nurses and visiting mothers.
5. Field nursing service for instruction of the mothers, special attention being given to the promotion of breast milk secretion. Breast milk in the home reduces the number of hospital days.
6. A supply of a simple type of heated beds is lent for the use of graduates in the home. This is of special value in reducing the number of return cases due to acute illnesses after discharge.
7. An out-patient clinic is maintained for instruction of mothers and the care and supervision of graduates not having private physicians.

With the hope of lowering Chicago's newborn infant mortality rate, Dr. Herman N. Bundesen, president of the Board of Health of Chicago, became interested in promoting a city-wide effort to save some of these small infants.

EXHIBIT I

MINIMUM REQUIREMENTS FOR HOSPITAL CARE OF
PREMATURE BABIES

TO BE POSTED IN A CONSPICUOUS PLACE IN THE NURSERY

ACCOMMODATIONS—It is recommended that if possible, a separate room be set aside for the care of premature infants. Otherwise they may be cared for in the nursery.

Every hospital should have some type of heated bed in the nursery or premature room.

Oxygen should be used whenever indicated and a supply for use in emergencies with necessary equipment should be kept in the room occupied by the premature infants.

Provision for the prompt transfer of the premature infant from the delivery room to the nursery should be made, so that there is no exposure of the infant to chilling.

EQUIPMENT FOR NURSING CARE—Individual equipment should be provided for the premature infant especially a bath basin and a thermometer.

If the premature infant is cared for in the nursery with the other infants, it is advisable to keep the feeding equipment for stored breast milk (droppers, nipples, etc.) in a separate place from that of the other infants.

Every baby should have his own catheter.

There should be running water in the room or nursery, or it should be easily accessible.

Cans or diaper bags should be available for soiled linen and diapers. If possible, a warmer for clothing and diapers should be available.

The room or nursery should have a "high and low" thermometer (to show the temperature variation within 24 hours) and a hygrometer.

A heated bath table is desirable.

NURSING CARE—The nursing care of the premature infant should be supervised by a graduate nurse, who has had special training in the care of the premature infant. The Board of Health, upon request, will send a nurse to give instructions in the management of premature infants. A twenty-four-hour nursing service should be provided. Nurses and attendants with respiratory or intestinal infections should be excluded from the nursery.

A minimum amount of handling is advised for premature infants. There are few nursing procedures, with the exception of weighing and bathing, which ne-

cessitate removal of the infant from the heated bed.

Wool is the preferable material for the clothing of the premature and the infant must, at all times, be guarded against exposure to cold during dressing.

It is recommended that physicians, nurses and all others entering the room in which the premature babies are cared for should wear a clean gown and face mask.

The room temperature should be 78-80°.

Proper nursing hygiene, especially washing of hands, is essential to prevent infections. Infected cases should be isolated.

It is advised that every premature baby receive breast milk. If the milk is obtained outside of the hospital, it should be boiled in the hospital for from one to two minutes before it is used.

The Board of Health, upon request, will furnish information as to where breast milk for premature infants can be obtained.

Nurses caring for premature infants should be familiar with the methods of treating cyanosis in such infants.

It is strongly recommended that the obstetrics department in hospitals where it is customary to place the responsibility for care of the newborn upon the pediatric department, notify the pediatric department in advance of every delivery in which the utero-gestation is expected to be less than term and more than four months. It is also suggested that the pediatric department respond to such notification by assigning to the delivery room and attendant especially trained in the early care of premature infants. Such attendant should be a member of the hospital personnel and constantly on call. The premature infant should always be placed under the care of the premature department immediately after birth.

DISCHARGING INFANTS—No premature infant who will not be under the care of a private physician at home should be discharged from a hospital without first notifying the Board of Health. If parents are not financially able to have a private physician for the infant after its discharge from the hospital, the Board of Health will assign a nurse to the home to give instructions to the mother and to render the necessary follow-up service.

Therefore, we developed the following program, which is an attempt to apply institutional procedures, expanded to meet the demands of a large metropolitan community.

It became apparent that it would be necessary to determine through a survey exactly what facilities the hospitals of Chicago afforded for the proper care of the premature infant. This seemed the more important in that an analysis of the death certificates of the year 1934 showed that the death rate of premature infants in institutions properly equipped for their care was from one-tenth to one-fifth that of the rate in institutions where such care was not available. The percentage of deaths among premature infants who were born and died in the twenty-four hospitals of Chicago having the highest number of regular births were as follows: Three reported less than 10 per cent; three others, less than 20 per cent; eleven, between 20 per cent and 30 per cent; and six, between 30 per cent and 40 per cent and one 70 per cent.

Before making the survey, with the advice and help of the physicians who had specialized in the care of the premature infant, a set of minimum requirements for hospital care of premature infants was drawn up. These requirements served not only as a yardstick for the survey but a copy was sent to every hospital to be posted in a conspicuous place in the nursery (Exhibit I).

Requirements for Hospital Care of Premature Infants.—A graduate nurse, trained at the Sarah Morris Hospital Premature Station and experienced in the care of the premature infant, was assigned to make such a survey. She has been engaged in this service for three months and is now making a resurvey.

After the completion of the survey a scoring sheet was drawn up, and each hospital was rated on the basis of equipment for caring for the premature, as compared with the minimum requirements established by the Board of Health (Exhibit II).

EXHIBIT ii—SCORING SHEET

Hospital -----			
Accommodations			
Room			
Separate	-----	3	-----
Section of nursery	-----	2	-----
Incubators			
Grade 1	-----	20	-----
Grade 2	-----	15	-----
Oxygen	-----	6	-----
Delivery room satisfactorily located	-----	1	-----
Isolation room for infected cases	-----	2	-----
Equipment			
Individual equipment			
Bath basin	-----	2	-----
Thermometer	-----	1	-----
Running water in nursery or workroom	-----	7	-----
Cans for soiled linen or diaper bags	-----	1	-----
Hygrometer	-----	1	-----
Heated bath table	-----	1	-----
Separate equipment for premature infants	-----	1	-----
Sterilization process satisfactory	-----	2	-----
Provision for refrigeration of feedings			
Ice box in nursery	-----	2	-----
Other ice box	-----	1	-----
Nursing care			
Graduate nurse in charge of obstetrical division during 24 hours	-----	5	-----
Satisfactory personnel	-----	3	-----
Supervision of health of nurses	-----	1	-----
Gown technic	-----	1	-----
Face masks	-----	1	-----
Temperature of nursery or room	-----	1	-----
Washing of hands	-----	7	-----
Consulting pediatrician	-----	7	-----
Satisfactory methods of resuscitation	-----	4	-----
Breast milk	-----	20	-----

All hospitals which did not meet these requirements were sent a detailed statement of the points in which they fell short and given a definite point of time in which to secure the equipment necessary. A follow-up investigation for assistance to the hospital is also made by a specially trained physician.

The survey showed that there were two hospitals, i.e., the Sarah Morris and the Cook County Children's Hospitals, maintaining well-equipped premature stations and receiving infants born outside of their own hospitals. In these two institutions the premature station is completely independent of the other hospital departments. Their respective capacities are 25 and 35. Equipment and trained personnel are commensurate with the demands of such as service. It is a part of the general plan to have a third such station opened as soon as possible, preferably in a large Catholic maternity hospital.

An interesting point brought out by the survey was that, while equipment is important, elaborate equipment does not necessarily mean efficient and effective service. More important is an intelligent understanding of the care of the premature infant, especially in respect to such points as the treatment of

cyanosis and knowledge of feeding ,with an enthusiastic support regulated by much common sense. With all this it is possible to accomplish much in the interest of the premature infant.

For a better understanding of the causes of death of premature infants, a plan for the investigation of the death of every premature infant in the city after Jan. 1, 1935, was instituted. Wherever any evidence of negligence or lack of equipment is found to be a contributing cause of death, such evidence is recorded on the record, kept by the Board of Health, of the physician or hospital responsible for the care of the infant.

It immediately became apparent that in attacking the problem of prematurity, just as in an epidemic the number of cases of contagion must be known, it would be essential to bring to light the number of premature births. Therefore, on March 5, 1935, the Board of Health, passed a regulation making premature births immediately reportable by telephone, followed by written confirmation within twenty-four hours. Notification of this ruling was sent to all physicians, midwives, and hospitals.

The public health nurse has demonstrated her value in so many life-saving activities that it was felt she would be an essential factor in the carrying out of this program. However, if she were to render effective service, it would be necessary for her to be well-trained in a rather highly specialized and, as a public health activity, new and untried phase of nursing.

Such a program of training was started at once. The nurses of the staff of the Board of Health were assigned in small groups at a time to Sarah Morris Hospital and Cook County Children's Hospital, which were conducting premature stations. As soon as three nurses had finished the training, the city was divided into three districts and one of these nurses assigned to each district. Each nurse is responsible for the premature infants in her district. As other nurses finished their training and the work grew, additional nurses were assigned to the districts as needed.

The district nurse is responsible for every premature in that district whether the infant is at home or in a hospital. If the baby is in a hospital, the nurse maintains contact with the hospital so that she will know when the baby is to be discharged. A baby in a hospital may reside in a different district. Therefore, the nurse in the district where the baby is hospitalized notifies the nurse of the district where the baby resides when the baby is to be discharged from the hospital. In all hospital cases the nurse goes to the home shortly after the birth and before the baby is discharged, if it is a hospital case, to see that the necessary preparations are made for the proper care of the baby. All such services are rendered through cooperation with the family physician.

All nurses were instructed in the method of hand expression of breast milk, so that they in turn would be able to teach the mothers of premature infants to maintain the supply of breast milk.

It is particularly important that student nurses be made to realize the importance of breast feeding and be training in manual expressions; she should be able to teach the latter. An effort is being made to have superintendents of schools of nursing include in the curriculum an intensive course in breast feeding and manual expression.

It was realized that there will always be infants who cannot have breast milk from their own mothers and that some of these will be prevented from having it from commercial supplies because of economic reasons. To provide for this latter group of infants, a mothers' breast milk station has been established by the Board of Health. This brings the number of breast milk stations in the city to four; there are three in hospitals (two in the hospitals that maintain the premature stations previously mentioned) and a commercial station in another hospital. The first two hospital stations attempt to care primarily for their own needs, having a limited amount only for sale. It has been agreed with the commercial station that it will take any case that can afford to pay something, though below the price ordinarily charged. The Board of Health station is caring for the wholly free cases.

It is important to understand the relationship of the nurse to the private physician in this program. If an infant is under the care of a private physician, the nurse checks with him before taking active charge of the case. The services of the nurse are at the disposal of the physician. At his request she goes into the home to help in such matters as maintaining the supply of breast milk, teaching the mother manual expression, and, if the circumstances of the family so indication, assist with the nursing care of the baby.

A group of infant welfare physicians, the members of which are so distributed as to serve all parts of the city, has been especially trained in giving care to sick premature infants. If a feeding problem or illness occurs in the case of a premature infant and it is not possible to have a private physician, one of these physicians is sent to make a special call.

There have been established three additional conference clinics for premature infants who have graduated from hospital premature stations and those born and cared for in their own homes—one each on the north, west and south sides of the city. Others will be opened as needed. The nurse in charge of that particular district will also be in charge of the conference on prematurity.

All cases from the Cook County Hospital needing antisyphilitic care are reported to the Board of Health and then are assigned to the field nurses for special follow-up. This is to insure as nearly as possible the return of these women to the clinics for antisyphilitic treatment.

An illustrated pamphlet, outlining in detail the proper care of premature babies, has been prepared in easily understandable language, and will be sent to all physicians and nurses, as well as the mothers of premature babies.

A study of the death certificates also revealed that many of the premature infants died within several hours of birth. It was thought that possibly in some cases these deaths were the result of improper methods of resuscitation. In order to determine what the medical profession considered acceptable methods, a questionnaire was sent to all physicians practicing obstetrics. The replies to these questionnaires were tabulated. Some methods were found to be in disrepute, while others were highly advocated. Steps are now being taken to disseminate this information to physicians and hospitals in order to set up a routine for proper resuscitation of asphyxiated infants.

In this campaign there is not great effort put forth in trying to determine new procedures for saving premature babies, but rather the attempt is to secure wide-spread application of those methods which have been shown to be so successful at the Sarah Morris and Cook County Hospitals premature stations. The program has been under way too short a time to draw conclusions as to ultimate results from this campaign in behalf of prematurely born and congenitally debilitated infants.

As the training of the nurses continues, as hospitals become better and better equipped, and as physicians in hospitals give their attention to the problem, it is believed there will be a steady decrease in the mortality from prematurity. Plans for the future will entail a vigorous attack on the prevention of prematurity through proper and more adequate prenatal care. As previously stated, this phase of the problem is receiving widespread attention throughout the United States, manifestly through cooperation between obstetricians and pediatricians.

DR. ETHEL DUNHAM (NEW HAVEN, CONN.).—I am very much interested in the program which is being carried on in Chicago to cope with the problem of death of premature infants. I have said on many occasions, that we are not all really aware of what a problem it is. The reduction of mortality from prematurity is of the utmost importance in the reduction of the high rate of neonatal mortality. Prematurity ranks by the far the highest among the causes of death in infants in the neonatal period.

It is obviously the most important cause of infant mortality, and a very high percentage of all the deaths from this cause take place in the first month. Although in the twelve years from 1921 to 1933 in infants under one month resulting from prematurity in the United States birth registration area are reported to have decreased in number from 27,932 to 19,718, the rate per 1,000 live births in the area decreased only from 16.8 to 15.3 in this comparatively long period of time.

In the different states in the same year, 1933, the mortality rate from reported premature births varied between a low rate of 10.6 reported in Arkansas and a high one of 24.3 in the District of Columbia.

The incidence of premature births for the birth registration area is not known. The figures for New York state have, however, been made available for 1933. There were 3,203 premature births which constituted 3.9 per cent of the total live births in the state for that year. A total of 1,350 deaths from premature birth occurred, a mortality rate of 410.8 per 1,000 live premature births. Forty-one per cent of the premature infants born alive died of "premature birth."

Figures on the incidence of premature births in hospitals show considerable variation. Brandt reported an incidence of 10.4 per cent of 5,439 births in Cologne, Germany; Hadley, 6 percent of 3,709 births in the New Haven Hospital; Clifford, 3 per cent in the Boston Lying-In Hospital.

Reports from hospitals of mortality from prematurity also differ widely. The differences may be attributed in part to variability in criteria for the diagnosis of prematurity, in part to differences in the periods of observation at the end of which the report is made, and in part to the numbers of infants in high or low weight groups.

For example, Clifford reports as premature only those infants who weight five pounds or less at birth, while Hadley used the criteria established by Ylppo, namely, a birth weight of 2,500 gm. or less. Other observers base the diagnosis on other criteria such as history of period gestation, clinical evidences or length, etc. As far as the period of observation is concerned, it is obvious that the same periods as well as the same criteria for diagnosis must be used by different observers to make results comparable.

Ylppo reported that of 668 premature infants studied, 9 per cent died on the first day; 18 per cent before the fifth day; 31 per cent during the first month; 41 per cent during the first six months; 50 per cent during the first year. From the first to the fourth year, however, only 3 per cent more had died. Obviously reports of mortality at the end of the first month cannot be compared with those at the end of six months.

That the mortality of premature infants varies greatly with differences in the birth weights was also pointed out by Ylppo. Though the average mortality during the first month of the total group of 668 infants reported by him was 31 per cent, in the group with the highest birth weight it was 15 per cent; in the lowest it was 84 per cent.

Reports of mortality from prematurity are not very numerous. The total mortality reported varies between 12.9 and 75.5 per cent. It is obvious that it is difficult to evaluate figures of mortality from prematurity for some of the reasons which have been already pointed out.

A student was undertaken in New Haven Hospital to determine the mortality from premature birth and to set up certain criteria for analysis of material in an attempt to stimulate interest in the problem and to help make results comparable with those of other investigators. The study included 244 liveborn premature infants. All infants were considered premature who lived for any period at all, no matter how short the period, even if the beating of the heart was the only evidence of life. A birth weight of 2,500 gm. or 5 pounds eight ounces or less was the criteria used for diagnosis. All of the infants were born in the New Haven Hospital or cared for in the New Haven Hospital.

The period of observation, from birth to discharge, averaged about forty days. The slide shows the number of infants in each weight group. Sixty-six of the 244 infants died, a mortality of 27.1 per cent. If the mortality in the two weight groups show on the slide is considered, it was 12.5 per cent for those in the higher weight group but 71.7 per cent in the lower, or more than five times higher in the latter than the former.

The cause of death of the infants was analyzed. Prematurity alone was by far the most frequent cause and was naturally diagnosed most often in infants of low birth weight. Infection took second place, intracranial hemorrhage third, while congenital defects took fourth place.

The causes of premature birth were studied, and the incidence of complications of the mother's pregnancy was found to be high. The type of complication appeared to be not so important as the time at which the complication occurred; in other words, the weight of the infant was the determining factor in the survival. The conclusions reached were that to reduce mortality from prematurity two lines of attack are clear: first, the prevention of complications of pregnancy which bring about labor so prematurely that infants with a birth weight below 1,500 gm. are born and, second, improvement in methods of caring for these very small infants. Satisfactory reduction in mortality has been made over a period of years among the infants in the higher weight groups, while that in the lower has remained practically unchanged.

CHAIRMAN HESS.—Did you include in your statistics all babies who breathe?

DR. DUNHAM.—Yes.

The Collection of Breast Milk for the Premature Infant **M. L. Blatt, M.D., Chicago**

In an effort to decrease the mortality rate in the premature infant ward at Cook County Hospital; the production of a large quantity of breast milk became necessary. The number of premature infants in the ward varies between 20 and 45.

At the beginning of the study four years ago, the only source of supply was the obstetric wards of our own institution. There are 250 births in these wards per month, and the normal mother without

complications is discharged from the hospital in from eight to ten days. The milk from these postpartum women was needed for the weak infant on the obstetric service as well as for the premature infant in the pediatric hospital. An irregularly supply of milk, rarely exceeding two quarts per day, was available for the use of the premature station. This was obtained with difficulty although a nurse whose special duty was the manual expression of the breasts of these new mothers was put on duty for this purpose alone.

To supplement this inadequate supply, the Women's and Children's Hospital of Chicago furnished us with a limited amount of breast milk at first gratis but later, as their funds diminished, at a cost of ten cents per ounce.

In order that the premature infants' and the children's wards might become independent of the uncertain supply from the obstetric wards and the expensive supplement from the Women's and Children's Hospital, it seemed advisable to establish a breast milk collecting station of our own. Mothers were selected from the obstetric wards to be employed as wet-nurses. It was found impractical to house them. We, therefore, established the price of five cents per ounce for mother's milk; the women were to come into our station twice daily for manual expression. In addition to the cash compensation, these women were given lunch and a quart of milk to drink. The compensation was later reduced to four cents per ounce as we acquired a larger milk supply.

Every mother, before acceptance of her milk, is given a complete physical examination. A history of syphilis or a positive Wassermann reaction, a history of tuberculosis or any tuberculous findings, a positive neiserian slide or evidence of disease in the throat or breasts is sufficient to prevent her acceptance into the group. We place 16 ounces as a minimum production per day for employment. It is found much easier to handle fewer mothers with a large individual milk supply than numerous mothers with a small supply. The time spent in sterilization of breasts, gowns, and necessary equipment is too great to warrant continuing such mothers in the group.

There has been one exception to this rule—in order that the breast milk of the mother whose infant is in the hospital may be continued, she is urged to come to the station for manual expression while her baby is under our care. She receives no compensation for the milk so expressed other than lunch and her quart of cow's milk. By this means we gain a limited amount of breast milk per day and at the same time stimulate lactation in the mothers thus enabling them to take their premature infants home at an earlier age.

Through the cooperation of Dr. Bundesen of the Chicago Department of Health, under Dr. H. C. Niblack's supervision, we have recently advanced this process one step further. Nurses from the department came to us for training in manual expression and care of the premature infant, returning to their district to teach mothers whose infants are in the hospital or at home, too weak to nurse, the procedure of manual expression.

In order to have an adequate milk supply available at all times not interrupted by bad weather or sudden loss of a large number of wet-nurses, it is deemed advisable to collect and preserve such milk as can be obtained beyond our daily need. At Johns Hopkins Hospital, it has been found that boiling the milk in a Mason jar and immediately sealing it (cold pack) are adequate for preservation. We instituted the same method and have kept milk for as long as ninety days without apparent deterioration. The milk becomes brown with such boiling, and when iced, the fat separates in a hard mass. Bacteriologic examination shows it to remain sterile. Occasionally a few hay bacillus are reported by the bacteriologist, but at no time have we had difficulty from feeding this product. We make an effort to keep on hand at least 30 quarts of such milk. We are at present fractionally sterilizing by ten-minute boiling on three successive days in place of the single sterilization. The supply is only a few weeks old. It is used to complement feedings for the weaker infants, not premature infants in our own and other wards. When necessary, it has been fed to premature infants, who have done well with it.

It has long been a point of observation that breast-fed infants thrive and have a better tissue turgor than do those artificially fed. We decided, therefore, to produce a raw breast milk which could be preserved in its natural state and fed to the premature infant, using an aseptic technic and rapid cooling in the milk laboratory. We have produced and are feeding such a milk.

In order to produce a maternal milk with as low a bacterial count as possible, the wet-nurse removes her street clothing and dons a hospital gown, cap and mask. She then scrubs her hands and nails. Then she puts on a short rubber apron below the breasts, and a trained nurse cleanses her breasts with soap and water. The wet-nurse then cleanses her own breasts with boric solution. Her hospital gown is removed, and she is assisted by a trained nurse in putting on a sterile gown with separate breast curtains.

She steps into the milk collecting room where her milk is collected in a sterile graduate and poured into a graduated nursing bottle. Some of the women prefer a hand breast pump to start the milk flow. Manual expression is employed, and the milk collected in the sterile graduate (others use an Abt pump or hand breast pump).

After the milk is collected in the graduate, the wet-nurse pours it into the nursing bottle. Bottles are labeled, and the milk is iced immediately. It then goes to the milk laboratory where it is pooled in a sterile coffeepot to be poured into Kelley flasks. Surgically clean nurses prepare the formulas, transferring the milk from these flasks into graduated cylinders, if a compound formula, and directly into nursing bottles, if a simple one.

Breast milk consumption at the Cook County Hospital has steadily increased from 24,126 ounces in 1931 to 97,399 ounces in 1934. During this time, the amount of milk accepted from outside sources has been gradually reduced, and in 1934 all breast milk consumed was produced in the hospital under surveillance of a trained staff.

During 1934, 61,574 ounces were collected from wet-nurses in the breast milk station of the Cook County Hospital; 25,667 ounces were collected by a trained nurse in the obstetrical department, and an additional 10,157 ounces were collected in the breast milk station from mothers of infants in the hospital.

CHAIRMAN HESS.—What was the cost of breast milk at the County Hospital preceding the opening of our own station?

DR. BLATT.—In 1932 our costs were around seven or eight cents an ounce. When we reached the peak, that is ninety-seven thousand ounces, we were paying only four cents an ounce for the production, and our cost per month never was over two hundred dollars. The establishment of the station has produced an *esprit de corps* between general ward nurses, dieticians, and premature station nurses which we have never had before. They take great pride in this work, and, if we have accomplished nothing more, the work of Dr. Bundesen and Dr. Hess has made the practitioners, resident and interne, the nurses, and certainly all the pediatricians more “premature conscious” than before.

DR. STEWART CLIFFORD (BOSTON) referred readers to his paper in the round table discussion of last year. (J. PEDIAT. Vol. 6, p. 115, 1935.)

DR. L. EMMET. HOLT, JR (BALTIMORE).—I would like to ask Dr. Clifford how the reduction of stillbirths in the Boston City Hospital was brought about. Nor is it clear to me how the pregnancy was prolonged in order to make these premature infants more viable.

DR. CLIFFORD.—The stillbirths were reduced principally in the toxemic group; about 30 per cent of our premature infants born alive are from mothers with toxemia. A larger per cent of the premature infants born dead came from mothers with toxemia (according to the Bodes differential diagnosis of toxemia, that is, a mother who has a blood pressure of 140 without albumin). We shall not go into the controversial subject of the diagnosis and classification of toxemia; using the progressive differential diagnosis, we have diagnosed as toxemic 12 per cent of the women who appear in the clinic for prenatal studies. Of the 12 per cent, 6 per cent deliver stillborn babies. One-half of these weigh more than five pounds and half less than five pounds.

The obstetric management of these patients now is such that when the patient appears with a toxemia of moderately severe degree, an appraisal is made of the size of the baby and of the type and

degree of toxemia. We found in women whose blood pressures went to 180 or above, 50 per cent of those with a severe grade of toxemia delivered stillborn babies. The case is considered first, from the standpoint of the mother's condition and second with regard to the chances the baby will run as a premature infant or one of the weight it is shown to be by x-ray pictures.

If we find that by x-ray examination a mother has a 4-pound baby, that she has a blood pressure of about 180, and that she has lost one or more babies by miscarriage, the conclusion may be reached that the mother delivered of her 4-pound baby will have a greater chance of having a baby to take home with her than she would if we waited for a larger sized baby only to have it delivered stillborn. It is largely from the toxemic patients that the stillborn infants are salvaged.

Cases of placenta previa make up the other group. If bleeding is taking place, the fetus undergoes marked intrauterine asphyxia. The danger of the baby's being born dead increases from the onset of bleeding to the time when the baby is actually delivered. Women with placenta previa should not be examined and bleeding started, if there is just a slight flowing, until the baby is demonstrated to be of sufficient size to be viable; and then is necessary a cesarean section should be performed.

DR. HOLT.—The second question concerns the circumstances under which you prolong pregnancy to make the child more viable.

DR. CLIFFORD.—In the milder cases of toxemia, if the mother has about 160 blood pressure, a slight trace of albumin, a baby shown by x-ray to approximate, let us say only 3 pounds, the mother is put to bed in the hospital under close observation and kept there for two or three weeks. Under these well-controlled conditions in borderline toxemic cases, you can often prolong pregnancy and, instead of delivering at 3 pounds, deliver the infant at 4 or 5 pounds. The obstetrician has to determine the size of the baby, the blood pressure, and other findings of the mother.

DR. BLATT.—You have not described what to do for a mother who comes to the institution in early labor.

DR. CLIFFORD.—You cannot do anything.

DR. BLATT.—That is why we think our statistics are very high. The interne of resident obstetrician says the pregnancy will be aborted unless the woman is given morphine. Then she delivers a premature baby, and we are charged with premature death.

DR. CLIFFORD.—The staff has given considerable study to the effect of avertin and found it could be used effectively instead of morphine or ether to stop labor. Under certain conditions one may be forced to give morphine. The mother comes first.

DR. BLATT.—When avertin has been used, the babies seem very dull for about forty-eight hours.

DR. CLIFFORD.—Any analgesic given to the mother affects the baby to some degree. Dr. Irving had a very interesting experiment. He took five hundred consecutive deliveries in the district where no anesthesia was used. Only 10 per cent of the babies required resuscitation. He compared the series receiving so-called twilight sleep analgesia, and, instead of 10 per cent requiring resuscitation, 60 per cent had to be resuscitated. He compared that with the analgesia now popular—phenobarbital. There 40 per cent had to be resuscitated, fewer than in the morphine group, but still many more than in the group without anesthesia.

That is the price we pay for analgesia. If you take a 7- or 8-pound baby and put him to sleep with analgesia, what are you going to do with a 3-pound baby? Those are the babies who are being born dead.

They do not enter into any of our statistical figures. Every one washes his hands of a stillborn, and nobody assumes responsibility.

Through this study we are making on premature infants, we are all going to end by including stillborns. We will have to include them in our group. There is no reason why a baby at ten o'clock is stillborn but at ten-two premature.

DR. HUGH CHAPLIN (NEW YORK CITY).—Do I understand that the premature infants born alive did not show any serious after-effect in connection with toxemia?

DR. CLIFFORD.—The toxemia does not apparently affect any infant directly. A mother may have a high N.P.N. level with toxemia and may be really in convulsions, but the infant may have a normal N.P.N. content. If that toxemia produces premature separation of the placenta, the baby is killed by interruption of the placental circulation. As a whole, the babies of toxemic mothers are less well nourished than the babies of normal mothers. The babies of toxemic mothers constantly approach the minimum weight for their size.

CHARIMAN HESS.—Dr. Clifford has brought up the question of resuscitation of infants. Believing that some of the methods used for resuscitation of premature infants traumatize them, the Commissioner of Health of Chicago sent out a questionnaire to the obstetricians of Chicago, asking for their opinions as to the methods which might be advisable and safe for the newborn. The conclusions were that posture, pharyngeal, and, in exceptional cases, tracheal aspiration, oxygen, oxygen and carbon dioxide mixtures, warm baths, and mild forms of artificial respiration were recommended. All strenuous handling which might traumatize the infant was condemned.

Dr. Huenekens has recently stated that the tying of the cord of prematurely born infants almost immediately might be a factor in the high mortality rate.

DR. EARLE.—You spoke of breech delivery and cesarean section being equally dangerous. May I ask whether any of the mothers are allowed to have a trial by labor on the basis of measurements before cesarean section is performed?

DR. CLIFFORD.—Unless there is a necessity of early induced labor. The mother may have heart disease with impending failure or may have severe preeclampsia. The cesarean section is performed not because of any question of disproportion and not for the baby, but for the mother.

DR. LEWIS A. KOCH (BROOKLYN, N.Y.).—I should like to present a summary of a statistical study of the incidence of prematurity and its etiology and mortality as it occurred at the Long Island College Hospital during a ten-year period from Jan. 1, 1924 to Jan. 1, 1934. There is a well-organized prenatal clinic which assigns most normal cases to the student out-patient service for home delivery. Toxemia cases are managed in a very conservative manner and an attempt is made to prolong the pregnancy until term; very few inductions are practiced. The question arises in the light of Dr. Clifford's interesting work whether the relative incidence of stillbirths is appreciably higher as a result of this conservative attitude.

In this study, all infants, whether of single or multiple pregnancy, who were born alive (heart beating) and whose weight at birth was 2,500 gm. (5 pounds 8 ounces) or less were considered as premature, regardless of the period of gestation. It is routine for all infants born in the hospital to be placed in a heated bed in the delivery room immediately after birth, and as a result initial chilling seldom occurs.

Following delivery, the infants are transferred immediately to the pediatric service for the remainder of their care. Air-conditioned rooms are not available, and individual incubator care has to suffice. The nursing care is done chiefly by student nurses with a minimum number of graduate nurses in charge. The pediatric care varies but in few details from that practiced in other teaching institutions with

which I am familiar. Probably human milk has been more available at this institution than at most since a human milk collection depot was maintained by the Children's Welfare Federation in the out-patient department for many years.

During this ten-year period, 8,345 mothers were delivered in the Long Island College Hospital; 553, or 6.6 per cent, were delivered of living premature infants.

The average premature mortality was 30.5 per cent.

The incidence of prematurity among mothers who had had previous early labors was three and one-half times higher than the average total incidence of prematurity.

Multiple pregnancies occurred 95 times, of which infants 46.8 per cent were considered and treated as premature.

In one-half of the cases, no cause for early labor was apparent. In one-fifth of the cases, toxemia of pregnancy was considered responsible for the early labors; syphilis in this series was a relatively minor cause (4.5 per cent).

The mortality among those infants born of mothers suffering from toxemia was no greater than those of mothers with no apparent cause for their early labors.

Premature infants whose mothers suffered from heart disease, acute febrile diseases, placenta previa, and syphilis were apparently less viable than those with no apparent cause for their early labors.

The mortality among infants weighing less than 2,500 gm. who were born of multiple pregnancies was as high as among those of single pregnancies.

The type of labor apparently had but little influence upon the mortality rate of the premature infants. However, the type of delivery seemed of definite importance. The infant mortality in this series was definitely higher among the breech delivery cases than among the spontaneous vertex, forceps, and cesarean section cases. The mortality among those born by cesarean section was slightly less (27.4 per cent) than the totally average mortality (30.5 per cent).

There was a definite decrease in the mortality of premature infants during the last two years of this study. This is attributed to the increase in the number of graduate nurses in attendance.

Over half (57.7 per cent) of the premature infant deaths occurred during the first forty-eight hours of life. The discoverable causes of death among this group were asphyxia, persistent atelectasis, and intracranial hemorrhage. Among those surviving the first forty-eight hours, acute infections, especially bronchopneumonia, were the most important causes of death.

Toxemia occurred as a complication of pregnancy in approximately 8 per cent of the cases admitted to the obstetric service. In less than 6 per cent of these toxic cases was cesarean section performed or labor induced by bougie or bag. In 75 per cent, labor was spontaneous resulting in living babies weighing more than 2,000 gm. (average 2,950).

There were but 36 among 661 cases of toxemia which resulted in stillbirths weighing more than 2,000 grams and whose hearts were not heard at the end of the first stage of labor. These infants might have been born alive if labor had been induced earlier. However, since many of the intrauterine deaths in toxemia occurred in cases in which the blood pressure was not alarmingly high, and since the great majority were carried to term with conservative treatment, it might be unwise to recommend early induction of labor as a routine in all cases.

CHAIRMAN HESS.—One point which might account for the gross number in Dr. Koch's series as compared with Dr. Clifford's is the fact that Dr. Clifford had his dividing line at 5 pounds and Dr. Koch has his dividing line at 5.5 pounds.

DR. CLIFFORD.—It is a most instructive paper, and it is very interesting to find many points of similarity in the statistics from the two institutions. By comparison of statistics such as we have heard, we shall know our sore points and can reappraise our methods to see whether we cannot approach the Long Island figures in certain respects, particularly toxemia.

In toxemia a placenta can be severely infarcted. Very frequently you will find a clot that may possibly account for intrauterine death between the first stage and termination. The placenta, microscopically and grossly, is a very much diseased organ.

DR. DUNHAM.—My plea has always been for collecting figures and analyzing the figures, but I do think we have to be very careful in the interpretation of them. I was reminded of this when Dr. Koch spoke of the comparison of mortality rates between twin and single births, because I had analyzed our twin and single births and thought the mortality among the twin births was lower until I had interpreted the figures and found no significant difference in them. I think we should be careful about having four cases and saying 50 per cent die, comparing those with one hundred cases in which twenty-five die. You cannot make comparisons of that kind on a statistical basis.

One of the things in which we are most interested in all this work on prematurity is to get large enough figures so that they will be significant statistically. One reason why we are so anxious to have everyone working on the same criterion is so we can really pool figures.

CHAIRMAN HESS.—You are suggesting the use of what figures as the dividing line?

DR. DUNHAM.—We have urged the use of 5 pounds 8 ounces because Ylppo laid down that line back in 1919. The 2,500 gm. weight is one that everyone could use. If we can all agree on a weight to use in the analysis of our figures, it will be much easier to compare notes.

DR. CLIFFORD.—As a result of Dr. Dunham's work and in order to make our figures available, we are now keeping our figures at 5 ½ pounds. I have only one plea to make, which is that, instead of taking from 0 to 5 ½ pounds as Dr. Dunham recommends, we subdivide our figures into some unit or series of units. I would suggest 500 gm. weight groups.

The following resolution was passed:

For statistical comparison of results of care, a uniform standard for diagnosis of prematurity was important.

A premature infant is one who weights 2,500 gm. or less at birth (not at admission) regardless of the period of gestation.

All liveborn premature infants should be included, evidence of life being heart beat or breathing. Mortality should also be calculated:

1. In weight groups: number of casses should be studied in five weight groups—
 - (1) Under 1,000 gm.
 - (2) 1,000-1,250 gm.
 - (3) 1,251-1,500 gm.
 - (4) 1,501-2,000 gm.
 - (5) 2,001-2,500 gm.
2. Age at time of death of various weight groups.
3. Age at time of admission of infants received from other hospitals and homes in relation to Sections 1 and 2.

DR. EDWARD A. WAGNER (CINCINNATI, OHIO) presented the following figures on the mortality in relation to estimated fetal age and weight in 113 premature infants:

ESTIMATED FETAL AGE	WEIGHT	NO.	MORTALITY	PERCENTAGE
4 mo.	1-10-10 ½	2	2	100
5 mo.	1-12 ¼	2	2	100
6 mo.	19-3.2	14	12	85
7 mo.	2.4-5.9 ¾	43	29	67.4

8 mo.	3.7-4.15	45	17	37.7
9 mo.	3.14-4.14	7	2	28.5

The cause of death as ascertained in twenty-eight autopsies were as follows:

Intracranial hemorrhage	15	14%
Enteritis	4	14%
Cerebral congestion and edema	3	
Lobar pneumonia	5	8%
Hemorrhage—hematoperitoneum	1	

DR. WALTER F. WATTON (BROOKLYN, N.Y.).—The number of births at the Brooklyn Methodist Hospital during the five-year period beginning 1930 and ending 1934, inclusive, was 9,224. Among these there were 564 premature births, making 6 per cent of the total number. This group includes all premature babies who showed any signs of life on delivery, irrespective of the months of gestation. We have no classified as premature that large group of small babies weighing less than 2,500 gm. with an obstetric history of being carried more than 8 ½ months.

TABLE I

Number of premature infants for the 5-year period from 1930 to 1934, inclusive	564	
Number of premature infants who lived	417	74%
Number of premature infants who died	147	26%
Number of premature infants weighing more than 2,500 gm.	214	
Number of premature infants weighing 2,500 gm. or less	350	
Number of deaths of premature infants weighing more than 2,500 gm.	21	OF TOTAL 14%
Number of deaths of premature infants weighing 2,500 gm. or less	126	86%
Mortality rate (omitting all premature infants over 2,500 gm.)		36%

There were 417, or 74 per cent, of these premature infants who lived, and 147 babies, or 26 per cent, died (Table I).

In our total group of premature infants there were 214 with birth weights above 2,500 gm. and 350 with birth weights of 2,500 gm. or less. Of the 147 deaths only 21, or 14 per cent, weighed more than 2,500 gm., while 126, or 86 per cent, of the total deaths fell in the lower weight group (Table II).

TABLE II
DEATHS

Total number of deaths	147	
Lived less than 1 hour	36	
Lived less than 1 day	49	
Lived less than 2 days but more than 1 day	9	
Lived less than 1 week but more than 2 days	13	
Lived more than 1 week	40	
Deaths before end of second day (obstetric problems)	94	
Deaths of premature infants 2 days or older (pediatric problems)	53	DEATH RATE 11.2 per cent

The period of gestation is the most important factor of the premature problem. Babies of less than six and one-half months' gestation practically all die (Table III). Since these babies were listed as premature, we have had to include them in this report. Of the infants born in the eight and one-half months' period, we lost only 3 per cent.

TABLE III
PERIOD OF GESTATION

PERIOD OF GESTATION (IN MO.)	NUMBER OF BABIES	NUMBER OF BABIES WHO LIVED	NUMBER OF DEATHS	PERCENTAGE OF DEATHS
4	1	--	1	100
4 ½	2	--	2	100
5	3	--	3	100
6	31	2	29	93
6 ½	16	3	13	87
7	74	41	33	45
7 ½	44	28	16	36
8	277	231	46	16
8 ½	116	112	4	3

A record of the feedings of these babies showed that 65 per cent of them received breast milk exclusively or part breast milk and that 35 per cent received artificial food only (Table IV). We could not classify fairly the results from artificial feeding and breast milk feeding because our weaker smaller babies obviously, having the less chance of survival, were given breast milk. There were seventy-one babies in this group who did not live sufficiently long to receive any feedings.

In reviewing the causes of the pediatric deaths of this group aside from prematurity alone, the problem of infection plays a very major part. Infections in premature infants seem to select the gastrointestinal and respiratory tracts most frequently. Some of the other more frequent causes of death among the premature infants were congenital malformations, intracranial hemorrhages, congenital atelectasis, asphyxia neonatorum, hemorrhagic disease of the newborn, and syphilis (Table V).

TABLE IV
FEEDINGS

	NUMBER OF BABIES	PERCENTAGE	
Breast milk only by nursing the mother	30	6.0	
Breast milk pumped, and also nursing mother	9	1.8	
Nursing and a whole milk formula P.C.	36	7.3	
Nursing and an evaporated milk formula P.C.	58	11.8	
Pumped breast milk only	54	11.0	
Pumped breast milk and whole milk formula	25	5.5	
Pumped breast milk and evaporated milk formula	106	22.0	65

No breast milk—evaporated milk formula only	142	28.8	
No breast milk—whole milk formula only	29	5.8	
No breast milk—evaporated milk and whole milk formula	4	0.8	35
Babies who did not live long enough to receive any formula	71	-----	

Total	564		

TABLE V
PREDOMINATING CAUSES OF DEATH

Prematurity alone	61
Prematurity with gastroenteritis	46
Prematurity with bronchopneumonia	15
Prematurity with gastroenteritis and bronchopneumonia	14
Prematurity with congenital malformations	11
Prematurity with intracranial hemorrhage	11
Prematurity with congenital atelectasis	9
Prematurity with asphyxia neonatorum	4
Prematurity with hemorrhagic disease of newborn	3
Prematurity with syphilis	2

After tabulating the various maternal diagnoses in the premature group, we note that toxemia was most common. Hemorrhages, including placenta previa, ablation, etc., hold an important place in maternal diagnosis (Table VI). There were a few cesarean births, especially among the toxic mothers; however, this represents only 24 out of the 302 cesareans performed during this period. Syphilis in this group seems to be of minor importance as one of the causes of prematurity because we have a class of patients in whom the incidence of syphilis is unusually low.

TABLE VI
MATERNAL DIAGNOSIS IN PREMATURE GROUPS

Toxemia (including chronic nephritis)	120
Multiple pregnancies	49
Hemorrhages (placenta previa, ablatio, etc.)	38
Cesarean births	24
Cardiac disease	10
Hydramnios	10
Fibroids	9
Premature rupture of membranes	8
Pyelitis	8
Syphilis	8

Every premature infant who breathed is included in this series. The general mortality rate of our premature infants was 26 per cent. If all premature infants weighing over 2,500 gm. are omitted, the mortality rate was 36 per cent; and if the premature infants classified as obstetric problems because they lived less than two days are omitted, the pediatric mortality rate was then 11.2 per cent. We find that infections still play altogether too great a role in the causing of premature deaths; that 65 per cent of all of these premature infants were fed in part or totally on breast milk, which we believe is ideal; and that 35 per cent had to rely on a formula only. This study emphasizes that toxemia, multiple pregnancies, and hemorrhages stand high as important causative factors of prematurity.

CHAIRMAN HESS.—We have a very progressive commissioner of health in Chicago who believes that premature infants should be taken care of by a pediatrician. His recommendation was as follows: It is strongly recommended that the obstetric departments in hospitals where it is customary to place the responsibility for the care of the newborn upon the pediatric department notify the pediatric department in advance of a delivery in which the uterogestation is expected to be less than term and more than four months. It is also suggested that the pediatric department respond to such notifications by assigning to the delivery room an attendant, especially trained in the early care of premature infants. Such an attendant should be a member of the hospital personnel and constantly on call.

DR. CHAPLIN.—To what extent does humidity play a part in this matter of mortality?

CHAIRMAN HESS.—There is a good deal of diversified opinion. When I discussed the requirement for a station in a small hospital, the opinion was expressed that that equipment was of less importance than good nursing care and breast milk. We have no provision for controlling humidity other than opening windows or hanging wet sheets over an ordinary screen.

We believe our results, both as to morbidity and mortality, compare favorably with any results so far published. I think Dr. Dunham might want to say something on this subject. The system at Yale has been modified like that at Harvard to control ventilation, humidity, and temperature.

DR. DUNHAM.—We have analyzed all the cases in the last eight years from the viewpoint of how the treatment affects mortality. During the last four years we have had air-conditioned rooms. During the previous four years, we had no air-conditioned rooms. It is not a satisfactory comparison because the cases were not in all other respects the same.

We found, in comparing the mortality in the two four-year periods, that we lowered the mortality in the higher weight groups, those over 1,500 gm., but had not affected the mortality in the lower weight group. Since one would expect and hope that an air-conditioned room would be a great asset to the babies in the lower weight group, we do not feel we have anything definite to show.

CHAIRMAN HESS.—How about the morbidity?

DR. DUNHAM.—I cannot give the results, but they are not very striking.

DR. EGBERT EARLY MOODY (LOS ANGELES).—We have heard all the figures from the East. We will give some figures from Los Angeles. Since January, 1934, I have had charge of the newborn service at the Los Angeles General Hospital. We have as our premature nursery an ordinary nursery. We have no graduation room, no apparatus for humidity. Our sterilizer was put into the room for sterilization. That has been largely the method by which our humidity has been controlled. In our heat bed we use only a pan of water.

Since January, 1934, we have admitted to this department for premature infants only those who are born in the hospital, or infants born outside whose mothers come into the hospital bringing their infants with them. We accept no premature infants except those accompanying the mother to the obstetric ward.

We have had during the seventeen months, and these figures are up to May 25, 1935, 429 premature infants of whom 311 lived. Of the group under 3 pounds, only 9 lived, a mortality of 90 per cent. In the weight group between 3 and 4 pounds, 58 children lived, a mortality rate of 30 per cent. In the weight group between 4 and 5 pounds, we had 109 children with a mortality rate of 8 per cent. Between 5 and 5 ½ pounds, 135 infants lived, a mortality rate of 4 per cent. We obtained autopsies in 59 per cent of the deaths. It was interesting to note that atelectasis was indicated in 50 per cent of these cases. Cerebral hemorrhage accounted for death in 15 per cent, pneumonia 7 per cent, syphilis, and otitis media each 4.5 per cent.

It is interesting to note that enteric infections were almost nonexistent. These babies were fed exclusively, up to 4 pounds in weight, with breast milk. During this time, our service has used more than 50,000 ounces of breast milk, which has been furnished by a wet—nursing bureau run in connection with one of the smaller clinics as a commercial enterprise.

Seventy-five of the deaths occurred before forty-eight hours elapsed. Eighty-one per cent of these died within twenty-four hours. We considered as premature any infant who reached the premature nursery. There has not been good liaison between the obstetric and the pediatric departments; consequently, those babies who died before they reached the premature room at not included in the record.

DR. J. VICTOR GREENEBAUM (CINCINNATI).—In the Jewish Hospital, we installed six of Dr. Hess' beds and reduced our mortality to less than 20 per cent for the babies born in the hospital. For the children who are brought into the hospital, statistics are less available.

DR. C. W. WYCKOFF (CLEVELAND).—What is your experience and the experience of other men in the follow-up work on premature infants six months and twelve months after birth, as to paralysis, hydrocephalus and so forth?

CHAIRMAN HESS.—Moore and Bartelme selected for a mental and physical study the 250 oldest premature infants discharged from our station. The station has now been open thirteen years. Among the 250 are all of the cases of intracranial hemorrhage which we could locate. There was a total number of 69 cases which were diagnoses as intracranial hemorrhage while in the hospital or in which evidence of hemorrhage appeared after graduation. Of those 69, 42 show no physical or mental defect. Eleven are in what we call a "bad" group, of which either 6 or 7 are mentally deficient and the other 4 or

5 are physically subnormal. The next group, those showing moderate evidence, includes 9, and of those 4 are mentally deficient. Five are fairly good mentally but show more or less what I would say was at least moderate physical change. Of the 7 in the other group, 2 are mentally deficient, and the other 5 show very minor evidence of hemorrhage. Two of them are moderately retarded, and 5 show such minor changes as strabismus, increased reflexes, and so forth. Twenty-seven out of 69 show more or less severe changes; 42 none, so far as we could find, mentally or physically. Undoubtedly we have lost sight of a considerable number. Some of them died.

We have had up to Jan. 1, 1934, 168 cases showing intracranial hemorrhage out of 386 which we autopsied.

The meeting adjourned at 5:30 P.M.