Research Roundtable Summary

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SEVENTEENTH

in a Series of Seminars

on MCHB-funded

Research Projects

Evaluation of the Guidelines for Maternal Transport

September 23, 1997 • Parklawn Building, Conference Room P

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U.S. Department of Health & Human Services
Public Health Service
HRSA
Health Resources & Services Administration
Maternal & Child Health Bureau

This series is sponsored by the Maternal and Child Health Bureau
and coordinated by the National Center for Education in Maternal and Child Health (NCEMCH).
This publication was produced by NCEMCH under its cooperative agreement (MCU-119301)
with the Maternal and Child Health Bureau, Health Resources and Services Administration,
Public Health Service, U.S. Department of Health and Human Services.
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About This Series

The Research Roundtable Series, sponsored by the Maternal and Child Health Bureau (MCHB), disseminates the results of MCHB-funded research to policymakers, researchers, and practitioners in the public and private sectors. The results of these projects influence future service, research, and policy development. The Research Roundtable sessions provide an opportunity for researchers to discuss their findings with policymakers, MCH program directors, service providers, and other health professionals.

The MCHB Research Program is directed by Dr. Gontran Lamberty and administered through the Division of Systems, Education and Analysis, MCHB, Health Resources and Services Administration (HRSA). HRSA is a component of the Public Health Service (PHS), U.S. Department of Health and Human Services (DHHS). The purpose of the MCHB Research Program is to support applied research relating to maternal and child health services that shows promise of substantial contribution to the advancement of these services.

Introduction

Dr. Gontran Lamberty introduced the speakers for the Research Roundtable. Dr. Strobino is a professor of maternal and child health at The Johns Hopkins University School of Hygiene and Public Health. Her research interests include preventive health services use in children, infant and child mortality, and perinatal outcomes. Dr. Strobino has served on the MCHB Research Grants Review Committee and is currently a member of the Expert Panel on Racial Differences in Infant Mortality, sponsored by the Maryland Commission on Infant Mortality. She also serves as a consultant to numerous local and State maternal and child health programs. A past recipient of the National Perinatal Association's Recognition Award and The Johns Hopkins University's Golden Apple Award for Excellence in Teaching, Dr. Strobino received her doctorate in population dynamics from The Johns Hopkins University. Dr. Dawn Misra, a member of the research team, also presented findings from the study.

Dr. Buekens is a professor and chair of the Department of Maternal and Child Health at the University of North Carolina's School of Public Health. Previously, Dr. Buekens was vice president of the School of Public Health at the Free University of Brussels. His research interests include perinatal

epidemiology, evaluation of perinatal services, and minority health. Dr. Buekens has also served as a maternal and child health consultant to the United Nations Fund for Populations Activities, UNICEF, and the World Health Organization. He received his medical and doctoral degrees from the Free University of Brussels and completed his residency training in obstetrics and gynecology at the Saint Pierre University Hospital in Brussels.

Presentation of Research and Relevant Findings

Statement of the Problem

Development of regionalized systems of care has been a major advance in the delivery of perinatal care over the past few decades. Regionalization evolved from the recognition that most births are uncomplicated and that providing care to mothers or newborns who experience severe complications is expensive and requires specialized equipment and personnel. An important component of a perinatal regional system is the transport of women with complicated pregnancies from community hospitals to tertiary centers. Successful perinatal regionalization depends on the appropriate referral and transport of high-risk mothers and newborns, based on knowledge of the effectiveness of intensive care in treating their complications.

There is consensus that maternal transport, when indicated, is preferable to neonatal transport. Hospital stays are shorter among neonates who are transported antenatally than among neonates transported after birth. Moreover, a survival advantage has been reported for newborns transported antenatally to a tertiary center, compared with those delivered in Level I or Level II hospitals. Maternal transport also reduces the risk of separation between mother and newborn.

Although maternal transport has widespread support, the issue of which mothers and their newborns are most likely to benefit from transport remains unclear. The most common indications for transport are preterm labor, premature rupture of membranes, and hypertension of pregnancy. In addition, although women are frequently referred antenatally for treatment of chronic disease, they are most commonly transported for acute conditions. Nevertheless, for most indications of transport (except the delivery of the preterm infant), the benefit of maternal transport for either the mother or the newborn remains unknown.

Research Questions and Hypotheses

The purpose of this study was to evaluate the guidelines for transferring high-risk mothers from community hospitals to perinatal centers. The study used data from a sample of women admitted for labor and delivery in 15 hospitals constituting the Southern New Jersey Perinatal Cooperative (SNJPC). Two major hypotheses were evaluated. First, the transfer of pregnant women to a tertiary center conforms with the recommended guidelines for maternal transport. Second, the transfer of pregnant women is optimal when their newborns are expected to develop complications requiring intensive care, because a tertiary center has the technology needed to manage high-risk infants at birth.

The evaluation of the guidelines for maternal transport represents a significant contribution of this research. As maternal transport has become widespread, the need to establish guidelines within specific areas, apart from the transport of women in premature labor, has become increasingly important. Yet little is known about the full impact of maternal transport, particularly regarding the postpartum health status of mothers with complications and the health status of newborns who were not transported to a facility with the necessary capabilities.

The importance of this research stems from its use in a sizable geographic area of a large population-based sample of all pregnant women who had complications that might lead to maternal

transport. Previous population-based studies were constrained by sample size and limited to transported mothers who delivered the smallest infants. Results of previous studies have been mixed, in part because of potential selection bias in the regions where the studies were conducted.

Study Design, Methods, and Population

This study used a nonconcurrent prospective epidemiologic design. Women in the study were followed from arrival at the hospital to delivery, and newborns were followed via medical records from birth to hospital discharge or death. By design, the study sample was restricted to women at greatest risk for transport. The study sampled all women who (1) were admitted for labor and delivery at the 15 hospitals providing perinatal care in the 7 southernmost counties in New Jersey at the time of the study, and (2) had complications of pregnancy that were likely to lead to transport. These hospitals were part of SNJPC and included a mix of Level I, Level II, and Level III hospitals in rural and urban communities serving mothers and newborns at various socioeconomic levels. A nonprofit network of hospitals, SNJPC was the primary organizational structure coordinating all perinatal services and activities in the area in 1984 and 1985.

All women who were transferred to Level II, Level IIA, and Level III SNJPC hospitals and to some Pennsylvania and Delaware hospitals in 1984 and in the first 6 months of 1985 were included in the sample. Also included were all mothers and newborns who remained in Level I and Level II SNJPC hospitals for delivery and who had complications potentially requiring transport, based on the guidelines for transport developed by the American College of Obstetricians and Gynecologists (ACOG) and the American Academy of Pediatrics (AAP). This sample was identified in two steps, based on detailed labor/delivery and nursery logs maintained at each hospital. First, all mothers with newborns delivered at or before 35 weeks' gestation or weighing less than 2,000 grams at birth were selected, along with mothers who experienced severe complications (e.g., insulin-dependent diabetes or preeclampsia requiring hospitalization during the prenatal period). A second group was identified based on the eligibility criteria for each complication occurring in women with newborns delivered after 35 weeks' gestation and weighing more than 2,000 grams. The criteria included the signs and symptoms of severe cases of each complication.

A total of 278 women were identified as having been transported. Of these, 98 were transported from Level I hospitals, 145 from Level II hospitals, and 29 from Level IIA or Level III hospitals. (No information on the referring hospital was available for 6 of the women.) Data on labor and delivery were available for 239 women, 86 percent of the eligible sample of known maternal transports; 82 were transported from Level I hospitals, 130 from Level II hospitals, and 27 from Level III/IIA hospitals. A total of 1,554 nontransported women were identified as eligible for the study sample. Of these, 307 delivered at Level I hospitals, 658 at Level II hospitals, 176 at Level IIA hospitals, and 413 at Level III hospitals. Data from medical records were available for 1,445 (93 percent) of these women.

The sample for the analysis of the likelihood of maternal transport and for evaluating the effect of transport on postpartum morbidity in the mother was restricted to women who delivered a potentially viable fetus. Excluded from the sample analysis were women with stillbirths (N = 162) or women whose fetus was born too early (before 20 weeks, N = 1) or too small (less than 500 grams, N = 9). For women with multiple births, one of the babies was selected at random to yield only one record for each mother. The resulting sample for analysis included 1,512 women, of whom 228 (15.1 percent) were maternal transports. The analysis of the data on newborns included 1,422 mothers for whom newborn data were obtained, or 94 percent of the mothers with maternal data.

The primary source of data for the study consisted of medical records from the 15 SNJPC hospitals and the hospitals in Pennsylvania and Delaware. Data were abstracted from the records of

mothers and their babies for all study hospitals to which they were admitted during the intrapartum, postpartum, and neonatal periods. The abstracted data included demographic information about the mother, diagnoses and signs and symptoms of the most commonly occurring complications in the mother and newborn, and major procedures or therapies given to the mother or newborn.

The study focused on both the process and outcome of transport. The dependent variable included in the study of the transport process was the likelihood of transport. The transport variable became an independent variable in the study of the appropriateness of transport. The dependent variables in the study of the appropriateness of maternal transport included both maternal and newborn outcomes. Maternal outcomes were length of maternal postpartum hospital stay and presence or absence of significant postpartum morbidity and postpartum infection. Newborn outcomes included 5-minute Apgar scores, resuscitation at birth, length of nursery stay, presence and severity of respiratory distress syndrome, confirmed neonatal sepsis, seizures, intraventricular hemorrhage, necrotizing enterocolitis, and early neonatal mortality.

Among the independent variables, maternal obstetric and medical complications included premature rupture of membranes, preterm labor, maternal hypertension, multiple gestation, third trimester bleeding, diabetes, heart disease, other chronic disease, and maternal infection. Other independent variables included in the analysis were cesarean delivery and demographic and prenatal care variables.

The first step in the analysis involved investigating the variables associated with maternal transport; the analysis was performed separately for each level of hospital. A bivariate association between the likelihood of transport and maternal obstetric complications, medical complications, maternal demographic variables, and the hospital and prenatal care variables was performed first, followed by a multiple logistic regression. The variables defining maternal complications and their severity, gestational age, maternal demographics, and prenatal care use were included in the regression analysis. This analysis was performed separately for Level I and Level II hospitals, and the results of the regression were compared to evaluate possible interactions of the effect of the variables on transport rates by level of hospital.

The first step in the analysis of the impact of transport was a bivariate analysis in which maternal and newborn outcomes were compared between transported and nontransported women. This was followed by a multivariate analysis. Logistic regression was used for the dichotomous dependent variables and multiple linear regression was used for the continuous dependent variables, the same approach as with likelihood of transport. The regression coefficients were compared for Level I and Level II hospitals, with a primary focus on the coefficient for maternal transport.

The final step in the analysis was to evaluate each case with a maternal transport index (MTI). In this analysis, women were assigned an MTI value based on the complications they experienced, and the MTI was related to the odds of mortality in the newborn.

Research Findings

Women who presented at the hospital with early gestation or had preeclampsia, acute bleeding, incompetent cervix (premature dilation of the cervix), chorioamnionitis, or a multiple pregnancy were more likely to be transported from Level I or Level II hospitals than women without these complications. All of these conditions were included in the guidelines. On the other hand, intrauterine growth retardation, diabetes, and other chronic illnesses were not related to maternal transport. The most interesting findings with regard to predictors of maternal transport involved the effects of the source of prenatal care. Independent of their complications, women who received prenatal care from private physicians were less likely to be transported from Level I or Level II hospitals than women who had other sources of prenatal care. This effect was stronger at Level I than at Level II hospitals.

None of the measures of maternal outcomes were related to transport status, with the exception of the mother's length of stay in Level II hospitals. The shorter stays of transported women remained significant, even with adjustment for maternal complications, length of pregnancy, and cesarean delivery.

Maternal transport had a positive effect on 5-minute Apgar scores. Resuscitation scores were significantly higher among transported babies independent of gestational age, suggesting that the technology needed for the newborn of the high-risk mother was made available following maternal transport. However, the positive effect of maternal transport did not extend past the time of birth. Mortality and morbidity rates were no better for infants of transported mothers, and were worse only for infants with respiratory distress syndrome whose mothers had been transported from Level I hospitals.

In general, the study findings support the hypotheses that the predictors of transport conform to the ACOG/AAP guidelines for transport and that differences in transport rates between Level I and Level II hospitals are greatest for women with severe complications. The findings also suggest that improvements in maternal outcomes may be gained with transport of mothers at risk for major complications. For the most part, however, any improvements in newborn outcomes occurred only with regard to 5-minute Apgar scores. Transports did not appear to increase the occurrence of problems in the newborn.

A second implication of the findings relates to the positive effect of transport on maternal length of hospital stay and on 5-minute Apgar scores. These findings suggest that the availability of immediate intensive postpartum care can improve the outcomes of both mother and newborn. The fact that the higher-risk mothers were transported and had outcomes similar to those of nontransported mothers also supports the continued need to utilize the resources of tertiary centers in an area.

The findings that may have the most important policy implications address the selective retention of private patients at Level I and Level II hospitals. For a regionalized system of care to work effectively, there must be cooperation and communication among providers. It is surprising that in an area with a formal cooperative of hospitals working together for the health of the mother and the newborn, such selective behavior was noted.

This population-based study needs to be repeated in a more contemporary population. The issues of managed care and selective retention of patients may be even more pertinent today than in 1984 and 1985. It is difficult to tell from these results whether selective retention may have a negative effect on the mother or newborn.

Reactor Response

Dr. Buekens complimented Dr. Strobino on her research and its contribution to the study of maternal transport. He identified the study's most significant strength as its population-based design. He noted the inherent difficulty in identifying comparison groups and commended the researchers on their efforts to adjust for bias in their sample selection criteria.

In discussing the study's limitations, Dr. Buekens noted that the study design, though unique and important, was very complex. Specifically, he noted that different selection criteria were used for transported and nontransported women. Group 1 included all transported women. Group 2 included women at high risk who were not transported. Of those transported, some may have been transported by mistake; of those not transported, there may not have been time to transport.

Dr. Buekens also noted that the study used different information and timing for the subsamples. Thus, it may be difficult to know whether the groups were comparable. He suggested that an alternative design might identify a population at risk, using one population-based definition

of risk, and look within that group for those women who were or were not transported. He also suggested the use of one time point or starting point (e.g., a multiple pregnancy). Using the same definition of risk and the same time point as a basis, the study would then differentiate between those women who were transported and those who were not.

Discussion

Participant discussion focused on whether women in need of high-risk care are actually receiving such care. One participant mentioned an observational study that examined this issue in geographic areas with a high concentration of managed care versus geographic areas with a low concentration. Participants also discussed the impact of infrastructure and personnel changes within Level I and Level II hospitals and the systems within which they function. Participants shared their insights on the expansion of de-regionalization and the increase in perinatologists and other specialists at Level I and Level II hospitals.

Publications

Strobino DM, Frank R, Oberdorf M, Shachtman R, Kim YT, Callan N, Nagey D. 1993. Development of an index of maternal transport. *Medical Decision Making* 13:64–73.