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Variation in the Hospital Care of Premature Infants*

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THE resolution on prematurity passed at the 1947 Annual Meeting and today's discussion at a joint meeting of the Health Officers and Maternal and Child Health Sections of the Association attest to the growing emphasis placed upon a public health approach to the problem of prematurity. We are leaving the hit or miss era in premature care and entering the stage of large-scale organized programs. If energy and funds are to be expended wisely in this field, critical appraisal must be made of the content of programs, existing and planned, and techniques must be developed to evaluate the results of such programs.

As a first step in this direction it is desirable to have a picture of the types of care given to premature infants in leading teaching hospitals, and to determine what effect, if any, variations in such care have upon the fate of the premature. Such knowledge is also

helpful in planning additional or improved facilities for adequate care of premature infants in a given area according to accepted medical standards.

With these factors in mind a study was made of the care given to premature infants born during 1945 and 1946 in 6 teaching hospitals in New York State, 2 in New York City, and 4 elsewhere in the state. Data were obtained by statisticians directly from the hospital records of all infants weighing less than 2,500 gm. at birth covering such matters as birth weight, weight at time of transfer from one type of service to another, and on discharge from the hospital, and number of days' care given in incubators, in premature nurseries not in incubators, and in the regular new-born nursery. Lists of such infants supplied by each hospital were cross-checked with information on birth and death certificates available in the Office of Vital Statistics.

All the hospitals studied had special facilities for the care of premature infants including premature nurseries with modern incubators. The adequacy of

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TABLE 1

Per cent of Infants Weighing 1,750-2,499 Grams at Birth, and Surviving to Discharge, Receiving Care in Premature Nursery

Hospital	Per cent placed in premature nursery			Per cent of those placed in premature nursery receiving incubator care		
	1,750-1,999 grams	2,000-2,249 grams	2,250-2,499 grams	1,750-1,999 grams	2,000-2,249 grams	2,250-2,499 grams
Total	97	88	34	67	60	40
A	79	72	54	100	100	100
B	100	88	17	100	100	100
C	100	96	6	100	100	100
D	97	80	20	97	98	78
E	100	96	2	27	11	—
F	100	100	100	23	8	3

these facilities and the qualitative aspects of care rendered were not investigated. The data obtained can only provide a picture of actual practice in selected teaching institutions during a given period of time.

No significant variation was found in the 6 teaching hospitals in the type of care rendered to premature infants who weighed less than 1,500 gm. at birth. All infants in this birth weight group who survived the delivery room were placed in incubators in the premature nursery. In the birth weight group between 1,500 and 1,750 gm. only minor variations in care were noted. At the dividing line of 1,750 gm., deviations in the type of care became rather marked. As seen in Table 1, in 1 hospital only 79 per cent of the infants in the weight group, 1,750 to 2,000 gm. were placed in the premature nursery in contrast to the other study hospitals in which all, or nearly all, the infants were placed. Among the heavier prematures the differences in care were even sharper. In 1 hospital in New York City, all infants weighing up to 2,500 gm. received care in the premature nursery. In the other hospitals the percentage of infants placed in the premature nursery dropped off in the weight group 2,000 to 2,250 gm., and in 4 of the hospitals most of the infants in the weight group above 2,250 gm. were placed in the regular new-born nursery.

Further variation was discovered in

the percentage of infants who received incubator care. In 3 of the 4 upstate study hospitals, all infants who entered the premature nursery were placed in incubators and remained there until discharge from the hospital, even though special heat and humidity controls were discontinued well before discharge. At the opposite extreme, in the hospital in New York City in which all infants less than 2,500 gm. were admitted to the premature nursery, incubator care was given to only 23 per cent of infants weighing between 1,750 and 2,000 gm., to 8 per cent in the next weight group, and to 3 per cent in the group just below 2,500 gm.

In the planning of facilities for care of premature infants it is important to have an idea of the average days of hospital care required for all premature infants, surviving or dying. In the study hospitals an average of 22 days of care is found for all premature infants (exclusive of those held for non-medical reasons) if a half day of care is arbitrarily assigned to infants dying during the first day of life. The range was 19 to 25 days. The greater part of the care was given in the premature nursery even in those hospitals in which the majority of the larger infants were placed directly in the regular nursery, since the hospital stay of the larger infants was comparatively short.

A similar analysis was made of the care rendered infants surviving to dis-

charge from the hospital as this gives a better picture of the actual care rendered. An average of 27 days of care was given to the surviving infants, with a range of 24 to 32 days in the various hospitals studied. The average number of days' care in incubators in the 2 teaching hospitals in New York City was very low since many infants were removed fairly promptly from the incubator to an unheated crib in the premature nursery.

These data were broken down further by weight, and the weight group 2,000 to 2,250 gm. is chosen to illustrate in detail the variations involved (Table 2). In the 4 upstate study hospitals about 12 per cent of the total care rendered premature infants was given in the regular new-born nursery. Of the 2 study hospitals in New York City, 1 gave no care to prematures in the regular nursery at any time, and the other gave only 1 per cent of care in the regular nursery.

Marked variation was also found in the proportion of care given in the incubator and in unheated cribs in the premature nursery. In the 2 study hospitals in New York City, 98 and 99 per cent of the total care to premature infants in the weight group 2,000-2,250 gm. was given in unheated cribs in the premature nursery as contrasted with the 3 other hospitals in which 73 to

97 per cent of care to the group was given in incubators.

The variation was also marked in the next lower weight group from 1,750 to 2,000 gm., although not so great. Extreme variations were found in the care of infants weighing between 2,250 and 2,500 gm.

Analyses of the average daily gain in weight and of the average weight at discharge at the various hospitals disclosed little information of interest. The average daily gain in weight was related in general to the length of stay of the infant in the hospital, being greater in infants who remained longer. A weight of about 2,500 gm. was apparently the criterion used in determining the time of discharge from the hospital, the range in the actual average weight at the time of discharge being 2,460 to 2,660 gm. No relationship was demonstrated between the birth weight of the infants and the weight at the time of discharge.

The neonatal case fatality rates (deaths under 1 month per 100 live births) by broad weight groups in each of the 6 study hospitals are shown in Table 3. Since mortality varies so markedly with the weight of the infant, the crude case fatality rate in any hospital is dependent to a large extent upon the distribution of the births in that hospital by birth weight. In order

TABLE 2

Total Number of Infants Weighing 2,000-2,249 Grams at Birth, and Surviving to Discharge, with Average Number of Days' Care Received in Hospital, by Type of Care

Hospital	Total Infants	Average Number of Days' Care	Per cent of Care			
			In Premature Nursery			In Regular Nursery
			In Incubator and Crib		In Crib Only	
Incubator	Crib					
Total	334	28	45	12	34	9
A	54	32	73	—	—	27
B	40	21	92	—	—	8
C	27	28	97	—	—	3
D	81	30	56	32	1	11
E	46	33	*	11	88	1
F	86	23	3	8	90	—

* Less than 0.5 per cent

TABLE 3
Per cent Case Fatality under 1 Month of Age among Premature Infants, 1945-1946 *

Hospitals	Total		Less than 1,500 Grams	1,500-1,999 Grams	2,000-2,499 Grams	Birth Weight Not Stated	
	Crude	Adjusted				Per cent of Total Prematures	Case Fatality
All Upstate hospitals	21.3	19.6	75.5	23.0	6.5	7.5	44.1
Non-teaching	21.4	19.5	75.7	22.8	6.3	7.7	46.0
Teaching	21.1	19.8	74.1	24.4	6.7	5.9	24.8
Study hospitals							
Upstate	23.0	19.9	75.4	23.6	6.8	—	—
A	25.9	20.2	78.4	23.1	6.7		
B	23.8	21.0	72.7	24.5	8.8		
C	21.5	15.6	63.6	20.0	3.9		
D	21.0	20.9	83.0	24.2	6.5		
New York City	18.2	15.8	66.7	17.2	4.4	—	—
E	18.6	16.5	66.7	20.3	4.5		
F	17.8	15.2	66.7	14.3	4.3		

* "Crude case fatality" includes infants whose birth weight was not stated but who were of premature gestation. The adjusted case fatality excludes them.

to obtain comparable total rates for each of the study hospitals which could then be compared with the rates for other hospitals, the rates for the 6 study hospitals were adjusted to the distribution of births by birth weight in all hospitals in the upstate area in 1945-1946. This adjustment was made by calculating the number of deaths per 100 births that would have occurred had the distribution of births by weight in each hospital been the same as that among births in all upstate hospitals.

The 2 study hospitals in New York City had definitely lower rates in each of the weight groups than did the 4 upstate hospitals combined and the difference between the adjusted total rates (21 per cent) is statistically significant. When the deaths under 1 day are excluded, the difference between the rates for the study hospitals in New York City and upstate is even greater, the rate for infants 1-29 days of age in New York City study hospitals being 36 per cent lower than in the study hospitals upstate. Hospital C upstate had rates lower than any of the 3 other upstate hospitals but, since there were only 130 premature births in this hospital in the 2 years of the study period, its rates are not significantly lower than those of the group as a whole.

The hospital with the lowest adjusted rate is hospital F in New York City. This hospital has paid particular attention to the problem of prematurity for many years. In reviewing the type of care given in this hospital, it will be recalled that all infants weighing less than 2,500 gm. at birth were admitted to the special premature nursery and kept there until discharge. In this hospital more infants are placed in incubators for a day or two and are then kept in the premature nursery when the incubator is no longer considered necessary. These infants, plus the infants placed directly in unheated cribs in the premature nursery, raise the proportion of care in unheated cribs far in excess of the other study hospitals. It is of interest that hospitals C and E, the hospitals with the next lowest adjusted rates, admitted the next highest percentages of infants up to 2,250 gm. to the premature nursery. In these hospitals, only 4 per cent of the total care to infants weighing 2,000 to 2,250 gm. at birth was given in the regular newborn nursery as compared with 12, 20, and 28 per cent in the 3 hospitals having higher rates.

It should be emphasized that no conclusion is being drawn that the differences in the types of care *per se* were

responsible for the lower neonatal case fatality rates. There are many other factors at work—above all, the quality of care rendered—which were not measured. However, in pointing out the association, it would seem that the methods employed by hospitals which save a greater proportion of infants could well serve as a model unless other methods are shown to be better in some or all respects.

For the upstate area, neonatal case fatality rates by birth weight are available for all hospitals, since infant deaths are routinely matched to their corresponding birth certificates, and birth weight is obtained on over 90 per cent of all certificates. Table 3 shows the rates for all hospital births, and also for those occurring in teaching and non-teaching hospitals. While the teaching hospitals are all fairly large (none had fewer than 900 births in 1945), tabulations have shown that except for slightly higher rates in hospitals having less than 100 births a year, there is little variation in the fatality rate according to size of hospital.

The rates in each of the 3 broad weight groups are practically the same as the corresponding rates in the upstate study hospitals, the total adjusted rate for the non-teaching group being slightly lower than for the teaching group which, in turn, is slightly lower than that of the upstate study group. None of these differences are statistically significant.

Exact comparison between the study hospitals, the teaching hospitals as a group, and others, is complicated by the fact that although birth weights are reported for over 90 per cent of all births, the group of births with weight not stated includes a considerable number of infants of premature gestation. Most of these, in view of the high correlation between gestation and birth weight, would weigh less than 2,500 gm. If these children are included in the total

premature group, the mortality of the group is raised. In the non-teaching hospitals in Table 3, they formed 7.7 per cent of the total premature births, with a fatality rate of 46 per cent, and in the teaching group, 5.9 per cent, with a mortality rate of 25 per cent. If it were possible to distribute these births to the proper weight group, the total adjusted rate for the non-teaching hospitals would be increased more than that for the teaching group, probably eliminating the differences between them. In the study hospitals, birth weights were obtained from the hospital records for all prematures and this alone may account for the fact that the adjusted mortality for the upstate study hospitals appears slightly higher than for the upstate teaching hospitals as a group.

In comparing the case fatality among prematures in different hospitals, or in various areas, the inclusion of these infants with birth weight not stated is as important as the adjustment of the rates for birth weight.

For the evaluation of the results of a premature program, then, certain points must be kept in mind.

1. In comparing case fatality rates, mortality of all premature infants, regardless of the stated cause of death, must be included. The infant mortality from "premature birth" as given by statistics of infant deaths by cause is not an adequate measure of the mortality associated with premature birth. For a state, county, or city, this means the matching of infant deaths to birth certificates and obtaining accurate birth weights on all birth certificates. Birth weight has been included on the face of the Standard Certificate to be adopted in 1949. Effort must be made to obtain complete data on birth weight since the failure of some hospitals to record the birth weights of infants who die soon after birth reduces the comparability of mortality figures for these hospitals and the areas which they serve.

2. Deaths included should be those occurring in a stated age period, for example, under 1 month of age. Hospital data are likely to include all deaths occurring in the hospital, regardless of age at death, and to exclude occasional deaths at less than 1 month of age that occur after the infant has left the hospital.

3. The births should include all those occurring at a particular place during a stated period of time. Hospitals should not include infants born outside and moved to the hospital after birth. These infants have already survived the period of greatest hazard.

4. In order to be comparable, case fatality rates should be computed by birth weight groups, or the total rates adjusted for differences in the distribution of births by birth weight.

SUMMARY

1. Marked variation was found in 6 teaching hospitals in New York State in the average number of days' care given premature infants and in the type of care given those weighing 1,750 gm. or more at birth. Some hospitals placed a considerable proportion of the larger infants in the regular new-born nursery. Only 3 of the hospitals had crib facilities other than incubators in the premature nursery.

2. The 3 hospitals which made the greatest use of special facilities for premature infants had the lowest case fatality rates. There appeared to be no association between the average number of days' care and case fatality.

3. Evaluation of premature programs necessitates the development of adequate statistics on the case fatality of all premature infants, regardless of stated cause of death. Because of the marked variation of the fatality rate with birth weight, it is essential that a rate adjusted for birth weight be used in comparing case fatality rates.

Outbreak of Yellow Fever in Panama Controlled

Dr. Miguel Bustamante, Secretary General of the Pan American Sanitary Bureau, reports that no cases of yellow fever have occurred in Panama since December 31, 1948, indicating that the results of the work performed by the health authorities of Panama, with the aid of personnel and vaccine contributed through the Pan American Sanitary Bureau, by Brazil, Colombia, and the United States, were completely successful. Dr. Adhemar Paoliello, of the Pan

American Sanitary Bureau, has reported from Panama that by April 15, 1949, 315,000 persons had been vaccinated against yellow fever and that most of the dwellings throughout the country had been sprayed with DDT. The teamwork among the four countries and the international health agency for the Americas was benefited by an increased budget for public health in Panama. The people of Panama provided all possible facilities and cooperation.