Research Issues in the Assessment of Birth Settings: Report of a Study

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RESEARCH ISSUES IN THE ASSESSMENT OF BIRTH SETTINGS

Report of a Study
by the Committee on Assessing
Alternative Birth Settings

INSTITUTE OF MEDICINE
Division of Health Sciences Policy
AND
NATIONAL RESEARCH COUNCIL
Commission on Life Sciences

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This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering and the Institute of Medicine.

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Contents

Introduction

The Institute of Medicine (IOM) of the National Academy of Sciences (NAS) collaborated in this study with the Board on Maternal, Child, and Family Health Research of the Commission on Life Sciences of the National Research Council (NRC) to determine methodologies needed to evaluate current childbirth settings in the United States. Although the proportion of nonhospital births runs as high as 4.4 percent annually in Oregon, insufficient data exist to permit complete evaluation of the various birth settings. The application of good research methods should lead to scientific findings that provide the basis for informed, rational decision making about alternative settings for childbirth.

A committee of 11 experts was appointed to review current knowledge, provide background knowledge, and identify the kinds of research designs useful for assessing such matters as the safety, quality of maternity care, costs, psychological factors, and family satisfaction of different birth settings. The committee was also charged with preparing a report that could be used to solicit, evaluate, and fund proposals for studies on childbirth settings. The committee did not design specific studies to be carried out, but rather attempted to point out issues that should be considered by researchers because it believed that the best proposals would arise from investigator-initiated research. Gaps in research could be filled by requests for proposals developed by agency staff and the agency peer review committee. In addition, IOM staff members and several consultants provided background papers for the committee's consideration. The research that results from this report will be useful to policymakers and to consumers searching for information to aid in making decisions about birth settings.

Summary and Recommendations

CHILDBIRTH TRENDS AND STATISTICS

Since the turn of the century the birthplace for children in the United States has moved from the home to the hospital. Less than 5 percent of the babies born in 1900 were delivered in a hospital. By 1940 the proportions had shifted to about 50 percent in each location, and by 1979 hospital deliveries accounted for 99 percent of all births. Much of the impetus for the turnaround in selection of birth sites was provided by the application of expanding scientific and medical knowledge in the field of obstetrics, which led to improvements in techniques and changes of emphasis in maternity care. Beginning with a principal concern that the progress of labor and delivery be made safer for the mother, the medical aspects of obstetrics grew in importance. Later the concern for maternal welfare was broadened to include better relief of pain during delivery, often by the administration of analgesic drugs and anesthesia. More recently, a significant reduction in the neonatal mortality rate has resulted from improvements in maternal and pediatric care.

Improvements in obstetrics have resulted in improved physical outcomes for mothers and babies. From 1955 to 1980 the maternal mortality rate declined from 47 to 7 deaths per 100,000 live births. Neonatal deaths in the same period declined from 19.1 to 8.4 deaths per 1,000 live births.

For a number of reasons, social as well as medical, a new interest has developed in the psychological factors surrounding the birth experience. An increased interest in birth settings other than the conventional hospital one oriented toward treating disease and toward physician management of patients has also developed. The changing social context in which these childbirth interests are expressed includes the advent of the women's movement, consumerism, a desire for a more natural delivery than that associated with medical intervention, and concern about rising health care costs. The effect of this has been a reexamination of obstetrical practices.

During the 1970s there was rising concern that births were increasingly occurring in places other than hospitals. Accurate figures are not available, but it is estimated that between 36,000 and 158,000 babies were delivered outside hospital settings in 1980. Births at home (both planned and unplanned) are now estimated to be about 1 percent of

the total number of births per year, a percentage that has not increased, according to the National Center for Health Statistics. However, the number of freestanding birth centers grew from 3 in 1975 to about 130 now. Birth certificates and related recordkeeping do not usually contain the information necessary to indicate how many babies are delivered in each of the various birth locations. However, a few states (such as Oregon) do have accurate data. In Oregon 4.4 percent of the babies born in 1981 were not born in a hospital (see Appendix F).

THE BIRTH SETTING

Factors contributing to the definition of a birth setting include the recipients of care, its locale, the providers of maternity care, and the practices of those providers. The well-being of mother and baby are the primary concern in any birth setting. Advocates of hospital births express concern for the availability of advanced technological care by skilled practitioners in the event of an untoward event during delivery. Advocates of nonhospital births emphasize the contributions toward maternal and neonatal well-being made by increased family support and participation in the birth, minimal medical intervention, and lower costs.

Maternity Care Providers

Maternity care providers include physicians and a small number of certified nurse midwives. The role and numbers of these two kinds of providers have changed dramatically over the years. In 1910, "granny" lay midwives delivered 50 percent of babies; by 1979, midwives (primarily certified nurse midwives) delivered 1.6 percent. Physicians attended more and more births, delivering 98.1 percent of the babies in hospitals and 34.2 percent of those born elsewhere in 1979. Other health care personnel, such as naturopaths and chiropractors, deliver a very small percentage of babies. Some women, either by choice or circumstance, are not attended at birth by any professionally trained person.

Providers of maternity care agree that identifiable high-risk pregnancies necessitate the use of specialists and advanced technology. There is less agreement on how to define and manage a normal birth. These disagreements are exacerbated by a lack of adequate data on the effects of various maternity care practices.

Delivery Sites

The range of delivery sites includes the home, freestanding birth centers, hospital-based birth centers, and conventional hospital maternity units. These sites vary as to the primary provider of care, use of technology, atmosphere, facilities, and proximity to emergency care. The variation within and among the different sites contributes to the complexity of conducting research in this area and to the difficulty of

following clients across different locations for purposes of full and complete data collection.

Birth Practices

Maternity care practices have changed in recent years and appear to differ in the various birth settings. For example, the frequency of induction of labor rose from 8.6 percent of births in 1967 to 11.8 percent in 1977, and the rate of cesarean section rose from 7.3 percent in 1972 to 13.4 percent in 1977. Practices that are fairly uniform across the different settings include prenatal care and patient education in childbirth and the care of infants. Practices more often seen in hospital settings include protocols and procedures related to the provision of care for high-risk mothers, fetuses, or infants. Practices more likely to be found in the nonhospital settings include participation of the family in prenatal care and at the birth, classes for siblings, and the decreased use of technology and medication during delivery.

APPROACHES TO RESEARCH AND STUDY DESIGNS

The study committee's major task was to consider research designs for the evaluation of birth settings. Certain general approaches--observational and experimental--for designing studies in scientific research were reviewed. Each would be useful in addressing different aspects of research of birth settings, depending on the scope of the investigation and the objectives of the study. The strengths and weaknesses of several different designs and methods for data collection were identified and their use for assessing birth settings reviewed.

Observational Approaches

The committee believes that there is a lack of good descriptive studies on birth settings, especially alternative settings, and that well-conducted prospective descriptive and observational studies, even if without controls, could improve our understanding of the issues and be useful for generating hypotheses for further study.

Experimental Designs

Randomized Clinical Trials The committee determined that randomized clinical trials could be used to study many different techniques, or differences in the birth attendants, in similar birth settings. In the past such trials have been conducted on birth settings to examine the effects of such variables as the position of the mother during delivery, the presence of a supportive lay person during delivery, and the use or nonuse of electronic fetal monitoring. Randomization among sites may not be generally possible, because women choosing to deliver at one

site, or their care providers, may not be willing to be randomly assigned to a different site. However, there may be situations when such randomization is possible--for example, when a woman is of a divided mind or open to randomization to a site offering an approach to childbirth that is similar to that of her original choice.

Prospective Matched Groups Nonrandomized designs are likely to be proposed by researchers studying the impact of alternative birth settings. Although randomized experiments are most desirable for interpreting causal relationships, prospective studies using rigorously matched groups delivering in different settings may provide useful information about the safety and psychological benefits of alternative settings. For example, comparisons could be made among women who have selected particular birth settings, such as a freestanding birth center, a birth room in a hospital, or a tertiary care hospital. Various types of data could be collected before and after the birth. Comparisons could be made of mortality, morbidity, and various psychosocial measures, including anxiety, satisfaction with the care received, mother-infant bonding, and the like. The most obvious problem with this design is the possibility that any differences among the groups can be attributed to selection of different sites by mothers with different characteristics. Regardless of how well the study is planned, this problem may not be overcome. Despite this limitation, however, the committee believes that prospective studies would provide much-needed information on the spectrum of birth settings.

Cooperative Registries A possible way to collect data with which to evaluate different birth settings is to organize groups of hospital and nonhospital birth centers to collect uniform information on each birth at a central data-collection center. Both hospital and nonhospital settings could be chosen so as to represent the major points along the spectrum of birth settings in the United States. The data set should include important prognostic factors so that subsets within the population of mothers and infants could be properly compared. A cooperative registry could eventually result in a data base useful for answering questions on quantitative aspects of birth practices, especially ones that occur very rarely. This would be a major and very expensive undertaking similar to the collaborative perinatal project of the National Institute of Neurological and Communicative Disorders and Stroke (NINCDS) that studied 50,000 pregnancies at 12 different institutions.

Surveillance Methods The greatest utility of surveillance methods has been for situations in which the presence of a single adverse event, for example, the death of a mother during delivery, mandates a chain of public health activities, including review of the case to determine its preventability. Special studies often are added to routine data collection to examine the specific circumstances surrounding a maternal death. Similar types of studies could also be used to evaluate different birth settings.

The routine recording of births and deaths by all 50 states could serve as a useful starting point for analysis of the risks to mother and infant as mediated by place of delivery and provider. In most reporting areas in the United States, documentation of low birth weight or preterm gestation is possible with reasonable accuracy. In some reporting areas, low Apgar scores and complications of pregnancy and labor are recorded. Although not all of these events can be regarded as avoidable, their presence in a planned nonhospital delivery may reflect a failure of the risk assessment screening process. Identified adverse events could be reviewed by a panel of experts to determine the degree of their preventability. Considerable experience has been accumulated in this method of assessment by committees established in every state to investigate the cause of maternal mortality.

The disadvantage of surveillance is that data currently available from vital records do not give specific information on intended place of delivery, actual place of delivery, and birth attendant(s). The committee recommends that such data be recorded on all birth certificates.

Case-Control Studies If counts of the denominator populations are not available, and if events to be studied occur infrequently, one recourse is to match adverse events with control births free of adverse outcomes and investigate the circumstances of the pregnancy. For example, if planned nonhospital deliveries are found more frequently among cases of adverse events than among oontrols, this can be taken as evidence for a differential effect of place of delivery on the adverse event. A retrospective approach is more likely to have confounding elements than the preferred prospective approach, however, and questions will always remain. Nevertheless, a case-control approach may be one of the least costly ways to gain information about very rare events.

RISK ASSESSMENT

Any comparisons of birth settings will need to be carried out carefully because women who deliver in different sites may differ in many characteristics. For this reason characteristics of the study population will need to be carefully described by researchers and any differences controlled for in the study design or analysis. Differences in levels of risk among the women result from the screening process used to increase the likelihood of a normal delivery in a nonhospital setting. Women delivering in a freestanding birth center will have to be compared with similar low-risk individuals delivering in the hospital.

Women who select different settings are also likely to differ with respect to demographic and psychological variables. Therefore, the researcher must direct special attention to assessing psychological variables to assure similarity among groups.

The screening process for determining the potential for complications to develop during pregnancy, delivery, or the neonatal period is called obstetric risk assessment. An understanding of obstetric risk

assessment is essential for conducting research on childbirth settings. Risk status is assessed through a scoring system that assigns pregnancies to various levels of probability of outcome; this measurement of risk provides a probability statement with an error rate. Attempts to improve the precision of obstetric risk measurement are aimed at reducing the rate of error.

Most of the existing risk assessment instruments used for screening pregnant women are based on prediction of perinatal mortality or morbidity. Variables common to most instruments are demographic and socioeconomic and variables based on past pregnancies, past medical history, and present pregnancy. In some of the more recent studies, fetal heart rate and uterine contraction data from electronic monitoring have been included. Further development of risk assessment methods is needed to make them more useful for predicting maternal outcomes and perinatal morbidity and for research on birth settings. Approximately 20 percent of women predicted to be at low risk experience complications that require transfer to a hospital setting during pregnancy or delivery. Approximately 14 percent of women assessed ineligible for delivery in a low-risk setting experience no complications.

Selection of Variables

Investigators should provide detailed statements of how variables are defined and used in their studies. Fetal, neonatal, and maternal deaths occur now with less frequency than in previous decades and can no longer be taken as the sole measure of quality of care. Morbidity is becoming a more frequent measure of pregnancy outcome. Interest has shifted to studying the effects of maternal and perinatal care on such morbidity indices as neurological deficits, developmental problems, and satisfaction with the birth experience. Therefore, outcome measures must be defined for these indices, including the quality of bonding established between parents and infant; "parenting" ability; and the emotional, intellectual, and physical development of the infant. The committee concluded that more research is needed to define outcome measures other than mortality that can be accurately measured for studying birth practices.

RECOMMENDATIONS

The committee concludes that reliable information about the safety and efficacy of different birth settings (see Appendix A), the psychological benefits of different practices (see Appendix D), and the differences in economic costs of the alternatives (see Appendix B) is lacking. Rigorous data will promote informed debate and policy development by advocates of the various settings. Nonetheless, the committee recognizes that many values surround childbirth and that issues and arguments will continue regardless of research and new information.

Although it realized the difficulty of doing research on this topic, the committee identified several approaches that could begin to generate

information. The committee's observations and recommendations are as follows:

- Research into the safety and efficacy of the various birth settings has high priority. Recommended research designs or methods for collecting data (described in detail in Chapter 2) include randomized clinical trials wherever possible to study different techniques or methods used in similar birth settings; prospective matched group or cohort studies of low-risk women delivering in different settings; intensive surveillance methods--for example, surveillance of live births and their complications--together with special data collection and methods of evaluating adverse events; and a registry to collect data useful for evaluating maternity care in a number of different institutions and in different settings. Specific recommendations or caveats about research on birth settings are given in Chapters 2, 3, and 4 of this volume.
- Lack of data has been a major impediment to research in the evaluation of birth settings. Government agencies responsible for designing birth and fetal death certificates should include space for routine recording of the intended and actual site of delivery (e.g., conventional hospital delivery room or alternative birth room, freestanding birth center, planned home delivery, accidental nonhospital delivery) and the precise type of provider (board-certified or certificate-eligible obstetrician, general or family practitioner, certified nurse midwife, midwife with no special training, other individual). Births in freestanding birth centers should not be described as occurring in a hospital. These data will enable investigators to determine the numbers of births planned in different settings, to analyze trends in the choice of birthplaces, and to identify the health care provider. Linked to mortality and morbidity data, this information will be especially valuable for studying birth settings.
- Risk assessment of patients is crucial in determining research population eligibility for delivery in an alternative setting. Most existing risk assessment instruments can predict that a low-risk pregnancy will not result in a perinatal death. More than 98 percent of pregnant women labeled as low risk will have live infants at the end of the neonatal period. These instruments are less accurate for predicting neonatal morbidity. Therefore, a number of women and their infants will need to be transferred to a hospital during labor and delivery. Research to perfect and extend the reliability of risk assessment methods is desirable because accurate screening will minimize the need to transfer mother and child before, during, or after delivery (see Appendix E).
- The lack of sound empirical data about the psychological benefits of one or another birth setting makes it difficult for potential parents and physicians to choose the one most appropriate. Appendix D of this report reviews the literature on some of the psychological aspects of birth and raises methodological issues for consideration by researchers. Priorities in this area are studies of differences in developmental outcomes of the child and parent-child relationships ac-

cording to birth settings. Does one setting foster a closer relationship between parent and child than another?

• Because of the range of settings and the breadth of questions to be answered, the committee urges a multidisciplinary approach and the formation of multidisciplinary teams for research on birth settings. A good research program will require a variety of investigators to assure valid screening and selection of a study population and competent handling of the range of settings and the flow of patients across a system of care. Experts in research design should be a part of such an effort.

1 Basic Concepts and Descriptive Data

Recognizing a need for research on alternative birth settings, the Office for Maternal and Child Health (OMCH) provided a grant in September 1980 to the National Academy of Sciences (NAS), through its Institute of Medicine and Commission on Life Sciences, to undertake a study of methodological approaches for such research. The OMCH supports projects on alternative birth settings but generally lacks data on which to make judgments about the strengths and limitations of various child-delivery facilities. The absence of adequate evaluation data has fueled a growing controversy among the various advocates of particular birth settings regarding a whole range of outcome measures, such as safety, cost, and quality of the childbirth experience. The controversy, OMCH concluded, will abate only with the development of a sound body of data about various aspects of current birth practices, including birthplace. The methodological difficulties in conducting such research, however, are great--thus the request to NAS for guidance on how best to design research directed at increasing the available information on alternative birth settings. The presumption is that good research methods should lead to scientific findings that provide the basis for informed, rational decision-making about various options for childbirth.

In approaching its task the study committee focused on three sets of issues: (1) the provision of background information along with a range of research designs and approaches appropriate to the study of various aspects of childbirth practices; (2) the use of risk assessment and screening criteria and how this affects the choice of a study population; and (3) valid outcome measures--including medical, psychological, and social variables--and ways to study them. These three sets of issues are examined in Chapters 2-4 and are supplemented by papers in Appendixes A-F. The committee did not address economic issues directly, because they were considered to be outside its range of expertise. However, recognizing that cost issues will be an important part of any choice of appropriate maternity care by prospective parents, the committee commissioned the paper that appears in Appendix B.

The committee recognized that the experiences of such countries as Britain and Holland are relevant sources of information about various birth settings and decided that a critical review of this literature would make a valuable contribution. As a first step the committee

reviewed the history of maternity practices in the United States and studied the range of birth settings currently in use, both the physical sites and the typical maternity care providers and practices. Data on trends in childbirth settings were reviewed. The committee recognized that there are many value judgments surrounding childbirth and that questions and arguments will probably continue regardless of new information. This chapter gives an overview of the background and definitions of the birth setting.

HISTORY OF MATERNITY CARE IN THE UNITED STATES

During the nineteenth century in the United States, obstetrics had not yet developed as a medical specialty, and the training of birth attendants was meager. Most deliveries took place at home and were attended by granny (or lay) midwives whose knowledge and experience varied widely. In 1900 fewer than 5 percent of all American babies were born in a hospital. Midwives with little training attended approximately 50 percent of home births; other births were attended by neither physician nor midwife. Controversies surrounding the quality of midwife services helped to bring public and professional attention to the problems associated with inadequate childbirth practices. In one study, midwives in New York City in 1906 were found to be "hopelessly dirty, ignorant, and incompetent" (Edgar, 1911). Laws were passed requiring formal training, licensing, and supervision of midwives, and in 1931 a formal education program for nurse midwives was established in the United States (Lubic, 1980).[1]

At that time, also, training of physicians in birth practices was considered poor, and obstetrics was viewed as the weakest of medical specialties (Flexner, 1910; Williams, 1912).[2] Increased attention to medical intervention in childbirth encouraged the training of more obstetricians and the delivery of more babies in hospitals. Now the role of physicians has eclipsed that of midwives as birth attendants. By 1979 physicians were attending 97.4 percent of U.S. births, primarily in hospitals (Devitt, 1977; National Center for Health Statistics, 1981b), while certified nurse midwives (CNMs) and lay midwives attended only 1.6 percent of all births, about 80 percent of them in hospitals.

Maternity care during the twentieth century has gone through four

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[1]Since 1931 a graduate training program has existed in the United States for training nurse midwives who are then certified by the profession. Lay midwives today often must receive training before they can be licensed by a state.

[2]Numerous articles document the history of obstetric care and the controversy over the variability of childbirth settings in the United States and Europe (Baldock, 1981; DeLee, 1920; Devitt, 1977, 1979a,b; Edgar, 1911; Huntington, 1913; Irving, 1937; Kosmak, 1938; Marlette, 1925; Moran, 1915; Williams, 1912; Ziegler, 1922).

periods of shifting emphasis. At first, concern was focused on the relatively high rates of maternal mortality and on the need to make labor and delivery safer for the mother. Hospitals were opened in rural areas; physicians expanded obstetrical training and research; and many developments in other fields, such as the discovery of antibiotics, benefited maternity care. As a result, the incidence of infection and the complications of bleeding and toxemia were drastically reduced, and maternal mortality rates fell (see Figure 1 and Table 1).

A second phase in maternity care emphasized the relief of pain during birth. Efforts were made to allay maternal anxiety about the labor and delivery process. Advances in analgesia, anesthesia, and psychoprophylaxis were applied to childbirth. Only later was it recognized that some types of anesthesia could adversely affect both mother and infant (Speert, 1980).

For many years the reduction in maternal mortality was not accompanied by comparable improvements in neonatal or infant survival rates (Table 1). Recognition of this discrepancy led to the third, or perinatal, phase of care that has characterized obstetrics for the past 15 years. Technological advances in methods of maternal, fetal, and neonatal surveillance, together with changes in clinical practice, have significantly improved the likelihood that the outcome of pregnancy will be a healthy infant (Chase, 1972; Committee on Perinatal Health, 1976; Lee et al., 1980; Paneth, 1982; World Health Organization, 1970; and Williams and Chen, 1982).

In recent years there has been a resurgence of interest in and emphasis on the effects of psychological factors on the short- and long-term health of mother and baby. This fourth phase of change in obstetrical practice has attempted to provide psychological satisfaction with safe physical outcomes of pregnancy (Ryan, 1981; Stone, 1979). Because a normal pregnancy does not strictly fit the medical model of disease, doubts have arisen about the necessity for conventional hospital care, and interest has developed in alternative forms of care that are believed to provide psychological benefits.

RANGE OF AND TRENDS IN BIRTH SETTING

A wide range of birth settings is available in the United States today. The birth setting is defined by the particular combination of providers of maternity services, the delivery site, the type of equipment, the range of services, and the recipients of care. Birth settings vary because of the philosophies and practices of those who control the childbirth environment. The within-category variation in childbirth practices, providers, and clientele may be as great as or greater than differences between sites. Childbirth practices will continue to evolve, and settings will continue to change, adding to the difficulty of research. In the sections that follow, five principal types of physical sites for childbirth are described, and some summary comments are made about their perceived advantages and disadvantages. Because of the issues raised above, these examples should be viewed as

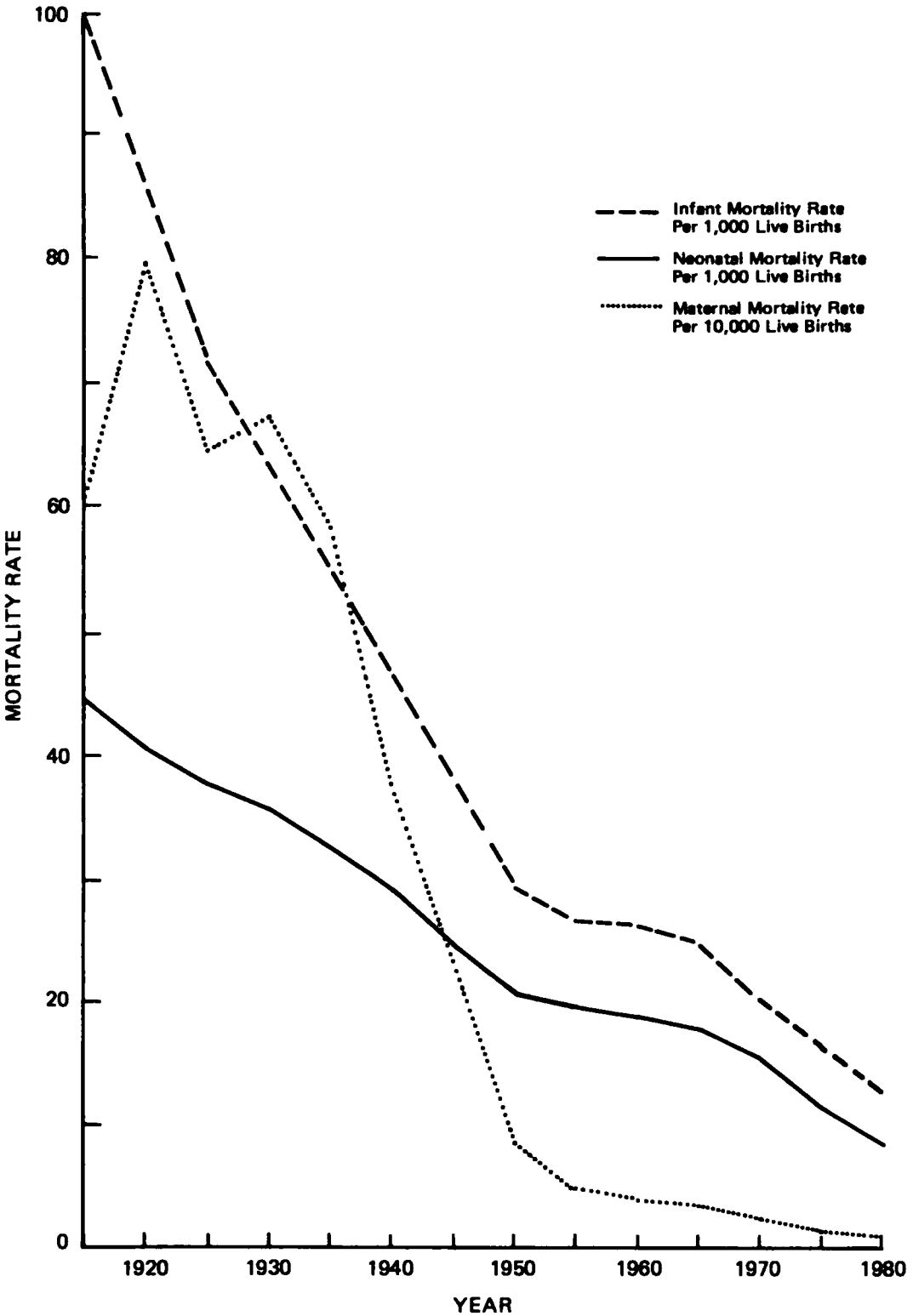

FIGURE 1 Neonatal, Infant, and Maternal Mortality Rates, 1915-1980.

TABLE 1 Neonatal, Infant, and Maternal Mortality Rates by Race, 1915-1980

Year	Neonatal Mortality Rate per 1,000 Live Births			Infant Mortality Rate per 1,000 Live Births			Maternal Mortality Rate Per 10,000 Live Births		
	Total	White	Black and Other	Total	White	Black and Other	Total	White	Black and Other
1980	8.4	N/A	N/A	12.5	N/A	N/A	0.7	N/A	N/A
1975	11.6	10.4	16.8	16.1	14.2	24.2	1.3	0.9	2.9
1970	15.1	13.8	21.4	20.0	17.8	30.9	2.2	1.4	5.6
1965	17.7	16.1	25.4	24.7	21.5	40.3	3.2	2.1	8.4
1960	18.7	17.2	26.9	26.0	22.9	43.2	3.7	2.6	9.8
1955	19.1	17.7	27.2	26.4	23.6	42.8	4.7	3.3	13.0
1950	20.5	19.4	27.5	29.2	26.8	44.5	8.3	6.1	22.2
1945	24.3	23.3	32.0	38.3	35.6	57.0	20.7	17.2	45.5
1940	28.8	27.2	39.7	47.0	43.2	73.8	37.6	32.0	77.4
1935	32.4	31.0	42.7	55.7	51.9	83.2	58.2	53.1	94.6
1930	35.7	34.2	47.4	64.6	60.1	99.9	67.3	60.9	117.4
1925	37.8	36.8	49.5	71.7	68.3	110.8	64.7	60.3	116.2
1920	41.5	40.4	55.0	85.8	82.1	131.7	79.9	76.0	128.1
1915	44.4	N/A	N/A	99.9	98.6	181.2	60.8	60.1	105.6

NOTE: Figures for 1980 are estimates; N/A indicates information not available for that year or category.

SOURCES: National Center for Health Statistics, 1981a; U.S. Department of Commerce, Bureau of the Census, 1975, 1980.

illustrative rather than definitive and are included only to give some feeling for differences.

Home Deliveries

Home births take place in circumstances ranging from no attendant other than family members to an organized home birth service attended by licensed professionals. The circumstances of the delivery are as varied as the home environment. Several reports of existing home birth services cite both the advantages and disadvantages of home births (Adamson, 1981; Adamson and Gare, 1980; Burnett et al., 1980; Cameron et al., 1979; Eischen and Nelson, 1981: Mehl et al., 1977; Stillwell, 1979) (see Appendix A). The advantages include psychological benefits of giving birth in familiar surroundings and supported by family and friends, and lower costs. Standards for the delivery of care in the home have been established by the American College of Nurse Midwives (1980), but many still consider home births unsafe. The lesser ability of home birth attendants to deal with complications and the relative lack of emergency backup are considered major disadvantages.

Freestanding Birth Centers

Freestanding birth centers are facilities separate from hospitals that provide maternity care to those expecting normal childbirths (Bennetts and Lubic, 1982; Lubic, 1980; Lubic and Ernst, 1978). The facilities are customarily managed by nurse midwives and are typically equipped to provide prenatal, peripartum, and neonatal care. Following delivery, families stay in the center for 12 to 24 hours and receive follow-up care in their homes, often by public health nurses. Participating attendants may including obstetricians, certified nurse midwives, nurse midwife assistants, pediatricians, public health nurses, ancillary and support personnel, and families themselves. Freestanding birth centers must meet local health and safety codes and usually have agreements with a laboratory, an ambulance service, and a backup hospital for use as needed by their patients.

Many families feel that there are advantages to deliveries in places other than hospitals (Adamson and Gare, 1980; Bennetts and Lubic, 1982; Eischen and Nelson, 1981; Pragmatics, Inc., 1978; Stillwell, 1979). The advantages of birth in a freestanding center include a recognized standard of care by professional providers, an environment seen as both medically safe and psychologically secure, and a cost less than that in hospitals. Disadvantages include physical separation from emergency personnel and hospital facilities.

Hospital-Based Birth Centers

The hospital-based birth center, an integral part of a hospital's obstetrical service, is designed to provide low-risk obstetrical

patients with family-centered care in a homelike setting. The birth center conforms with the licensing regulations that apply to the hospital itself, but the philosophy of most centers is to provide a more relaxed setting than is present in the conventional obstetrical facility (Barton et al., 1980; Faxel and Keiffer, 1980; Nelson, 1979; Pragmatics Inc., 1978; Schmidt, 1980; Sumner, 1976).

One major advantage claimed for the hospital-based birth center over the freestanding center is proximity to emergency care facilities. Some critics, however, feel that noninterventive, personalized care for a normal birth in such centers is eroded by the proximity of a high-technology setting.

Conventional Hospital Perinatal Units

Modern conventional hospital perinatal units reflect varying degrees of integration of conventional and alternative practices. Present-day practice is moving from the traditional separate labor and delivery rooms to a single room. Immediately after delivery, mother and baby remain together for a period of time. In many hospitals, mothers can opt for "rooming-in" of their babies.

Hospital Maternity Units

The conventional hospital maternity unit consists of discrete labor, delivery, postpartum, and nursery areas. In addition, facilities for dealing with obstetrical complications are located close to these units: high-risk labor rooms, operative delivery rooms, intensive care nurseries, and special maternal recovery rooms. Labor occurs in one room, and the patient is moved to a second room for the actual birth. The infant often is taken immediately to a nursery. Physical facilities and practices tend to separate family members. Advocates of births in places other than hospitals believe that the use of technology and intervention in normal births may lead to iatrogenic disease and complications.

Trends in Delivery in Different Sites

Trends in births in the various birth locations described above are difficult to determine because no reliable nationwide data about birth sites are available. The National Center for Health Statistics (NCHS) has derived data on birthplaces from state birth certificates and designates place of delivery as "in hospital," "not in hospital," or "not specified." Table 2 shows the number and percent distribution for hospital and nonhospital (including not specified) births for selected years through 1979. According to these statistics, there was a steady decrease in the percentage of nonhospital births from 1960 to 1974; the percentage of nonhospital births increased minimally in 1977 and then fell again.

TABLE 2 Number and Percent Distribution of Live Births by Place of Delivery, 1960, 1965-1979

Year	Total Live Births	Hospital		Not in Hospital	
		Number	Percent	Number	Percent
1979	3,494,398	3,460,484	99.0	33,914	1.0
1978	3,333,279	3,300,659	99.0	32,620	0.9
1977	3,326,632	3,277,536	98.5	49,096	1.5
1976	3,167,788	3,123,963	98.6	43,825	1.4
1975	3,144,198	3,104,549	98.7	39,649	1.3
1974	3,159,958	3,133,797	99.2	26,161	0.8
1973	3,136,965	3,114,503	99.3	22,462	0.7
1972	3,258,411	3,233,703	99.2	24,708	0.8
1971	3,555,970	3,523,840	99.1	32,130	0.9
1970	3,731,386	3,708,142	99.4	23,244	0.6
1969	3,600,206	3,566,260	99.1	33,946	0.9
1968	3,501,564	3,449,250	98.5	52,314	1.5
1967	3,520,959	3,459,771	98.3	61,188	1.7
1966	3,606,274	3,534,608	98.0	71,664	2.0
1965	3,760,358	3,660,712	97.4	99,646	2.6
1960	4,257,850	4,114,368	96.6	143,482	3.4

NOTE: Figures for births occurring outside hospitals include cases for which place of delivery was not specified.

SOURCES: National Center for Health Statistics, 1977, 1980, 1981b, 1981c.

The method used by NCHS for classifying hospital and nonhospital births may obscure small shifts in nonhospital births. For example, births in freestanding birth centers are classified by NCHS as hospital births. Yet the number of freestanding birth centers has increased from 3 in 1975 to 130 in 1982 (Lubic, 1982). Also, nonhospital births occur in such diverse locations as doctors' offices, ambulances, public places, and homes. Therefore, these data are unreliable indices for demonstrating trends in planned home births.

Because of inadequacies in the NCHS data, it is difficult to estimate the numbers of births that take place outside hospitals. The Oregon State Health Division reported that 4.4 percent of all registered births in the state in 1981 were outside hospitals (Oregon Center for Health Statistics, 1982). Using the Oregon figure as an upper limit (NCHS indicates Oregon is one of the states with a high percentage of home births) and the NCHS average figure of approximately 1 percent (conceding that this underreports the number of nonhospital births), it can be determined that, out of 3,598,000 live births in 1980, between 35,980 and 158,422 babies were born outside of hospitals. A second estimate can be derived from data on births in hospitals during 1980 (American Hospital Association, 1980). Subtracting 3,408,482 hospital

births from the total of 3,598,000 live births in 1980 yields an estimated 189,518 nonhospital births. Data from the American Hospital Association produce a higher estimate because of the absence of a 100 percent response rate, exclusion of noncommunity hospitals (i.e., federal and other public health facilities), and birth estimates based on data collected for only one-half to three-quarters of the calendar year.

Some states have higher rates of nonhospital births than others (see Appendix F for information from Oregon). Unpublished data from NCHS show that 31 states had more than 100 nonhospital births delivered by physicians and midwives, and 12 states had more than 500 similarly delivered births (Table 3). Washington, North Carolina, Texas, California, and Oregon are recognized by the NCHS and others as having a larger percentage of planned home births than other states (Arms, 1975; Burnett et al., 1980; Dingley, 1979; Shy et al., 1980; Stewart, National Association of Parents and Professionals for Safe Alternatives in Childbirth, personal communication, 1981). Data available from a few states may be useful for documenting trends in nonhospital births. Only 1.5 percent of all births in Oregon in 1974 took place in freestanding clinics, doctors' offices, homes, and other nonhospital addresses. By 1981 the percentage had increased to 4.4 percent (Oregon Center for Health Statistics, 1982).

NCHS is now undertaking a large study that may redress some of the informational deficiencies about birth location. The studies are termed "follow-back" surveys, because they trace information on one or more individuals identified on a vital record, such as a birth or death certificate. They provide the opportunity to collect more detailed information than is available from vital records. Some data on such items as obstetric care, personnel, and place of birth should be available to state and local public health agencies by December 1982 and to the general public by July 1983 (Placek, 1981).

The committee also reviewed related data on the users of the different birth settings, although in general the data on this issue also are inadequate. Some data, particularly for hospital births, are available for characterizing the mother by sociodemographic factors. The 1972 National Natality Survey from NCHS provides information on mother's age and education, child's race, region of residence, family income, and health insurance coverage of women during legitimate live births in the hospital in 1972. The 1980 National Natality Survey also will contain this information (Placek, 1981). Because of the large percentage of births occurring in hospitals between 1972 and 1980, demographic findings related to users of hospital maternity facilities are deemed representative of the U.S. childbearing population as a whole. Bennetts (1981) found that in a case comparison study using 4,790 mothers from the 1972 National Natality Survey as controls, women who went to freestanding birth centers were older (2 percent were 30 years of age or more), more highly educated (most having completed some college), and typically were white (63.1 percent) or Mexican American (33.8 percent).[3]

[3]The percentage of Mexican Americans is so high because this study included one of the largest freestanding birth centers in the country, and that center primarily serves Mexican Americans.

TABLE 3 States with More than 500 Out-of-Hospital Births Delivered by Physicians and Midwives, 1978

State	Total Number of Out-of-Hospital Births Delivered by Physicians and Midwives	Percent Distribution of Live Births by Physicians (Out of Hospital)	Percent Distribution of Live Births by Midwives (Out of Hospital)
New York	721	0.2	0.1
Pennsylvania	549	0.3	0.1
Ohio	868	0.5	0.0 (49)
Illinois	960	0.5	0.1 (12)
North Carolina	573	0.6	0.1
Florida	789	0.2	0.5
Tennessee	703	0.6	0.4
Alabama	863	0.5	1.0
Texas	5052	0.2	1.9
Washington	951	1.0	0.6
Oregon	578	0.7	0.8
California	1978	0.5	0.1

SOURCE: National Center for Health Statistics, 1981, unpublished data.

In her examination of 300 elective home births in the San Francisco Bay area, Hazell (1975) found that about 90 percent of the families choosing home birth lived in single-family dwellings, were white, and the fathers were employed. Usually both members of the couple had attended some college but neither had graduated. Unfortunately, no comparison groups were studied.

MATERNITY CARE PROVIDERS AND TRENDS IN THEIR USE

Physicians--primarily obstetricians, family practitioners, and general practioners--constitute by far the largest group of maternity care providers attending childbirths. In 1979 they delivered 98.1 percent of in-hospital births and 34.2 percent of nonhospital births (National Center for Health Statistics, 1981b). According to a recent Manpower Planning Study (American College of Obstetricians and Gynecologists, 1981), obstetricians attended 81 percent of U.S. births in 1977, family practitioners 6 percent, and general practitioners 12 percent.

The training of these physicians varies from 4 years of postgraduate work for obstetricians to 3 months of training in obstetrics for family practitioners. In 1981 there were 16,000 board-certified obstetricians, 2,600 physicians eligible for certification, and 4,700 residents in obstetrical training. An additional 3,000 physicians called themselves obstetricians but had no special training beyond medical school (American College of Obstetricians and Gynecologists, 1981). Of the 56,200 licensed general practitioners in the United States (U.S. Department of Commerce, 1980), the number practicing obstetrics is unknown. However, isolated data are available. For instance, in North Carolina approxi-

mately 50 percent of the general and family practitioners care for pregnant women and a slightly smaller percentage do deliveries (Pearse, American College of Obstetricians and Gynecologists, personal communication, 1982).

Certified nurse midwives attend about 1 percent of U.S. births (American College of Obstetricians and Gynecologists, 1981). CNMs are registered nurses who have received graduate education for 1 to 2 years in midwifery and have passed a national certifying examination set by the profession. They perform deliveries in all types of birth settings, including freestanding birth centers and conventional hospital units. Approximately 2,500 CNMs have been certified since the founding of the American College of Nurse-Midwives in 1955; about 1,800 practiced midwifery in 1980 (American College of Nurse-Midwives, 1981; Rooks et al., 1978).

Lay midwives, who usually have no formal training, attend home births almost exclusively; there are many practicing lay midwives in Washington, Oregon, Arizona, Texas, Tennessee, and New Hampshire (Stewart, National Association of Parents and Professionals for Safe Alternatives in Childbirth, personal communication, 1982). Lay midwifery practice is illegal in some states and requires licensure in others. Over the years the number of lay midwives has decreased.

Nurses provide most of the intrapartum and postpartum care in hospitals, and some do follow-up home visits after discharge of the mother and child from a freestanding birth center. Nurses often assist physicians at a delivery. There were 1,059,000 registered nurses licensed to practice in the United States in 1978 (U.S. Department of Commerce, 1980). It is not known how many are involved in maternity care.

Other providers of maternity care include naturopaths and chiropractors. Their numbers and training vary substantially. For example, in Oregon, in 1980, 0.6 percent of all births were attended by naturopaths; most of these deliveries were nonhospital ones (Oregon Center for Health Statistics, 1981). Another 0.3 percent of the 1979-1980 births in Oregon were attended by chiropractors (Oregon Center for Health Statistics, 1981). Twenty-five states have specific legislation preventing chiropractors from providing maternity care (Duhart, American Chiropractor Association, personal communication, 1982).

Trends in the birth-attendant(s) aspects of maternity care cannot be accurately determined because of discrepancies and omissions in the available data. For example, if a birth takes place in a hospital, it is often classified as a physician-attended birth, although a midwife or medical student may have delivered the baby. Lay midwives sometimes list themselves as "friends" on the birth certificate (see Appendix F). In some birth settings, physicians routinely sign the birth certificates of certified nurse midwives who attend the entire birth. Obstacles to complete and/or accurate reporting and to participation in research arise from these practices as well as from the legal ambiguity of some nontraditional childbirth attendants and the lack of understanding and trust that may exist among the various maternity care providers.

TRENDS IN MATERNITY CARE PRACTICES

In a 1979 report to Congress, the U.S. General Accounting Office (GAO) defined major obstetrical practices associated with high-risk pregnancies that must be considered in the evaluation of particular birth settings. These practices included medical and/or surgical induction of labor, forceps delivery, vacuum extraction, cesarean section delivery, intrauterine fetal procedures, and the use of anesthesia in spontaneous deliveries.

Other practices that should be considered in research on birth settings include the completion of childbirth and/or parenting education classes, nutritional intake during pregnancy, length of stay, breast feeding, and parent-infant bonding. Many of these practices, despite their widespread use in both low- and high-risk settings, have received only cursory attention by researchers.

Data on trends in the application of various maternity care practices often are difficult to obtain and usually are incomplete (see Table 4 for a preliminary compilation). Data sources reporting specific practices are the National Center for Health Statistics, the collaborative perinatal study sponsored by the National Institute of Neurological and Communicative Disorders and Stroke (NINCDS), the American College of Obstetricians and Gynecologists (ACOG), and the Commission on Professional and Hospital Activities (CPHA) [U.S. General Accounting Office, 1979]. Information from these studies shows that cesarean section rates have increased, induction rates have remained approximately unchanged, and forceps delivery and use of anesthesia have declined. The committee believes that the frequency of fetal monitoring is increasing, although no national data are available to confirm this. Rates of breastfeeding, after a substantial decline, seem to be increasing (see Table 4).

Maternity practices would be expected to differ across birth settings, e.g., freestanding birth centers are for low-risk mothers, and hospital perinatal units are equipped for handling complications in both mother and child. However, adequate data to document the differences are not available (see Appendix C for practices in freestanding birth centers). Furthermore, there will be a great deal of variation across and within settings, contributing to the complexity of research. Two examples--use of anesthesia and breastfeeding--illustrate differences in practices.

From available studies, avoiding of the use of anesthesia in labor appears more common in nonhospital settings, although hospitals appear to be using less anesthesia in labor than they once did. Table 4 has only one row providing comparative information on trends in maternity care practices across birth settings. For freestanding birth center deliveries surveyed by Bennetts (1981), 56 percent of the women received no anesthesia during labor. This figure is higher than the percentages in the larger national samples making up the rest of row 5 in Table 4. However, chronologically, going from the top to bottom lines in the row, a trend toward less use of anesthesia in labor can be discerned. Also, the figures from different large studies seem to correspond (e.g., 7.8 percent and 7.0 percent nonuse of anesthesia from CPHA and NCHS data,

TABLE 4 Trends in Maternity Care Practices: Studies, Sample Size (When Given), Years, and Percent of Sample Receiving Practice

	Sources Cited in U.S. General Accounting Office Study, 1979														Bennetts, 1981; 1972-79 N = 2,000 deliveries in freestanding birth centers	
Procedure	ACOG, 1967; 1967 N = 2,060,440		CPHA (unpublished) 1970 N = 262,000 1977 N = 1,300,000		NCHS, 1972; 1972 N = 2,800,000		NICHD, 1981		NINCDS Niswander and Gordon, 1972; 1959-65 N = 55,908		U.S. Senate Subcommittee Hearings, 1978					
Induction of labor	1967	8.6%	1970 1977	13.0% 11.8%					1959-65	5/10%[a]						
Forceps delivery	1961	34.6%	1977	25.6%					1959-65	57/32%[a]						
Cesarean section			1967 1974 1977	5.1% 9.8% 13.4%	1972 1977 1980	7.3% 13.8% 17.2%[b]	1931-49 1950-68 1965-75	4.0% 3.1% 9.5%	1959-68	5%	1968 1972 1974 1975 1976	5.0% 6.7% 8.7% 9.9% 11.4%				
Anesthesia in labor (use of one or more anesthetics)	1967	80-100%	1970 1977	92.2%[c,d] 81.2%	1972	93%										
No anesthesia in labor (assumes spontaneous deliveries)	1967	0-20%	1970 1977	7.8% 18.8%	1972	7%			1959-66	8/26%[a]					1972-79	56%
Intrauterine fetal procedures[e]			1977	10.4%												

NOTE: Abbreviations are as follows: ACOG, American College of Obstetricians and Gynecologists; CPHA, Commission on Professional and Hospital Activities; NCHS, National Center for Health Statistics; NICHD, National Institute of Child Health and Human Development; NINCDS, National Institute of Neurological and Communicable Diseases and Stroke; N, number of subjects in sample.

[a]Percentages are by race, white and black respectively; percentages not given for total study population.
[b]Obtained by dividing number of cesarean sections performed in 1980 (NCHS, 1982) by number of births in the U.S. in 1980 (NCHS, 1981a). Figures are .651 and 3.598 million respectively.
[c]Rates vary by region of country.
[d]Rates vary by type of patient (e.g. Medicaid recipient or Maternal and Child Health Program participant).
[e]CPHA indicates that these data reflect almost entirely the use of fetal monitoring. A recent report (Council on Scientific Affairs, 1981) cites estimates of use of continuous electronic fetal monitoring during labor as ranging between 60 and 70 percent.

respectively). Data from CPHA in 1977 indicate a jump in the nonuse of anesthesia to 18.8 percent.

Women who deliver in freestanding birth centers appear to have higher rates of breastfeeding. National prevalence data on the practice of breastfeeding is best estimated from the 1965 National Fertility Study (NCHS, 1965) and the 1973 National Survey of Family Growth (NCHS, 1973). These studies indicated a dramatic decline in breastfeeding in the United States from 72 percent of women breastfeeding their first child in 1931-1935 to 29 percent in 1971-1973. This decrease was especially marked among blacks, the poor, and less-educated women. A reversal in this trend was noted by the American Academy of Pediatrics in 1978, when it was found that 46.6 percent of women from all socioeconomic groups delivering in hospitals breastfed their infants (Martinez and Nalezineski, 1979). This finding is consistent with preliminary data from the 1980 NCHS National Natality Survey analysis, which indicates that 45 percent of all childbearing women in the United States used breastfeeding alone on discharge from their care providers. In contrast, in a study of 1,938 women who began labor in freestanding birth centers, Bennetts (1981) found that 79.4 percent used breastfeeding alone on discharge from the freestanding birth center.

PERINATAL REGIONALIZATION

In addition to reviewing different birth settings and the trends affecting them, the committee considered how different settings fit into the current organization of perinatal services and the relevance of such a system for research on this topic.

In 1971 the American Medical Association House of Delegates adopted a statement that urged development and operation of centralized community or regional perinatal programs with physician, government, and public involvement. Other professional organizations, such as the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics, have continued active attempts to improve perinatal outcomes through systematic applications of knowledge and technology, including development of professional standards of care. Since the original proposal for the regionalization of perinatal health care delivery, documentation of the benefit of regionalized care has appeared in the research literature. Debate continues (Sinclair, et al., 1981), but there are certain gains, such as improved survival of low birthweight infants, that can reasonably be attributed to better perinatal health care delivery (Lee, et al., 1980; Paneth, et al., 1982).

Perinatal regionalization is a systems approach that defines care in terms of a continuum for a specific geographic and demographic area. Perinatal care has been subject to some of the most structured and complete planning in the United States, with much of the country at least nominally involved in a systems approach. Three levels of care described in Toward Improving the Outcome of Pregnancy (Committee on Perinatal Health, National Foundation-March of Dimes, 1976) form the basis for most perinatal systems currently in existence. Simply stated,

Level I care is envisioned as occurring wherever hospital birth occurs. Care is available for uncomplicated obstetrical events, but hospitals at this level should be able to detect high-risk patients as early as possible and to provide emergency care. Level II care should be available at hospitals able to provide all services of Level I plus care for most of the complicated obstetrical difficulties and for certain neonatal illnesses. Level III care should be able to cover all types of obstetrical, fetal, and neonatal problems in addition to providing teaching, evaluation, and research services. Level III centers serve as referral tertiary care centers for 8,000 to 12,000 births annually.

Perinatal health care planners view the levels and units within a given region and the regional systems themselves as interdependent or linked. Risk identification, movement of patients to locations with appropriate resources, and outcome are important concepts that depend upon linkage for implementation of solutions. Lowering rates of mortality and morbidity has been given high priority. This effort has emphasized ready employment of technological advances, many of which have become available in routine hospital and office practice (Philip et al., 1981; Wallace, 1978). Although systematic regionalized perinatal care does manifest concern for interpersonal dimensions of human experience, it does so in a less uniform fashion than it does for technological innovation. For example, in perinatal planning little attention has been directed to other than hospital-based births. Although most plans do not summarily exclude alternatives, they do not respond readily to the needs and desires of individual clients or their families when a nonhospital birth is proposed. Integration of services has varied widely in different regions, depending on many factors.

THE BIRTH SETTING CONTROVERSY

Because of the variety of birth sites, personnel, and practices, controversy continues over which arrangements are desirable for childbirth. At present, opinions about various alternatives tend to cluster in groups favoring "conventional" or "alternative" obstetrics.

In the "conventional" practice of obstetrics, the health professional is a physician who has a direct, guiding relationship with the patient and makes appropriate decisions about her care. Technological advances such as anesthesia, analgesia, and electronic fetal monitoring are typical elements of care, and the hospital is usually the preferred site of birth. Conventional obstetrics tends to emphasize such practices as:

- procedures to deal with group risks such as infection
- monitoring fetal and neonatal well-being
- hospital atmosphere, with nearness to equipment, use of technology

In the "alternative" practice of obstetrics, the health provider may be a certified nurse midwife or physician or other practitioner with a relationship to the patient that emphasizes choice on such

matters as the birth environment and location. Technological advances are considered important when warranted, but they may be viewed with skepticism or avoided. Homes, birth rooms in hospitals, and free-standing birth centers are locations associated with alternative settings. Most alternative locations depend upon hospital back-up systems when an emergency arises.

Practices more likely to be associated with alternative settings include:

- homelike atmosphere for birth
- individual choice of activity for the laboring mother, e.g., walking, eating, etc.
- family participation and control in the birth process

The "alternative" movement has already caused a reexamination of conventional obstetrical practice and some resulting changes. Both factions place high value on such basic issues as the safety of the mother and child, good prenatal care, childbirth education to increase a laboring woman's comfort and decrease her use of anesthesia and analgesia, encouragement of breastfeeding, and education about infant care.

Unfortunately, the absence of adequate data on a whole range of issues associated with birth settings makes it unlikely that the controversy will ease in the immediate future or that parents can make informed choices about the setting best for them.

The committee commissioned a review to assess the literature on the safety of nonhospital birth settings (Appendix A). The review makes it apparent that the literature is insufficient for a conclusive determination of whether safe, appropriate care can be provided in unconventional settings. Risks are neither clearly identified nor quantified. There are no good comparative studies; the number of subjects studied is small and the studies are poorly controlled. In fact, there is little, if any, objective evidence about the advantages or disadvantages of any birth setting (Adamson, 1981), or whether low-risk pregnancies managed in unconventional settings have outcomes that are worse, the same, or better than outcomes in traditional hospital practices. As Adamson and Gare (1980) have stated, the "lack of data has been a major factor preventing effective and reasoned dialogue among health professionals and lay people, especially those holding widely divergent views."

In scientific and lay discussions on aspects of childbirth settings, clear distinctions have not always been made among the various maternity care practices, personnel, and places. Evidence of beneficial or detrimental effects of one compared with another can be statistically unreliable or anecdotal. In addition, assertions based on unreliable research have made their way into discussions and policy statements with seemingly little follow-up evaluation.

The controversy over various types of maternal and child care, the lack of available data, the interest among recipients of care in alternative settings, the declining fertility rates (Figure 2 and Table 5), and the competition among providers for this "market" indicate that

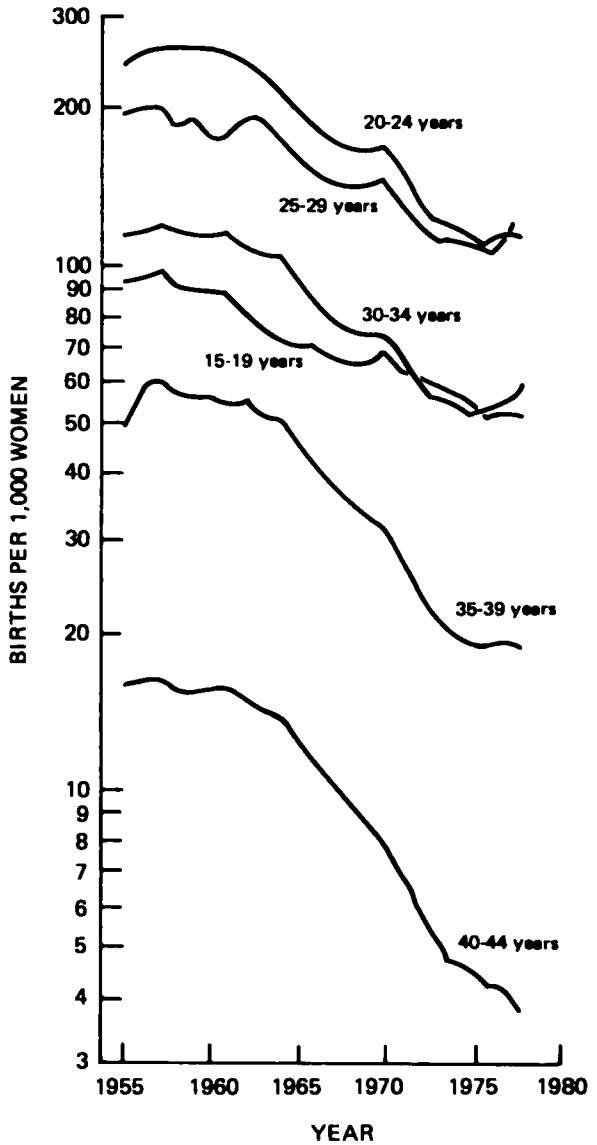

FIGURE 2 Age-specific birth rates: United States, 1955-78.

SOURCE: National Center for Health Statistics, in press.

research into the safety, efficacy, psychosocial value, and costs of the various alternatives is urgently needed. Such research would assist prospective parents to choose the most suitable birth setting and also would provide policymakers with information for making decisions about allocation of resources for maternity care.

The committee recognizes the difficulties of doing good research in this area. Issues of psychological health and satisfaction will be hard to quantify in persuasive ways. Furthermore, the large number of birth setting combinations of providers, locations, and practices add to the difficulties of generalizing any results to other settings. The confounding influence of the regional perinatal system, in which patients are transferred from one setting to another, means investigators will have to keep track of clients across settings. They will have to deter-

TABLE 5 Live Births, Crude Birth Rates, and Births per 1,000 Women by Age of Mother, According to Race: United States, Selected Years 1950-1978 (data are based on the national vital registration system)

Race and Year	Live Births	Crude Birth-Rate[a]	Live Births per 1,000 Women by Age of Mother							
			10-14 Years	15-19 Years	20-24 Years	25-29 Years	30-34 Years	35-39 Years	40-44 Years	45-49 Years
Total										
1950	3,632,000	24.1	1.0	81.6	196.6	166.1	103.7	52.9	15.1	1.2
1955	4,097,000	25.0	0.9	90.3	241.6	190.2	116.0	58.6	16.1	1.0
1960	4,257,850	23.7	0.8	89.1	258.1	197.4	112.7	56.2	15.5	0.9
1965	3,760,358	19.4	0.8	70.5	195.3	161.6	94.4	46.2	12.8	0.8
1970	3,731,386	18.4	1.2	68.3	167.8	145.1	73.3	31.7	8.1	0.5
1975	3,144,198	14.8	1.3	56.3	114.7	110.3	53.1	19.4	4.6	0.3
1977	3,326,632	15.4	1.2	53.7	115.2	114.2	57.5	19.2	4.2	0.2
1978	3,333,279	15.3	1.2	52.4	112.3	112.0	59.1	18.9	3.9	0.2
1979	3,473,000	15.8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1980	3,598,000	16.2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
White										
1950	3,108,000	23.0	0.4	70.0	190.4	165.1	102.6	51.4	14.5	1.0
1955	3,485.000	23.8	0.3	79.1	235.8	186.6	114.0	56.7	15.4	0.9
1960	3,600,744	22.7	0.4	79.4	252.8	194.9	109.6	54.0	14.7	0.8
1965	3,123,860	18.3	0.3	60.6	189.0	158.4	91.6	44.0	12.0	0.7
1970	3,091,264	17.4	0.5	57.4	163.4	145.9	71.9	30.0	7.5	0.4
1975	2,551,996	13.8	0.6	46.8	109.7	110.0	52.1	18.1	4.1	0.2
1977	2,691,070	14.4	0.6	44.6	109.8	113.8	56.3	17.8	3.8	0.2
1978	2,681,116	14.2	0.6	43.6	106.3	111.1	57.9	17.6	3.5	0.2
1979	n/a									
1980	n/a									
All Other										
1950	524,000	33.3	5.1	163.5	242.6	173.8	112.6	64.3	21.2	2.6
1955	613,000	34.5	4.8	167.2	281.6	218.2	132.6	74.9	22.0	2.1
1960	657,106	32.1	4.0	158.2	294.2	214.6	135.6	74.2	22.0	1.7
1965	636,498	27.6	4.0	138.4	239.2	183.5	113.0	62.7	19.3	1.5
1970	640,122	25.1	4.8	133.4	196.8	140.1	82.5	42.2	12.6	0.9
1975	592,202	21.2	4.7	108.6	143.5	112.1	59.7	27.6	7.6	0.5
1977	635,562	21.9	4.3	102.4	145.7	116.5	64.8	27.5	6.9	0.5
1978	652,163	22.1	4.1	99.1	145.7	117.3	66.7	27.0	6.5	0.4
1979	n/a									
1980	n/a									
Black:										
1960	602,264	31.9	4.3	156.1	295.4	218.6	137.1	73.9	21.9	1.1
1965	581,126	27.5	4.3	144.6	243.1	180.4	111.3	61.9	18.7	1.4
1970	572,362	25.3	5.2	147.7	202.7	136.3	79.6	41.9	12.5	1.0
1975	511.581	20.9	5.1	113.8	145.1	105.4	54.1	25.4	7.5	0.5
1977	544,221	21.7	4.7	107.3	147.7	111.1	58.8	25.1	6.6	0.5
1978	551,540	21.6	4.4	103.7	147.5	110.6	59.6	24.0	6.0	0.4
1979	n/a									
1980	n/a									

NOTE: Data are based on births adjusted for underregistration for 1950 and 1955 and on registered births for all other years. Figures for 1960, 1965, and 1970 are based on a 50 percent sample of births, for 1975-1978, they are based on 100 percent of births in selected states and on a 50 percent sample of births in all other states. Beginning in 1970, births to nonresidents of the United States are excluded.

[a]Live births per 1,000 population.

SOURCE: National Center for Health Statistics, 1981a.

mine how to handle births in which labor is conducted in a nontraditional setting and/or is managed by someone other than a physician until a complication occurs, after which the mother is transferred to a hospital and the delivery is completed by a physician. It will be very difficult to muster a powerful, well-controlled study to determine conclusively if one birth setting is incrementally more or less safe than another. Nevertheless, the committee believes research can illuminate some of the issues and provide information to make better decisions about maternal and child care.

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2 Research Strategies for Assessing Childbirth Settings

This chapter reviews general research designs and indicates the particular strengths and weaknesses of several of them. Investigators should consult available texts on research design for more exhaustive treatments of research methods (e.g., Campbell and Cook, 1979; Campbell and Stanley, 1963; Cochran and Cox, 1957; Hicks, 1973; Spector, 1981; Susser, 1973; Winer, 1971). (Appendix D discusses some of the methodological issues concerning the assessment of psychological variables and identifies a number of gaps in information.)

Whatever design is used, the committee believes that assessment of the safety and efficacy of birth settings should receive priority in research. Also important is an assessment of the psychological benefits of one birth setting versus another.

A research strategy consists of three elements: the research design (randomized or nonrandomized), the type of data collection (prospective or retrospective), and the methods of analysis. The first two elements are discussed in this chapter. The choice of the strategy reflects the scientific questions to be answered and the extent to which an investigator can intervene in a continuing process. Several strategies exist for planning experimental and observational investigations, ranging from designs in which investigators have control of most of the variables to designs in which the investigator cannot specify all of the conditions.

Often the choice of a study design is dictated by the circumstances in which data are collected. Ordinarily the data may be collected prospectively or retrospectively. The term "prospective" indicates that data will be collected specifically for the purposes of the study in question; the term "retrospective" means that the data for the study will be obtained from one or more existing data sets. One of the main distinctions between prospective and retrospective data-gathering systems is that the prospective data collection can be specially designed and implemented to relate directly to specific hypotheses. In contrast, retrospective studies attempt to make use of data already collected, generally for other purposes.

Nearly all phenomena have variables[1] that affect the outcomes (see Chapter 4). For example, birth weight, social class, mother's

[1]A variable is a characteristic whose value can change from subject to subject. Anything that can be measured, counted, weighed, or

age, and parity are important variables affecting perinatal mortality (see Table 1). These factors must be accounted for when comparisons are made of subjects, to reduce the effect of prognostic factor bias. Biases can be reduced by the specific study designs (Cohen and Cohen, 1975; England, 1975; Hayden et al., 1982; Lancaster, 1974; Lilienfeld and Lilienfeld, 1980) and by statistical methods, such as regression models, logistic and loglinear models, and proportional hazard models (Breslow and Day, 1980; Draper and Smith, 1966; Marsden, 1981).

DESCRIPTIVE AND OBSERVATIONAL STUDIES

In some situations all the conditions under which the study is to be conducted cannot be specified. Nevertheless, it may be possible to learn much about a process by using an organized system of data collection.

The committee distinguished between descriptive studies that rely on available data and observational studies where new data is collected. The most common types of descriptive studies in maternity care are based on collections of vital statistics undertaken by federal and state health agencies. These vital statistics are important in documenting trends and in supplying ideas for further investigations.

The application of statistical methodology to vital statistics can result in the identification of important associations between population characteristics and the occurrence of disease. However, because most collections of descriptive data are not organized to answer specific scientific questions, caution must be exercised in their use. For example, if the data come from many different states, care must be taken to ensure that the same definitions are used by all states. Nevertheless, studies based on descriptive data have been and will continue to be important sources of information in the social and health sciences (Williams, 1979; Williams and Hawes, 1979; Williams and Chen, 1982). Proper attention to data quality and to the inclusion of potentially relevant variables is necessary for adequate research design.

In contrast to a descriptive study that relies on vital statistics, an observational study is one in which an organized system of data collection is introduced to examine some specific features of the phenomenon under study. For example, Lubic (1980) determined the outcome of clients in a freestanding birth center in New York City. Table 2 traces a population of 1,965 women from their initial appearance at an orientation session at a freestanding birth center to delivery by 455 of these women at the center. Careful prospective but uncontrolled observational studies of this type can make valuable contributions to understanding aspects of a birth setting and its problems.

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scored--a property, a characteristic, an event, an effect, an object--may vary from subject to subject in the same group or in the same subject at different times and under different circumstances. (See Chapter 4 for more details.)

TABLE 1 The Effect of Prognostic Factors on Perinatal Mortality

Factor	Maximum/ Minimum[a]	Comparison Groups
Birth weight	23	Less than 2.5 kg; greater than 2.5 kg
Social class	5	Unsupported mothers; social class 1
Age of mother	2	35+; 20-24
Parity	2	4+; 1

[a]Ratio of perinatal mortality rates by extremes of values within variables.

SOURCE: Chamberlain et al., 1975.

RANDOMIZED EXPERIMENTAL DESIGNS

When comparing alternative treatments or methods in a controlled study, it may be possible to assign the treatments or methods such that each subject has the same opportunity to receive any of the treatments under investigation. Assignment of treatments or methods to subjects is usually accomplished by the mechanism of randomization (Zelen, 1974). The role of randomization is to make the groups receiving the different treatments "alike on the average." Because any known or unknown factors that may affect the outcome are distributed randomly, interpretation of the outcome is usually unambiguous (Byar et al., 1976). Such experiments are called randomized clinical trials (Gore, 1981a,b,c,d). However, they sometimes present difficulties in execution. These difficulties may involve ethical issues associated with choosing treatments by chance, complicated logistics introduced by the randomization mechanism, the need for patient consent when human beings are involved, and the unexpected refusal of patients or physicians to agree to receive or administer the randomly assigned treatment. Sometimes these problems can be anticipated and minimized by the experimental design (Gehan and Freireich, 1974; Simon, 1979).

The use of randomized allocation rules to compare different birth sites may be difficult if it is necessary for the prospective mother to be assigned to a center or hospital that is different from the preferred place of delivery. It does not seem likely that a prospective mother or her physician would consent to enter a study wherein delivery would take place in a site that neither she nor her physician would prefer. Nevertheless, because randomization is an optimum way to study interventions, opportunities for randomization of women to different birthplaces should be sought. Examples of such opportunities are (1) when a prospective mother is of a divided mind about two different birth sites or (2) when the women choosing home births may be willing to be randomly assigned to a home-like birth room in a hospital.

Use of randomization may also be feasible when different technol-

TABLE 2 Patient Outcomes and Flow of Patients at a Freestanding Birth Center

Number of mothers who appeared for physical screening: 1,166.
(101 women deemed ineligible for participation in study.)[a]

Number of eligible patients: 1,065.
(167 women were still pregnant and awaiting delivery in the program at time of report publication; 42 women had spontaneous abortions, and 109 women withdrew or transferred.)

Outcomes of the 747 eligible patients:

189 women were antepartum transfers. Reasons for antepartum transfer included obstetrical problems (134 cases), such as ruptured membranes with no labor in 12 hours, nonvertex presentation, premature labor, and post datism; other pathophysiologic problems (40 cases); and circumstantial (15 cases). Two families whose labors were managed entirely in hospitals experienced neonatal death.

103 women were intrapartum transfers. Reasons for intrapartum transfer included delay in labor (56 cases), hypertension (16 cases), meconium staining (14 cases), prolonged second stage of labor (10 cases), nonvertex presentation (5 cases), fetal brachycardia (4 cases), and no fetal heart tones (2 cases). Of these women, 27 had cesarean sections.

455 women gave birth at the center.

Patient transfers among the 455 freestanding birth center deliveries:

7 women were postpartum transfers. Reasons for transfer included retained placenta (2 cases), irregular vital signs (2 cases), labial hematoma (1 case), inspection and repair under general anesthesia (1 case), and hypertension (1 case).

11 infants were transferred to the hospital. Reasons for transfer included mild respiratory distress (6 cases), birth weight less than 2,500 grams (3 cases), appearance of clinical postmaturity (1 case), and question of sepsis (1 case). One infant experienced sudden death, in the second day of life at home.

[a]Reasons included pathophysiological problems determined by examination (41 cases) or by history (35 cases), nonpathological problems (23 cases), and circumstantial or not specified (2 cases).

SOURCE: Lubic, 1980.

ogies or methods are being studied within the same birth center. There are a large number of studies that have effectively employed such designs for study of a particular maternity care practice. For example, randomized clinical trials have been conducted to examine the effect of such variables as the position of the mother during delivery (Humphrey et al., 1973), the presence of a supportive lay person during delivery (Sosa et al., 1980), use of electronic fetal monitoring (Haverkamp et

al., 1976, 1979; Kelso et al., 1978; Renou et al., 1976; Langendoerfer et al., 1980), whether the mother received "extra contact" with the infant (Kennell et al., 1974; Ringler et al., 1975) or "rooming in" (Greenberg et al., 1973), the timing of initial contact between infant and mother after birth (Hales et al., 1977), and whether the initial contact was with a wrapped infant or was "skin-to-skin" (Curry, 1979). One study compared the Leboyer method (an approach to birth that employs a specific technique to minimize a neonate's first separation experience) with a control group of mothers giving birth in the same hospital without this method (Nelson et al., 1980).

MATCHED GROUPS

In many investigations where randomization is not possible, the use of the matching method can reduce or eliminate prognostic factor biases. The subjects assigned to the treatment group are "matched" to nontreated control subjects individually in terms of prognostic factors. A variant of matched groups that is widely used in epidemiological studies is the retrospective case-control study (Hayden et al., 1982). These are especially useful when attempting to associate the occurrence of a rare disease with a causal factor. There are many variants of matched group and case-control designs, all of which share the objectives of reducing biases arising from prognostic factors.

Although the most common use of matched groups is in instances for which the data of both groups is retrospective, it is also possible to conduct a study in which the matching is done initially and the data collection is prospective. One problem with matching is that it is difficult to match on more than a few variables unless one has a large pool of control patients. However, this problem may be resolved through the use of statistical procedures.

Prospective studies using carefully matched groups of women who deliver in different settings could be used for assessing birth settings. Both selection bias and bias in obtaining information would need to be considered by researchers when matching groups of women. However, the committee recognizes that is difficult, perhaps impossible, to eliminate bias completely when using this research approach. Women who self-select nontraditional birth care services may have characteristics that are different from other women, and the difference may not be accounted for when matched on demographic and health/obstetrical history variables classically associated with outcomes of pregnancy. Almost all prospective or retrospective studies will have to rely on data collected by those providing care to the subject mothers. Differences in training of the care providers, as well as different conceptual approaches to childbirth, will affect the data collected. Despite these problems, studies with rigorous prospective monitoring of planned deliveries in different sites could begin to provide essential data on the safety of care. Furthermore, such studies are less costly than some other approaches. Study of psychological variables using this approach could also begin to provide information on the benefits of different settings. At least two prospective studies are in progress (see Appendix A).

Case-Control Studies

In case-control studies (Hayden et al., 1982), a group of individuals, all of whom were subject to the event under study, are matched with a control group chosen from a pool of individuals who did not experience the event. One or more individuals in the control group are matched with each case on known prognostic variables (age, sex, etc.). Analysis is made of the frequency of the hypothesized causal factor among cases and controls. If planned nonhospital delivery is found more frequently among cases than among controls, for example, this may be taken as evidence for a differential effect of place of delivery on the adverse event.

Case-control studies may be one of the least costly ways of examining factors associated with events of low frequency. However, findings may be distorted by bias in the way cases are selected or by the way information is obtained or collected. Both of these biases are especially problematic in research on birth settings where patients themselves select specific settings and when different providers (who have their own biases) collect the information.

Case-control studies should be viewed, for general assessment purposes, as a secondary option. However, this method may be useful for certain unusual outcomes. For example, if an outbreak of staphyloccocal infection in neonates that results in hospitalization is recognized in a community, it could be useful to match such cases to infants free of the disorder and compare the birth locations of each group.

SURVEILLANCE METHODS

Another promising research strategy is to have a surveillance mechanism that monitors adverse events as they occur, so that corrective action can be taken. In its simplest form, surveillance means maintaining a count of certain predesignated events (Rutstein et al., 1976). This count may, in itself, be of interest, but more usually it serves as the starting point for more intensive investigation. Its greatest utility is in situations in which the presence of a single adverse event mandates a chain of public health activities, as, for example, in the presence of an infectious disease.

An example of surveillance is the Abortion Surveillance Program of the Centers for Disease Control (Centers for Disease Control, 1979, 1980; Cates, 1982; Cates et al., 1978). Most state health departments require the reporting of an induced abortion. Hence, with the use of an appropriate denominator population (e.g., the number of women in certain age groups), it is possible to calculate the relative frequency and characteristics of induced abortion in the United States overall, as well as by geographic area. Similarly, vital statistics data can be used to obtain counts of maternal deaths. When combined, these two frequencies can be used to obtain maternal mortality rates associated with abortions of different kinds, at different gestations, etc. In a direct analogy to birth practices, the Abortion Surveillance Branch of the Centers for Disease Control has been able to examine the effect on

maternal mortality of abortions performed in and out of hospitals (Grimes et al., 1978).

Special studies often are added onto the routinely collected data of surveillance studies to examine, for example, the specific circumstances surrounding maternal death (Cates and Jordan, 1979) or the effect of abortion-restricting legislation on abortion-related complications (Cates et al., 1979). Another use of the surveillance mechanism is to detect geographic and temporal clusters of adverse events. These can often point the way to specific problems in the system under surveillance (Centers for Disease Control, 1980).

ASSESSING ADVERSE EVENTS

Comparisons of different birthplaces, birth practices, maternity care providers, and populations all rest on a system of measuring the frequency of adverse events. Moreover, a judgment must be made as to whether the adverse event could have been avoided through some intervention or change in the birth setting. The suggestions that follow are frameworks for these kinds of comparisons; the method of choice largely depends on the nature of the available data. For example, in the absence of denominator data (a count of all deliveries at several delivery sites), case-control methodologies or perinatal audits may be the only feasible options. Given the availability of denominator data, a range of opportunities for assessment appears. The discussion that follows deals with the identification of adverse events and their use in evaluating birth settings.

A convenient and practical way of classifying adverse events is by three categories of data that document the events: adverse events documentable through vital statistics data alone, adverse events requiring the collection of special data, and adverse events whose definitions are based on expert opinion.

Use of Vital Statistics

The routine recording of births and deaths in all states of the United States can serve as a useful starting point for analysis of risks to mothers and infants as mediated by place of delivery and care provider. Events universally recognized as adverse and routinely recorded on vital certificates include maternal and perinatal deaths. In most reporting areas in the United States, documentation of low birth weight or preterm delivery is possible with reasonable accuracy. In some reporting areas, low Apgar scores and complications of pregnancy and labor are recorded. Although not all of these events can be regarded as avoidable, their presence in a planned nonhospital delivery may reflect a failure of the screening process (see Chapter 3).

The vital record data can be used to refine the definition of an adverse event, so as to obtain a better sense of the need to follow up the event to find an assignable cause. For example, death from labor asphyxia in a term baby weighing more than 2,500 grams with no reported

anomalies might be considered evidence of lack of optimum application of available resources.

It is unlikely, however, that vital statistics data by themselves would be sufficient for a rigorous and fair analysis of rates of avoidable adverse events. At best, they can provide early warning signals, the starting point for more detailed study in a system of surveillance. The use of birth weight standardization for purposes of comparing perinatal mortality rates is appealing (Paneth, 1982), but it is likely that the number of deaths found in comparisons of birth locations will be too small to make standardized rates meaningful.

Maximum utility of vital certificates will be achieved only if circumstances of delivery are clearly definable.

Collection of Relevant Special Data

The limitations of vital statistics data argue for considering procedures for systematically obtaining data on the circumstances of delivery and the postnatal complications of mothers and children. Birth certificates are completed as close to the time of birth as possible, and later morbidity data for mother or child cannot be obtained from such a source. Birth certificates are a poor source of information on congenital malformations because many of these disorders are not manifest at the time the certificate is filled out.

One way to monitor complications is to monitor adverse events in a community at large, for example, hospitalizations for infections of infants in the first three months of life. These complications could be linked with birth settings. No present surveillance mechanism exists for such phenomena, but hospital discharge summary data could be used as a basis for such surveillance, as it is for congenital malformations (Edmonds et al., 1981).

Use of Expert Opinion

In this system, adverse events (deaths, serious illness, etc.) would initially be signaled by examination of vital statistics data. The events would be reviewed by a panel of experts to determine the degree of preventability of the event in question. Their assessment would be based on a review of the medical chart, autopsy report, laboratory findings, and any other pertinent information. The initial signaling event would be agreed upon in advance, but the assessment of preventability would be based on expert judgment (Rutstein et al., 1976). Considerable experience has been accumulated in this method of assessment, initially with maternal mortality committees (Grimes and Cates, 1977) and, more recently, with groups performing "perinatal audits" (Mersey Region Working Party on Perinatal Mortality, 1982).

One advantage of monitoring adverse events by such a procedure is that they may be interpretable without reference to a denominator population. The simple presence of any preventable adverse event may be taken as evidence of the need for improvement in that birth location, regardless of the number of such events.

Adverse Events that Reflect Failure of Risk Prediction (Screening)

A general assumption underlying the discussion of alternate birth settings is that planned nonhospital deliveries will be carefully screened beforehand to select only low-risk mothers. Thus, certain kinds of deliveries at planned nonhospital locations attest to a failure of the screening process, e.g., low birth weight newborns, and deliveries by mothers with hypertension or diabetes. These kinds of events are easily detectable using most present birth certificate systems, as long as the planned delivery site can be ascertained.

Certain methods of obtaining information on adverse events have been detailed above. However, the relationship of these adverse events to place of delivery must be based on calculation or estimation of rates for such events at various delivery locations. Direct calculation of rates requires data on the total number of deliveries from which these adverse events arise, i.e., data on the denominator population.

As discussed in Chapter 1, available vital statistics do not give a reliable count of the number of deliveries in the different delivery schemes because state birth certificates generally do not contain provision for place of intended delivery. Most certificates do note whether the delivery was in a hospital; however, the hospital category includes births at freestanding birth centers and deliveries recorded as nonhospital ones include unplanned deliveries in many diverse locations (taxi, home, street). These vital statistics are biased toward prematurity, because the frequency of precipitate deliveries is inversely related to gestational age. Unplanned nonhospital delivery also may be related to lack of prenatal care and/or nonacknowledgment of pregnancy. For all of these reasons, perinatal mortality rates for nonhospital deliveries are invariably higher than for hospital deliveries (Burnett et al., 1980).

Assessment of rates of adverse events by birthplace would be greatly assisted by the incorporation into birth certificates of data that would clearly distinguish planned from unplanned nonhospital deliveries. A strong case can be made for recording planned nonhospital deliveries as a data item on all birth certificates. The data would be especially useful when combined with data on the training of the attendant at delivery, a variable now recorded in many states. If this information were available, it would be relatively simple to combine counts of adverse events, however determined, with the population at risk and thus to generate rates for such events at different delivery places. Such recordkeeping would allow for another objective of surveillance: monitoring of the frequency and characteristics of planned nonhospital deliveries, which at this time is not possible.

COOPERATIVE REGISTRIES

Another approach to obtaining data for the evaluation of different birth settings is to organize groups of hospital and nonhospital birth centers that will cooperate in submitting data to a central collection center. The aim of such a cooperative registry would be to collect

uniform information on all births. Eventually, a data base could be built that might answer questions on the quantitative aspects of birth practices. Because all states require the submission of birth information, both hospital and nonhospital settings are familiar with routine recordkeeping functions. Expanding the routine recordkeeping activities can provide a research data base that has uniform definitions and adequate quality-control checks. Information from a variety of birth centers could be collected, which would permit an evaluation of various birth settings. Furthermore, the data could include important prognostic factors, so that subsets within the population of mothers and infants could be compared properly. The drawbacks of this approach are that very large samples would be required to study rare events of interest. A registry would require much planning and standardization of collection procedures, which would be costly. Also, it would take a long time to accumulate and analyze the data. And since birth practices are changing so rapidly, the results might be outdated by the time they became available.

The formation of a cooperative registry would require selecting a range of birth settings. In effect, a cooperative registry was the method of the Collaborative Perinatal Project of the National Institute of Neurologic and Communicable Diseases and Stroke (NINCDS), which studied 50,000 pregnancies at 12 institutions between 1959 and 1966 (Niswander and Gordon, 1972). Another such effort is the Obstetric Statistical Cooperative formed by several Brooklyn hospitals in 1950 that has now accumulated a sufficiently large population so that rare malformations can be studied (Stein et al., 1982).

SUMMARY

The committee concludes there are a number of different research designs that can be used to study alternative birth settings. The frequency of the outcome chosen for study will determine to a large degree the research strategy. A very rare event will require very large sample sizes and may only be feasible to study by a surveillance, registry, or case-control approach. Because of continued controversy and the growing number of different birth settings, the safety and efficacy of these settings is a high-priority matter for research. Recommended research designs or methods for collecting data include randomized clinical trials wherever possible, matched groups or cohort studies of low-risk women delivering in different settings, and surveillance of live births and their complications together with special data collection and methods for evaluating adverse events. Other possible approaches are establishing a registry in order to collect data for evaluating maternity care in a number of different institutions and settings and case-control studies of adverse events.

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3 Risk Assessment

A woman's eligibility to remain in a particular birth setting through delivery is contingent on safety considerations, partly defined by an assessment of obstetric risk. Some birth centers automatically eliminate a prospective mother if a certain characteristic, such as high blood pressure, is present. Others rely on a score derived from a combination of characteristics. It is important that investigators understand risk assessment, because it determines the population eligible to deliver in a given setting and thus the populations available for study. The different ways in which such assessments are applied means that comparisons among settings must be made with care to ensure matched groups.

Obstetric risk assessment instruments are described at some detail in this chapter and in Appendix E. Much of the controversy surrounding childbirth settings would no longer exist if it were possible to predict with certainty that a low-risk woman or her fetus would experience no complications when delivering in a nonhospital setting. Research is needed to develop more accurate risk assessment instruments: While most instruments are useful for predicting neonatal mortality, they are less useful for predicting neonatal morbidity or maternal complications.

OBSTETRIC RISK ASSESSMENT

A typical risk assessment scoring system is based on variables associated with the occurrence of complications or adverse outcomes of pregnancy or childbirth. Nineteen risk assessment instruments are reviewed in Appendix E. They use different methodologies and scoring systems. Three instruments used most frequently to assess risks in women and their neonates are:

1. The Maternal-Child Health Care Index of Nesbitt and Aubry (1969) with the Labor Index of Aubry and Pennington (1973), which uses 50 factors for assessing risks in women.
2. The Antepartum Fetal Risk Score of Goodwin et al. (1969), which uses 21 factors for assessing risks in women.
3. The Problem Oriented Perinatal Risk Assessment System (POPRAS) of Hobel, et al. (1973) or its modification (Sokol, et al., 1977), which uses 91 factors to assess risks in the woman and 35 factors to assess risks in the neonate.

Measurement of Risk

Measurement of risk provides a probability statement with respect to a future event. The choice of an appropriate risk assessment instrument from among the many available instruments should be based on how accurately it identifies the level of risk for particular subjects to be enrolled in a study (see Table 1). This accuracy can be evaluated by determining the instrument's level of validity (defined as the ability of a test to measure a condition truly present). The sensitivity and specificity of the instrument are two indicators of its validity.

Sensitivity is an indication of a screening method's ability to identify correctly those patients with a given disease or condition. Among those with the disease, a very high proportion will be scored as "positive" on the risk instrument if the instrument is sensitive. Thus, the proportion of predicted perinatal deaths actually occuring to mothers who were classified as "high risk" is the sensitivity of the risk assessment method for the outcome: perinatal death. Those cases of perinatal death in which the mothers were labeled "low risk" are false negatives. The false negative rate is one measure of predictive inaccuracy and the insensitivity of the risk assessment method.

Specificity is an indication of the screening method's ability to identify correctly those patients without the condition. Among those free of disease, if a high proportion are labeled as low risk by the risk assessment instrument, then the test is highly specific. Thus, the proportion of live births whose mothers were labeled as low risk is a measure of specificity. Those live-born infants whose mothers were labeled as high risk are false positives. Thus, the false positive rate is a measure of the nonspecificity of the test.

The ability of the risk assessment instrument accurately to predict the eventual outcome is called the predictive value. Women are assessed as being at high risk with no certain foreknowledge of the actual outcome, so that accuracy must be estimated from previous use of the instrument. The predictive value of high-risk assignment measures the percentage of those subjects in the high-risk group who experience complications.

In assessing risk for alternative birth sites, the percentage of women assigned a low-risk score who subsequently experience complications is important. Most existing risk assessment instruments show good ability to predict that a low-risk pregnancy will not result in a perinatal death: More than 98 percent of women classified as low risk will have live infants at the end of the perinatal period. (See references and the last column of Table 2 in Appendix E for percentages of low-risk women associated with subsequent perinatal deaths.)

The risk assessment instrument must clearly differentiate between high- and low-risk groups and should achieve a sensitivity of 80 percent, an acceptable minimum according to Richards and Roberts (1967). Assuming that 5 percent of a population is at high risk, the occurrence of an outcome must be 16 times higher in the high-risk group than in the low-risk group before the sensitivity of the high-risk assessment can reach 80 percent. As an example, the Apgar score (Apgar, 1953) indicated that 6 percent of newborns were at high risk. The death rate

TABLE 1 Validity Measures of Screening Tests

Risk Assessment Result	True Disease Occurrence: Diseased Persons	True Disease Occurrence: Persons Without Disease	Totals
High risk	With disease and with high risk assignment (true positives)	Without disease but with high risk assignment (false positives)	All persons labelled as "high risk"
	A	B	A+B
Low risk	With disease but with low risk assignment (false negatives)	Without disease and with low risk assignment (true negatives)	All persons labelled as "low risk"
	C	D	C+D
Totals	Total number of diseased persons	Total number of persons without disease	
	A+C	B+D	

SOURCE: Adopted from Wilson and Junger, 1968.

for the high-risk group was 4 percent, versus 0.1 percent for the low-risk group. Hence, the death rate was 40 times higher for the high-risk group. The sensitivity of the score was 92 percent. Many current risk assessment methods are not as successful as the Apgar score in differentiating high- and low-risk groups for some specific neonatal outcomes.

Selection of Variables for Obstetric Risk Assessment

Variables common to most risk assessment instruments include demographic and socioeconomic data, data from past pregnancies, past medical history, and present pregnancy. In some of the more recent studies, fetal heart rate and uterine contraction data from electronic monitoring are included (see Appendix E, Table 1). Some variables are good predictors of more than one adverse outcome, e.g., some of the same factors that predict low birth weight also predict neonatal mortality.

Because decisions on the type of care to be provided during pregnancy and delivery usually are made prior to labor, most risk assessment instruments include variables that apply only to the prepartum period.

Only a few instruments contain sections to assess risk during labor and childbirth (Aubry and Pennington, 1973; Hobel et al., 1973). Nonetheless, the information collected before delivery can be used to evaluate the need for transfer of patients to settings that can provide care for severe complications. In designing or using a risk assessment instrument, it is important to know when selected data will be obtained (i.e., when during pregnancy, labor, or postpartum) because the prediction of risk can be altered according to the time the measurement is taken.

The decision about comprehensiveness of a risk assessment instrument cannot be isolated from the total study design nor from the place and practice in which the instrument will be used. The number of items included in a risk instrument is frequently of concern to researchers because more items to measure may mean more time spent on each subject. Furthermore, the total number of variables included is not always indicative of accuracy. Probably the minimum set of factors are those used by Goodwin et al. (1969). The sensitivity for neonatal mortality achieved by this measure has ranged from 46 percent to 86 percent depending on the study reporting it; the specificity of the measure has an even broader range (15 percent to 82 percent). The percentage of low-risk women who experience a neonatal death is very low (0.2 percent).

The Hobel et al. (1973) method includes the greatest number of factors to measure; it has a specificity of 48 percent and sensitivity of 59 percent. The percentage of low risk women experiencing a neonatal death is also very low (0.3 percent). It should be noted that Hobel's method can be used as the patient's medical record.

Each of the variables included in a risk assessment instrument has some association with the outcome of interest, the strength of the association differing among variables. Low birth weight, for example, is more strongly associated with neonatal mortality than is maternal education. In an aggregation of variables to predict the occurrence of neonatal mortality, the birth weight variable should therefore be given more emphasis (weight) than should maternal education. A synopsis of methods used for weighting risk factors is in Appendix E, Table 1.

Weighting the Variables

Once women are assessed for risk, several options are available for weighting risk variables. The weights of all characteristics can be summed (Apgar, 1953; Goodwin et al., 1969; Hobel et al., 1973; Nesbitt and Aubry, 1969). The sum may indicate the level of risk or it may be subtracted from a perfect score, perhaps 100 as used by Nesbitt and Aubry (1969). Second, one can use a multivariate technique for scoring (Butler and Alberman, 1969; Chik et al., 1979; Hobel et al., 1979; Larks and Larks, 1968; Rantakallio, 1969; Stembera et al., 1975). Last, one might calculate odds ratios and then multiply them (Fedrick, 1976).

Assignment of Risks

Two methods are frequently reported to assign risks: (1) predetermined cut-points, and assignment of the woman as "yes or no" high risk, or (2) a continuous score with a probability statement attached to the score. It is important to choose the score that will designate points at which each risk level begins or ends, i.e., the "cut-points," although risk is a probability statement and, therefore, a continuous variable. For example, if a soore of 10 is chosen as a cut-point, women classified above that point are at risk while those below it are not at risk. The predictability, sensitivity, and specificity of the instrument are regulated by the cut-points used to classify a woman as high risk, i.e., the score at which risk levels shift from low to high. The cut-points for declaring risk level are important and, ideally, should be derived for each population to be studied.

Two populations with different demographic characteristics may require different cut-points for accurate declaration of high risk. An illustration of this is the black and Hispanic population studied by Winters et al. (1979) using the Hobel instrument. When the cut-point for high risk is a score of 10 or more, which is what Hobel et al. (1973) employed, 95 percent of the group was labeled high risk. A cut-point of 40 or more points yielded 41 percent as being high risk. The sensitivity for a cut-point of 10 was 100 percent, while the sensitivity for a cut-point of 40 in this population was 52 percent. The original sensitivity ascertained by Hobel et al. (1973) at a cut-point of 10 in a California population was 37 percent.

Researchers using similar instruments should be aware that shifting cut-points from study to study decreases the comparability of studies of different groups. There are several examples of this in Appendix E, Table 2. Nesbitt and Aubry (1969) classified scores of 0-70 as high risk and achieved 43 percent sensitivity for perinatal death. Wilson and Sill (1973) used the same instrument but changed the scoring to 0-40 for high risk and showed only 6 percent sensitivity. Hebb et al. (1980) used the Goodwin et al. (1969) instrument with a score of 4+ indicating high risk and found 86 percent sensitivity, while Morrison and Olsen (1979) had a sensitivity of 70 percent, using a score of 3+ to designate high risk.

Examples of predetermined cut-points abound (see Appendix E, Table 1). Hebb et al. (1980) employed a summed score and decided that a woman with a score of 4 or more was at high risk of perinatal mortality; those with lower scores were not at high risk. Variables making up the score were weighted from 0 to 10. The disadvantage of this method is that two women, each with a composite score of 5, may have very different profiles in terms of the variable values affecting their scores. One woman may have a single characteristic weighted by 5 (which is a moderately severe weighting) while the other may have five characteristics each weighted by 1 (the score for a relatively unimportant factor). The attending physician may respond to the condition of each woman in a different way, but the composite score identifies both women as being at equal risk. In practice, a woman with a score of 20 may be regarded by a physician as being at the same risk as a woman with a score of 5.

Examples of use of continuous scores are less frequently found. Several authors (Donahue and Wan, 1973; Hobel et al., 1979; Larks and Larks, 1968; Rantakallio, 1969) used multivariate scoring, but some, like Hobel et al. (1979), revert to using preestablished cut-points when classifying the women. Others maintain the continuous scores and establish percentage level cut-points: Rantakallio (1969) classified those scoring 50 percent or more as being at high risk for perinatal death; Donahue and Wan (1973) used the upper 25 percent of the distribution of multivariate scores to designate high risk. Multivariate techniques tend to standardize weighting and scoring for each population to which an instrument is applied. Cut-points on the distribution can be similar, e.g., using the upper 25 percent of the distribution.

Preassigned weighting systems such as that of Nesbitt and Aubry (1969) can be employed to assign probabilities to each score; a more customized score for each woman may be achieved. Hobel (1979) discusses the use of such a scoring method and presents an example that can be calculated on a hand-held calculator.

Collecting Information

When conducting studies using obstetric risk assessment, the instrument for assigning risk should be a standard one that is applied uniformly at predesignated periods during pregnancy. It should be used by trained observers and tested before use so that results are similar among different observers and among multiple observations by the same observer. The procedures for conducting these analyses should be detailed by the investigator.

Most risk instruments necessitate direct observation of the woman and a few require that she be interviewed. Both observation and interview need to be conducted in a standardized manner. These methodologies are well developed and can be profitably used by researchers. Decision making about the presence or absence of a characteristic also must be standardized.

The level of risk assigned is critical in separating the women at high risk of maternal difficulties from the women at low risk. The lack of reliability resulting from nonuniformity in the collection of data at different times or across different cases can seriously compromise the findings of a study. Because these instruments are currently used in many freestanding birth centers to admit prospective parents into the program, investigators will have to ascertain which instrument is being used. A large number of false negatives occuring in groups assigned a low-risk score could lead to incorrect conclusions about the childbirth setting under study.

There should be provisions in the research design for handling changes in risk status during pregnancy. Some criteria should exist for changing the birth setting when risk factors are detected after original assignment. A study proposal should state how women will be followed through changing risk status and from one institution to another to assure complete collection of information.

Selection of a Risk Assessment Instrument

Decisions about the appropriate instrument and how to use it will depend on the purposes and design of research. The factors said to be measured by the chosen instrument should have a demonstrative association with the outcome being investigated.

The Hobel record (1976) is by far the most comprehensive obstetric risk assessment instrument. It also differs from many others in that it serves as the medical (obstetric) record for the patient. The information on weights and scoring is integrated into the patient record system, not collected separately. Most of the other risk assessment instruments are independent data collection systems. They are usually added to existing record systems for special purposes.

Occasionally biochemical tests and fetal monitoring are used in conjunction with risk assessment instruments. Appropriate use of these additional indices as successful predictors requires detailed knowledge and a thorough understanding of the implications of the results. Fetal monitoring, together with risk assessment methods, appears to increase specificity but not sensitivity. Fetal monitoring does not appear to decrease the false negative rate, which is one of the major concerns in risk assessment.

The outcome variables of interest should be considered when selecting an instrument (see Chapter 4). Although most reported instruments have a scoring system based on the occurrence of neonatal mortality, maternal complications are frequently considered as outcome variables in research on childbirth settings. Examples of maternal complications might include infection, hypertension, multiple pregnancy, abnormal presentation, failure to progress in labor, second state arrest, postdates, and meconium staining. Examples of neonatal complications might include respiratory distress, infection, low birth weight, birth injury, or prolapsed cord. (For a more complete listing, see Table 1 in Chey et al., 1976.) The risk instrument that contains factors and weights derived from data and literature and that is designed to focus on neonatal (or perinatal) mortality may have lower sensitivity when predicting morbidity (complications).

In general, false negative rates produced by risk assessment instruments are high. In Table 2 of Appendix E, for example, columns labeled "fal-" provide percentages of false negatives in studies reporting neonatal complications, low birth weight, or perinatal mortality outcomes. More than 20 percent of women or their infants experiencing undesirable outcomes typically have been assigned to a low-risk group. (See columns labeled "% low risk with problem" in Table 2, Appendix E.) Few existing risk assessment instruments achieve 80 percent sensitivity in predicting perinatal mortality. (See the heading "Perinatal Death" in Table 2, Appendix E, and compare, for these studies, the percentages under the column "sens," the sensitivity of the screening tool.) Those that do achieve this level of sensitivity are the Goodwin et al. instrument as used by Hebb et al. (1980) and Hobel's instrument as used by Sokol et al. (1977). Because most risk assessments will probably be performed in the prenatal period, provisions must be made for identifying women whose risk level may change during pregnancy or women who may

develop unanticipated complications in labor and delivery. A procedure will be needed for documenting such occurrences in a study and for handling them in the research analysis.

False positive rates present another research problem. It has been shown that 14 percent of low-risk women transferred from alternative birth facilities to other facilities because of predicted complications did not experience any complications (Bennetts, 1981). It is important to document the occurrence of falsely assigning women to the high-risk category.

LIMITATIONS OF CURRENT INSTRUMENTS

Current risk assessment instruments employ one set of weights for all mothers, regardless of the major demographic factors of age, ethnic group, and socioeconomic group. Yet there probably are group differences in responses to problems identified by risk factors. Separate weighting and scoring systems for each age group, ethnic group, and socioeconomic group might improve predictability but may not be feasible to put into practice. More research is needed in this area.

The same scoring system is used for primagravida and for multigravida women. A large part of most scoring systems depends on past pregnancy history to predict untoward events in the pregnancy. Therefore, the risk scores are not as good at predicting some problems among primagravida women (Fedrick, 1976).

There is evidence that the weights assigned to risk variables may require changes over time, even within the same population. Hobel (1979) reports detecting a change in the strength of the association of some variables with mortality between 1973 and 1979. This is another topic on which research is needed.

Weighting of factors is problematic because there is no "pure" measure of risk. We can never know the true rate of occurrence of disease related to a particular factor because, once a problem is detected, treatment occurs that may lessen the association between factor and disease. This means that all scores and cut-points are based on imperfect knowledge.

The risk inherent in the group may not apply to an individual because risk factors themselves (and weights for them) are derived from population or grouped data. Thus, clinical judgment is appropriate in determining treatment for an individual woman, and the risk assessment approach can be a useful adjunct. For research purposes, however, a risk assessment instrument is a more standardized method than clinical judgment for selecting groups of women with similar risks.

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4 Variables

Variables important in choosing a study population were described in Chapter 3 in connection with obstetric risk instruments. Furthermore, Chapter 2 pointed out how prognostic factors had to be carefully matched in research designs to ensure reliable conclusions. This chapter describes variables of interest to researchers assessing birth settings. It also reviews methodological issues that arise with the measurement of variables and the collection of data. The committee was able to develop a list of variables that might be considered in the study of birth settings and to develop several approaches for their conceptualization. However, it became clear that more research is needed to develop accurate outcome measures other than mortality. The single exception may be Apgar (1953) scores, which can be easily and readily measured at the time of delivery.

SOME GENERAL OBJECTIVES IN MEASUREMENT

A variable is a characteristic whose value can vary from subject to subject. Anything that can be measured, counted, weighted, or scored--a property, a characteristic, an event, an effect, an object--may vary in value from subject to subject in the same group, or for the same subject at different times and under different circumstances. Examples of variables include things like age, race, blood pressure, weight, and Apgar scores. Variables may be quantitative or qualitative; their measurements will yield either discrete or continuous score values. The strength and magnitude of the relationships among variables of interest are used by investigators to describe and understand a problem as well as to draw inferences and conclusions.

Independent variables are those thought to exert an influence on some outcome. Dependent variables show an effect or a change when the independent variables are manipulated. Variables can have different functions depending on what the investigator wishes to study. One investigator's dependent variable may be regarded by another investigator as an independent variable, according to each hypothesized chain of effects. In research, it often occurs that other factors, e.g., background, intervening, or confounding variables, exert an influence on the relationship between an independent and a dependent variable.

Their potential for influencing any observed associations should be kept in mind (Rosenberg, 1968).

Attention will be given in this section to issues important in measurement, including assurance of reliability and validity, standardization of measurement, and selection of variables. More detailed and extensive consideration of these general issues is available in many texts on research methodology and statistics, such as those by Campbell and Fiske (1959), Duncan et al. (1977), England (1975), Kerlinger (1973), Lancaster (1974), Miller (1981), Rosenberg (1968), and Selltiz et al. (1976).

STANDARDIZATION OF MEASUREMENTS

To study differences among birth settings, care should be taken to standardize measurements so that experimental conditions are similar for all groups. With standardized conditions, the effects of extraneous variables are apt to be cancelled out. Standardization implies that written procedures exist for making measurements in the same fashion every time by all investigators. The investigator should describe how variables will be measured, the nature and use of the equipment for measurement, how data is recorded, the execution of the study, and the skills and training of staff (see Appendix E). Investigators may either follow established procedures or create new ones, but clear and exact explanations of what will be done will help ensure that the study is carried out as intended and that it can be replicated by others.

Some variables have uniform definitions, e.g., age, educational level, and birth weight. If, however, such variables are defined in a different manner from their definition in existing literature, explanations must be given to support the need for this difference, because comparison of data between the proposed research and existing literature might be made more difficult. Often, commonly used variables are assumed to be defined similarly, but this assumption may be misleading. Parity, for example, can be defined either to include only live births or to include all births, live or stillborn. The differing definitions could lead to differing results. The need to state criteria for variable definition is particularly great for newly created variables.

RELEVANT EXAMPLES OF PROGNOSTIC VARIABLES

Race, maternal age, parity, socioeconomic status, and medical obstetric risk level are well known influences on the outcome of pregnancy. Other variables, such as personality characteristics, attitudes, health behavior, and beliefs may also be important determinants of outcome. For example, Fullerton (1981) found a more positive attitude toward choices in childbirth and a greater desire to control their own health care among women who chose a nonhospital birth experience than among those who chose to deliver in the hospital. Specific psychosocial variables

relevant to pregnancy outcomes have not yet been identified; studies to develop reliable and valid measures for these characteristics are needed (Yang, 1981).

Variables known to affect outcomes may be used in selecting comparison groups. In some research designs, study and comparison groups should be similar on known sociodemographic, medical-obstetric, and psychological characteristics. Selection bias can affect study results because individuals with specific characteristics may be included in the study while those without the characteristics are excluded. Self-selection is one of the most difficult problems in research on alternative birth settings and may be hard to overcome.

RELEVANT EXAMPLES OF OUTCOME OR DEPENDENT VARIABLES

Pregnancy outcome traditionally was measured by late fetal, neonatal, and maternal mortality. But those events have become so rare (with rates generally lower than 5 percent) that they no longer can be the only measure of quality of care. Morbidity is becoming a more frequent measure of pregnancy outcome. Morbidity is reported either as a cumulative score reflecting the total number of morbid conditions in the mother or infant, or as the incidence of selected individual morbid events.

Some types of morbidity, such as infections in mother or infant, birth injuries, neonatal asphyxia, or excessive jaundice, can reflect the quality of care. Others, such as the incidence of prematurity and some congenital malformations, are largely beyond our present ability to prevent. Indicators of potentially dangerous morbidity may vary between two institutions primarily because of the availability of tests to measure those conditions rather than because of varying quality of care or varying incidence. For example, hypoglycemia and hypocalcemia in the neonate may be related to the quality of care insofar as they could have been prevented or detected and properly treated. However, their incidence may also reflect a more active approach to neonatal management or the more ready availability and use of laboratory investigations. Because of differences in access to diagnostic procedures, care must be taken to evaluate whether reported selected conditions are truly different in incidence or only reflect laboratory testing.

Because interest has shifted to the effects of maternal and perinatal care on psychosocial parameters, efforts are needed to develop good outcome measures. Some short- and long-term possible topics for study include parent satisfaction with the birth experience; the quality of bonding established between parents and infants; "parenting" ability; and the emotional, intellectual, and physical development of the infant. It is not known at present whether any relation exists between maternity care and these or other similar outcomes. Hypotheses in regard to such associations need to be developed and tested, and appropriate measurements have to be developed. If such relationships are demonstrated, these outcomes could be used as complements to morbidity for evaluating the quality of maternity care.

TIME AS A VARIABLE

In research involving pregnancy and childbirth, the recognition of time as a variable deserves special attention. Variables such as risk assignment, presence of anxiety, or high blood pressure may change over the course of pregnancy and childbirth. Gestational age can act as a potential confounder to the number of prenatal visits. Study objectives reflecting an awareness of these temporal factors may require long-term follow-up to assess outcomes.

VARIABLES OF PLACE, PRACTICE, PROVIDER, AND RECIPIENT

Variables can be categorized according to the topics or concepts addressed as part of the research. One grouping pertinent to childbirth settings consists of four categories: place, practice, provider, and recipient of care. Place of birth variables describe the building, surroundings, atmosphere, equipment, and supplies that make up the environment where birth occurs. Provider variables describe physical, psychological, professional or technical training, and social aspects of the persons who give care to the childbearing family. Practice variables describe the organization, policy, and activities occurring in the setting. Examples of practices would include whether episiotomies are performed, whether fathers are allowed in the delivery room, the client's length of stay, and the extensiveness of childbirth education. Variables for recipients of care could include aspects of the biology, demography, or psychology of the study group. The fourfold categorization of variables here is meant only to be illustrative, not exhaustive.

SELECTION OF PLACE VARIABLES

The variables chosen to describe the place of birth follow from the study objectives or hypotheses, the design of the study, and its location. The physical surroundings and atmosphere of the birth site can affect how individuals or groups react to their experiences. Variables might include size of building and rooms, interior design, availability of parking, the client's perception of the atmosphere, cleanliness, and staff behavior.

The presence or absence of the equipment and supplies used in childbirth could be recorded and quantified. These facts usually determine the complexity of cases or the emergencies that can be handled at the facility. For childbearing families, this information can serve to alleviate or to produce anxiety. For researchers, information on the amount and type of equipment is most useful when there are accompanying data pertaining to practice.

The geographic location of the birth place in the community can provide information about distance from backup facilities, residential areas, and neighborhood ambiance. Variability in access to birth locations between and within studied groups might suggest explanations for subtle differences in outcomes.

Some provision should be made to measure factors known to affect use of services, e.g., distance to service, transportation availability, and fee scales, because these factors affect behavior toward a service. Every service appeals to a particular clientele, and these preferences should be documented. Use of a certain facility may be limited to individuals with special characteristics (such as high-risk or low-risk mothers). Such documentation by the investigator is important because it greatly influences the ability to make valid comparisons.

SELECTION OF PROVIDER VARIABLES

The physical, psychological, social, and behavioral aspects of providers are important factors in the interaction between the service and the client (Danziger, 1978). Provider training, skills, and experience affect both the care of the clients and the basic philosophy with which providers approach clients. For example, information on provider gender, ethnic group, social class, level of support to the mother, and disposition may be as important to collect and analyze as information on number of years of provider training and on number of deliveries attended. Selection of variables will depend on the types of providers chosen for study.

SELECTION OF PRACTICE VARIABLES

Choice of childbirth practice variables to be included will depend on the study, the place, and the provider. Generally, information on such activities and on aspects of care given should be collected. It is possible that some of these activities will be manipulated as part of the study design, but other variables may impinge on the manipulated activities and should be described as well.

The policies and organization of care can be determinants of the population that chooses to come to a place of birth. Differences and similarities in such matters as admission and discharge policies, organized referral and transport facilities, or hours of work for staff should be documented.

The process of care may be related to characteristics of the study population as well as to outcomes. Specific aspects of maternity care that are likely to influence outcome regardless of the setting are especially useful measures. Such practices might include electronic fetal monitoring for low-risk women as compared with high-risk women, routine cesarean section following a previous birth by cesarean section, use of anesthesia or analgesics, routine delivery of a breech by cesarean section, and the routine use of episiotomy. Newborn practices might also be of interest: extent of the encouragement of breastfeeding, rooming in, duration of postdelivery stay, parental contact after birth, and bathing procedures and other anti-infective measures such as use and timing of silver nitrate eye drops. Procedures of care found to be beneficial to women and their infants might eventually be implemented in all settings and those found harmful eliminated.

SELECTION OF POPULATION VARIABLES

Three categories of population variables are used in this discussion: sociodemographic, biological, and psychological variables. Besides serving as variables, they can help define population characteristics crucial to selection of study groups.

Selection of Sociodemographic Measures

Social and demographic factors such as maternal age, race, income level, or education have a pervasive influence in pregnancy and childbirth. Their effect is twofold: independent effect on outcomes (irrespective of birthplace) and effect on choice of birth setting and therefore indirect effect on outcome. They can also have important moderating effects on other variables of more direct interest to the investigator. For sociological and anthropological considerations of childbirth, see, for example, De Vries (1981), Jordan (1978), and Macintyr (1977).

Selection of Biological Variables and Sample Size

Age, infant gender, and obstetrical history are biological factors frequently selected as influential or independent variables. Mortality has been the major biological variable studied as an outcome in research on birth settings. Morbidity and birth weight should also be considered as outcome variables for study. Selection of variables is affected by the available population size and by the sample size required to use the variable reliably.

Mortality The 1980 infant mortality rate in the United States was approximately 12.5/1,000 live births, and the maternal mortality rate was approximately 6.9/100,000 live births (National Center for Health Statistics, 1981). The rates indicate a low incidence of mortality in the population, and there is an even lower incidence in settings that select low-risk patients. Therefore, the size of study groups has to be extremely large to use mortality data alone as an outcome.

Antepartum deaths are not influenced by the place of delivery, although prenatal care may have some effect. Stillbirth rates are, for the most part, composed of deaths before labor. Unfortunately, little is known about the epidemiology of intrapartum fetal deaths because few areas record it as separate from fetal deaths in general. Thus, overall stillbirth rates are poor indicators of obstetrical quality during delivery, but might be a useful measure of prenatal care. Late intrapartum death rates show promise as being useful indicators of obstetric care.

Some components of the perinatal death rate are only slightly influenced by medical care. These include many deaths due to congenital anomalies, deaths in infants whose birth weights are less than 750 grams, and deaths in the first few months of life due to Sudden Infant Death Syndrome.

Finally, the principal associations among perinatal mortality, birth weight, social class, age of mother, and parity are not well understood. Birth weight, which is the most important known determinant in perinatal outcome, is seemingly resistant to medical intervention (Chalmers and Adelstein, 1981; Paul et al., 1979; Sinclair et al., 1981; Stewart et al., 1981).

Although the neonatal mortality (death to the infant in the first 28 days after birth) rate is low (even when congenital anomalies are included), there are certain advantages associated with using neonatal mortality as an outcome measure. For instance, neonatal mortality is a finite event with an existing system in place to record its occurrence. For neonatal data to be meaningfully evaluated, the following types of variables should be studied: a) birth weight and gestational age; b) age at death in minutes, hours, or days; and c) diagnoses of congenital anomalies and other conditions identified as to prepartum, peripartum, or postpartum etiology.

Measures associated with maternal mortality are even more problematic than those of neonatal mortality. There is difficulty in obtaining a sufficiently large study sample because of the low maternal death rate. Furthermore, although there is an extensive literature that attempts to identify maternal factors that increase the risk of death or damage to the fetus, there are few reports that identify risks of delivery to the mother.

Morbidity In discussing measurements of morbidity, it should be noted that there are certain disadvantages associated with biological measures of neonatal morbidity, extrauterine adjustment, and other physiological factors, especially when these measures are used alone. First, the specificity of diagnostic criteria may be poor. Second, it is difficult to isolate these outcomes from their interactions with other processes or events. Finally, there has been a notable lack of systematic basic research on most of these outcome measures, with Apgar scores and some diseases constituting possible exceptions.

Nevertheless, many factors available for study may have linkages with well-studied and well-recorded factors such as birth weight and gestational age. Most of these outcome measures do not require a professional observer. Some useful measures could include Apgar scores and the presence of some abnormality. Other factors to be recorded might include extrauterine adjustment and physiological processes such as body temperature, time and details of the first feeding, weight (including time to regain birth weight), neurobehavioral status (Brazelton 1973), and laboratory data such as bilirubin level and bacterial colonization, e.g., of the intestinal tract.

Although there have been few attempts to identify factors that might predict poor maternal outcome, certain medical or obstetrical mishaps can be termed "poor maternal outcome." To underscore the importance of comprehensive demographic data, some of these events occur with reduced frequency in certain groups of women. Maternal biological variables could include the following:

- Use of oxytocin
- Use of analgesia and anesthesia
- Use of forceps
- Failure to progress in labor
- Fetal presentation
- Need for cesarean section
- Episiotomy
- Hypertension in labor
- Uterine dysfunction
- Retained placenta
- Laceration
- Blood loss
- Infection, such as mastitis, cystitis, pylonephritis
- Amnionitis
- Endometritis
- Thrombophlebitis

Selection of Psychological Variables

A wide range of psychological hypotheses can be studied in research on childbirth settings. Methods that are productive for obtaining information on psychological processes can be combined with methods used for obtaining information on physiological processes (Trause et al., 1981).

The opportunities for research on psychological aspects of childbirth settings are numerous (Chalmers, 1982). Appendix D describes some of the opportunities at length. In particular Table 1 of that appendix indicates the many areas for which no information exists on psychological aspects of family members' experiences related to childbearing.

SOURCES OF DATA FOR STUDY OF VARIABLES AND OUTCOMES

Vital statistics, medical records, and large-scale surveys are sources of data useful for analysis of events that occur infrequently in the population. Some modifications of vital and medical records would enhance our ability to answer questions about childbirth settings.

Retrospective studies would be greatly facilitated by several changes in vital records. At this time it is impossible to link birth and death certificates on a nationwide basis, though this is done routinely in many states (Burnett et al., 1980; Rindfuss et al., 1978; Williams, 1979; Williams and Chen 1982; Williams and Hawes, 1979). Such linking of records would be very useful for research on birth settings (Fedrick and Yudkin, 1976). Information on the actual place of birth, the attendant actually managing the birth, and whether the birth was planned to occur at that location must be added before we can determine the numbers of births taking place out of the hospital and who manages the birth. In the meantime the interpretations of results derived from vital records must be made carefully.

Information is frequently abstracted from medical records (Chng et al., 1980; Hall et al., 1980; McNay et al., 1977). Obstetric-medical

history may be used to assess a woman's likelihood of experiencing adverse problems during pregnancy or the peripartum period. However, medical records are typically designed not for research but rather to facilitate diagnosis and treatment. These records are not standardized as are interviews or questionnaires. A notable exception is the Hobel record system (Hobel, 1976; Sokol et al., 1977), which serves as the clinical document and as a research document. Researchers employing medical records will have to decide how reliability and validity of information contained in the record is to be assessed (see Dambrosia and Ellenberg, 1980; Institute of Medicine, 1977, 1980).

Investigators can choose to use interviews, observation, physiological indices of behavior, archival records, or some combination of these. Some questions, such as women's attitudes toward pregnancy or expectations about delivery, can be answered only by self-reports in questionnaires or interviews. In other cases several different procedures of data collection may be feasible. For example, an investigator interested in drug use during labor will have to decide whether to rely on observation, interview data, medical records, or some combination of these. In selecting a particular data collection procedure, the investigator should be able to explain the advantages and disadvantages of the alternatives and should provide a rationale for the procedure selected.

The use of existing data sets may limit the investigator's choice of variables for study. The Hobel record, for example, contains few psychosocial indicators. Thus, data to answer questions about psychosocial events may have to come from new research studies. However, the increasing levels of multidisciplinary collaboration among biomedical, behavioral, and social scientists offer promise that the existing obstacles to producing a scientific literature on childbirth settings can be overcome.

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APPENDIX A Review of the Safety of Maternity Care in Different Birth Locations

Gigliola Baruffi

The delivery of high quality maternity care is the desire of health professionals and the consumer. Although all the parties concerned agree that such care should be safe, the understanding of other components of quality and the assessment of their relative importance vary according to philosophy, values, way of life, and immediate interests. Even the definition of what constitutes a "safe" birth varies. Thus, contrasting viewpoints and strong beliefs have developed concerning the advantages and disadvantages of in-hospital births versus those that take place out of the hospital. Although agreement on the importance of safety exists, few publications have evaluated the safety of maternity care.

This paper reviews the literature addressing the physical safety of maternity care in different locations. Emphasis has been placed on the relationship of research methodologies and statistical analyses to the study objectives and the conclusions drawn. This review does not include reports on specific obstetrical techniques; individual obstetrical practices; selection of birth settings; satisfaction with services; comparison of different personnel; or emotional, psychological, and social factors.

CONVENTIONAL IN-HOSPITAL MATERNITY CARE

Changes in obstetric practice over time and different approaches to maternity care in the hospital were studied by Chalmers, et al., (1976a, 1976b, 1976c).

The data were derived from the Cardiff (Wales) Birth Survey, in which information was collected on 39,864 births occurring in Cardiff from 1965 to 1973. During this period hospital deliveries became routine practice (home deliveries decreased from 1 in 5 to 1 in 100), while the incidence of the following practices increased: induction of labor (from 7.5 percent to 26.5 percent), episiotomies (from 24.4 percent to 46.7 percent), elective cesarean section (from 2.9 percent to 3.4 percent), and forceps delivery (from 6.4 percent to 16.6 percent). Perinatal mortality did not change during this period.

Advantages and disadvantages of different approaches to the management of labor were studied by comparing infant outcomes resulting from

care provided to 9,907 women by two obstetrical teams at the Cardiff Maternity Hospital between 1968 and 1972. One team's approach was characterized by relatively greater use of induction and stimulation of labor, biochemical and electronic fetal monitoring, analgesia and anesthesia, and operative interventions during delivery. The study failed to demonstrate any advantage or disadvantage of a more "active management of labor." No significant differences were found when fetal distress, Apgar score, perinatal mortality or low birth weight were used as outcome measures.

These reports are based on retrospective data and have nonrandomized designs. The data were not originally intended to be used in evaluation studies. Despite these limitations, which the authors recognized, the results of the studies are similar, thus strengthening the case for the validity of the findings.

Yanover et al. (1976) evaluated early postpartum hospital discharge by studying the results of the Family Centered Perinatal Care program instituted by the Kaiser Permanente Medical Center in San Francisco. This program offered the opportunity for early postpartum discharge and home care by a perinatal nurse practitioner with the support of obstetricians and pediatricians. Of 362 low-risk women initially screened, 271 agreed to participate in the study and were interviewed. Of these, 143 women did not participate because of ineligibility based on failure to meet additional criteria, lack of interest, or other reasons. The remaining 128 were randomly assigned to the alternative care (experimental) group or the conventional care (control) group. Forty women did not complete the study because their medical status changed before delivery or during labor, or because of lack of interest, change of residence, or other reasons. Forty-four women remained in the experimental group and 44 in the control group. There were no group differences in reasons for discontinuing participation in the study. The median postpartum hospital stay was 26 hours for the study group and 68 hours for the control group.

There were no significant differences between the two groups in the number or type of maternal and neonatal morbidity during hospitalization or the six-week postpartum period. In addition to determining the safety of early home hospital discharge with follow-up care, the program proved economically feasible and was well accepted by the patients. This study is an example of a well-designed prospective study with random assignment to experimental and control groups.

UNCONVENTIONAL HOSPITAL MATERNITY CARE

Most of the literature on unconventional hospital maternity care (e.g., alternative birth centers or birth rooms) is descriptive in nature. Representative articles by Barton et al. (1980), Gillet (1979), Kerner et al. (1978), Klass et al. (1980), Rising (1976), Schmidt (1980), and Sumner (1976) provide varying degrees of specificity and emphasize different aspects of care.

The article by Barton et al. (1980) is one of the most specific and thorough treatments of this subject. The authors describe physical

facilities, staffing, admission procedures, and the selection and screening of patients for the Alternative Birthing Center (ABC) at the Illinois Masonic Medical Center in Chicago. Admission and transfer criteria at this facility are strict. Only women with a normal obstetrical history, no medical-obstetrical complications or detectable emotional problems, and those who are expected to have a spontaneous vaginal delivery are admitted. Any abnormal prenatal factor or any intrapartum or postpartum/neonatal indication for intervention warrants transfer. The authors conducted their study between March 1978 and March 1979. They reported the number of ABC applicants accepted, the number of women transferred and the reasons for transfer, maternal age and parity, type of delivery, and the incidence and type of maternal and neonatal complications. Of 309 women registered for the ABC, 218 (70 percent) were admitted; 166 of those admitted (76 percent) delivered there, and 52 (24 percent) were transferred to the conventional unit. Twenty of the transferred women received cesarean sections for a "substantial" rate of 9 percent. Eleven women (5 percent) transferred to the traditional postpartum unit after the ABC delivery. Although this is a valuable descriptive study, no conclusions can be reached about comparative safety, rate of complications, or medical intervention rate because of a lack of matched comparison groups or statistical analyses of the different outcomes of the ABC and transfer women.

Goodlin (1980) studied 500 women giving birth at the ABC located at the University of California at Davis Medical Center and compared them to a control group of 500 women who gave birth in the conventional delivery room at the same institution. Control women were of the same low-risk status and socioeconomic class and were offered similar antenatal childbirth education and care. It is not clear whether the two groups were matched for age, parity, and race. The author described in detail the obstetrical procedures at the ABC and those in the delivery room. The two settings differed greatly in the use of intravenous fluids, electronic fetal monitoring, anesthesia and analgesia, and attendants at birth. Twenty-three percent of the ABC women needed transfer to the delivery room. The investigator studied 42 variables pertaining to labor, delivery, and the neonatal and postnatal periods. Babies in the study were followed for a minimum of 4.5 months; the average follow-up time was 15.2 months. There was a statistically significant difference between the two settings in 14 of the 42 possible complications. All but 2 of the 14--meconium aspiration and readmission--were in favor of the ABC. The twelve other factors were: failure to progress in labor, oxytocin augmentation of labor, primary cesarean section, fetal distress, meconium-stained amniotic fluid, child abuse, both mild and severe congenital anomalies, central nervous system abnormalities, jaundice, polycythemia, and scalp infection. Among the maternal factors, infections such as endometritis, mastitis, and infected episiotomy were higher among the ABC patients than for the delivery room group. In the ABC group there was one case of severe toxemia accompanied by antenatal fetal death, one of abruptio placentae during labor, and one postpartum uterine inversion. There were no similar complications among the delivery room women. The author attributed the "unexpected" better neonatal outcomes at the ABC to different attitudes

toward general health, pregnancy, and labor/delivery among the women electing to deliver at the ABC. Goodlin suggested that the higher incidence of postpartum maternal infections among the ABC might result from the location of the ABC in a hospital environment.

In this study no attempt was made to analyze the association between obstetrical procedures and outcomes, although settings, procedures, and personnel are described and the study includes a control group. With procedures in the ABC different from those in the delivery room, the possibility exists that procedural differences as well as women's attitudes might be associated with different outcomes. Statistical analysis should be used to investigate this hypothesis.

NONHOSPITAL MATERNITY CARE: BIRTH CENTERS

Few studies evaluate the safety of out-of-hospital maternity care. A representative selection of publications offering a description of the philosophy, settings, procedures, and personnel of freestanding birth centers are the reports prepared by Bennetts et al. (1982), Ernst et al. (1975), Faison et al. (1979), Lubic (1976), and McCallum (1979). The most comprehensive and detailed description is provided by Faison et al. (1979), who noted the physical facilities, staffing, admission procedures, and the selection and screening of patients at the Childbearing Center in New York City. The authors reported the number of applicants, the number accepted, the number of women transferred and the reasons for transfer, maternal age and parity, type of delivery, and the incidence and type of maternal and neonatal complications.

Such a study is useful because it offers a description of events taking place at the birth center. Although this research cannot be used to draw conclusions about the safety of care provided, it does provide a good description of economical and satisfying care in the nonconventional setting.

Another freestanding birth center was evaluated by Halle (1980). In this study, 43 women who delivered at a Southern California center were pair-matched on medical-obstetrical risk, parity, age, and race with 43 women who delivered at a nearby community hospital. No differences were found in the incidence of intrapartum and neonatal problems, but patients at the birth center had a significantly higher incidence of postpartum complications such as operative or difficult delivery (mid-forceps, primary cesarean section, and vaginal breech), perineal lacerations, abnormally long labor, and postpartum infections, as well as neonatal infections and hematologic abnormalities.

Although this evaluative study is methodologically sound, its major limitations are the small sample size and the limited data analysis. The small sample size makes it difficult to interpret the differences in the incidence of perinatal problems between the two settings. Furthermore, it was not possible for the author to assign patients randomly to the two settings. A better understanding of the findings might have resulted if mention of individual perinatal problems had been provided in addition to their quantitative measurement. The study would also have benefited from a comparison of the process of care at the two

institutions and from an analysis of the relationship between those processes and outcomes.

Bennetts (1981) studied a stratified, systematic sample of 1,938 low-risk women who began labor between 1972 and 1979 in 1 of 11 selected out-of-hospital alternative birth centers with nurse-midwifery services and both physician and hospital backup. The sample was found to be much like those described in other sample studies of single centers. The mean age of the patients was 25 years. Sixty-three percent were white, 34 percent Hispanic, 88 percent married, 45 percent had completed at least 2 years of college, nearly one-third were professionals, and more than one-third were housewives. Ninety-five percent of the patients delivered infants at term, mostly without complication. Nearly 60 percent of the labors were unmedicated. Seventy-nine percent of the infants were breastfed. Fifteen percent of the patients required transfer to the hospital after the onset of labor due to a change in their risk status. The level of education of the transfers was considerably higher than that of the nontransfers, and the transfers often had no living children. The control group was selected from a follow-up study of hospital deliveries in the United States, which was conducted in 1972 by the National Center for Health Statistics (1972a, 1972b). A group of 4,790 women matched by race, age, gravidity, and obstetrical risk was compared to the group of women using the services of the centers. The ABC group had made significantly more antenatal visits and had better compliance with postnatal visits. Intrapartum use of anesthetics in the hospital sample significantly exceeded that in the ABC sample. There were no statistically significant differences in the numbers of neonatal deaths that occurred in the ABC and in the hospital groups, but the ABCs had proportionately fewer deaths.

This is the first national study of nonhospital birth centers operated by certified nurse-midwives with physician and hospital backup. The author provides a comprehensive description of the administration and services of the selected centers. In addition, the study demonstrates the ability of the certified nurse-midwife to select a low-risk population using obstetrical and sociodemographic criteria. The number of perinatal visits, patient compliance to appear for postpartum examinations, and neonatal mortality rates indicate that the centers provided safe care. The research methodology used in this study could not be evaluated because only an abstract of the original work was available at the time of this review. (However, see Bennetts et al., 1982, for more description.)

Two studies to evaluate the safety of alternative maternity care are in progress. Baruffi (1979) is studying a representative sample consisting of 802 women who delivered at the Booth Maternity Center and a control group of 817 women who delivered at the Thomas Jefferson University Hospital. Both institutions are located in Philadelphia, Pennsylvania, and all deliveries took place in 1977 or in 1978. The design is a prospective, nonconcurrent study in which these women are followed from the early phase of pregnancy to the immediate postpartum period. Race, age, parity, education, and previous pregnancy losses were used as matching variables to establish a control group. Medical-obstetrical risk was measured by the Hobel method (see Appendix E for a

review of obstetrical risk assessment methods). Pregnancy outcomes being studied include neonatal morbidity as measured by a neonatal risk score of $\geq$ 10, neonatal mortality, length of stay in the nursery, and intrapartum and postpartum maternal fever (temperature > 38°C for $\geq$ 48 hours). Selected process-of-care variables include induction and stimulation of labor, electronic fetal monitoring, analgesia and anesthesia, episiotomies, use of outlet forceps, cesarean sections, breastfeeding, childbirth education, and length of postpartum stay.

Bivariate and multivariate analyses are being used to examine the relationship of pregnancy outcomes to medical-obstetrical risk and process of care within and between the two institutions. Preliminary results suggest no difference in pregnancy outcomes between the two settings (Baruffi et al., 1981).

Ziskin (1980) is comparing care provided by three birth settings: a nonhospital birth center, a hospital birth room, and a hospital delivery suite in Englewood, New Jersey, during a five-year period (1976-1981). The sample consists of 500 women from the birth center, 300 from the birth room, and 5,000 from the hospital, all of whom are patients at low medical-obstetrical risk. Only Caucasian women not receiving Medicaid are included. Maternal age, education, gravidity, and parity will be controlled by statistical analysis. Variables to be studied include several measures of maternal and neonatal morbidity, fetal and neonatal mortality, and process of care. The data will be subjected to bivariate and multivariate statistical analyses.

NONHOSPITAL MATERNITY CARE: HOME BIRTHS

Home birth is the aspect of nonconventional maternity care that generates the most concern among professionals and the most controversy between providers of care and consumers. The following discussion is limited to studies addressing the physical safety of home births. Thus, papers not considered here include those on the philosophy of home births, on the emotional, social, and economic advantages, and on the reasons for selecting home birth settings.

Cameron et al. (1979) compared differences in planned home deliveries in Salt Lake County, Utah, in 1972 (62 deliveries) and 1975 (105 deliveries). Birth certificate data were studied and delivery status was determined to be planned or not planned for the place of birth listed on the certificate. The planning status was determined by studying the listed birth attendant and place of delivery on the birth certificate. Eighty-four women agreed to interviews, which took place two to 15 months after the birth (average, 8 months). (Fifty-five of these women were from the 1975 sample; 29 were from the 1973 group.) The age, race, marital status, and socioeconomic status of the 1975 study group were similar to the 1973 Utah population of women who bore children (also, see Cameron, 1979). However, 19 percent of the women in the 1975 study group had received inadequate prenatal care compared to 5 percent of the 1973 home birth group. Inadequate prenatal care was defined as no care, less than five prenatal visits, or care begun in the third trimester. Neonatal outcomes in the 1975 group included four low birth

weight infants (defined as weight at birth less than 2,500 grams), one infant with birth injury, and one infant with congenital malformation. The birth weight distribution and the incidence of birth injuries and congenital malformations for the entire state were not provided for comparison by the authors.

Cameron et al. ranked their interview data to determine the most important reasons for deciding to plan a home birth. The five elements individuals reported desiring were: 1) control over their own delivery, 2) a family-centered experience, 3) no interference with normal processes, 4) personalized care, and 5) low cost. The 55 women interviewed in 1975 were questioned about their infants' health. Although most of the infants were reported to have good health, two had been hospitalized (one for hernia repair, one for jaundice). Most infants had not received preventive health care (immunizations) at the time of the interview. It is unfortunate that the data were not subjected to any statistical analysis, and that the comparison made with total state births included only a few of the variables studied. However, the small sample size makes interpretation of results difficult (see Appendix F).

Dingley (1977, 1979) studied planned out-of-hospital births in Oregon in 1976 and 1977 by linking birth certificates with infant death certificates and full-term fetal death certificates. In 1976, 959 births (2.7 percent of all state births) occurred outside the hospital. In 1977 the figures increased to 1,492 infants (3.9 percent of all state births). Out-of-hospital births were examined by identifying the type of attendants (e.g., whether or not they were licensed and the size of their obstetrical practice), place of birth (e.g., home, clinic, or other residence), parental characteristics (e.g., education, maternal age, parity), trimester when prenatal care was initiated, number of prenatal visits, birth weight, and neonatal complications. Twenty-two percent of the attendants were licensed and delivered 61 percent of the infants. Sixty percent of the births took place at home, 32 percent in clinics, 7 percent at other residences, and less than 1 percent in "other" unspecified locations. Compared to statistics for the total state population, women giving birth outside the hospital were more educated, younger, and had more children. For both total state and out-of-hospital births, less than one percent of the women received no prenatal care. Of the nonhospital group, however, women attended by licensed personnel had received prenatal care similar to women across the state, but those attended by unlicensed personnel had fewer prenatal visits. Infants born outside the hospital were heavier and the neonatal mortality rate for this group was lower, but the fetal death rate was higher.

This study provides detailed comparisons of out-of-hospital births with all state births. But it is difficult to interpret the observed differences because no statistical analysis was performed on the data. State data of the type used in this study are primarily useful for descriptive purposes and for generating research hypotheses. For further examples, see Appendix F.

Shy et al. (1980) studied nonhospital deliveries in Washington State between 1975 and 1977. Of 3,203 infants in this category, 1,247 were born in birth centers, 1,614 in home residences, and the rest in clin-

ics, nonresidence homes, or en route. Home deliveries were found to be at higher risk than those in birth centers. The higher risks were more frequently associated with grand multiparity, advanced maternal age, multiple gestation, and low birth weight. Women who delivered at home were less frequently attended by trained personnel, had received later prenatal care, and had made fewer prenatal visits. All of these differences were statistically significant. After controlling for birth weight, infant mortality was found to be higher among home births than among birth center deliveries, but the difference did not reach statistical significance.

Although the authors differentiate out-of-hospital births by place of birth, they are aware of their inability to categorize them by planning status (i.e., planned or unplanned out-of-hospital births). Major maternal and infant variables affecting outcome were considered, and an appropriate statistical analysis was used. But it was not possible to study outcomes by controlling for obstetrical risk status. A second limitation of the study is the fact that infant mortality was standardized only by birth weight. Although maternal characteristics such as race, age, and parity were identified for the various groups, they were not controlled in the final analysis. This could have been accomplished by multivariate analysis.

Burnett et al. (1980) studied home deliveries in North Carolina from 1974 to 1976. The investigators determined whether the deliveries were planned or unplanned, whether there was a trained birth attendant (a lay midwife), and whether prenatal care and screening were performed. They found that the women attended by lay midwives had been classified by prenatal screening as medically low-risk pregnancies. Planned home deliveries not attended by lay midwives had not been screened prenatally.

Prenatally screened women, in spite of their high-risk demographic profile (e.g., poor, little education) had the lowest neonatal mortality (3 per 1,000 births). But women who were not prenatally screened had a higher neonatal mortality rate (30 per 1,000 live births) in spite of their low-risk demographic profile (e.g., not poor, more education). The neonatal mortality rate among unplanned home delivery was the highest (e.g., 120 per 1,000 live births).

This study of nonhospital births categorizes place of birth by planning status, that is, whether the birth was scheduled to take place where it did. A detailed description of the assumptions and criteria used in assigning planning status is presented. The authors compare sociodemographic characteristics of nonhospital births with those of total state births and control for birth weight when comparing neonatal mortality rates between the various groups. The authors fully discuss the limitations imposed by the use of birth certificate data and by the selection of neonatal mortality as an outcome measure.

Statistical analysis is limited to the calculation of relative risk of neonatal mortality and its 95 percent confidence limits. In this study, as in that conducted by Shy et al. (1980), the authors did not control for maternal sociodemographic characteristics in addition to birth weight. Nevertheless, the Burnett et al. study adds emphasis to the importance of differentiating between planned and unplanned home births.

Cox et al. (1976) studied 155 home deliveries among 1,937 total deliveries that took place between October 1970 and February 1972 in a study or "catchment" area in Middlesex, England. The socioeconomic characteristics of the home and hospital groups were similar. Of the home birth clients, three mothers in labor were transferred to the hospital as emergencies. Nineteen deliveries originally planned as home births were changed to hospital bookings during pregnancy; five women who planned hospital deliveries opted for home births. A review of the home births showed that 61 (39 percent) of the women had one or more high-risk factors. Among them, 15 (10 percent) should have been booked for hospital delivery from the time of the first prenatal visit, and 46 (30 percent) should have been changed to hospital bookings during pregnancy. Various neonatal problems were either ignored or unrecognized. No perinatal deaths occurred among the home births, but the perinatal death rate in the catchment area from which the study population was drawn was 21.7 per 1,000 total births. The authors noted the lack of adherence to established criteria for both place of booking and transfer from home to the hospital. They also noted that adequate postpartum care did not often follow for those discharged early from the hospital.

This is a descriptive study of prenatal and neonatal care provided in an epidemiologic catchment or study area within a community. The advantage of this prospective study design is counterbalanced by the lack of rigorous comparison between home and hospital deliveries. Cox and colleagues were more concerned with the weaknesses detected in the process of care and the referral system than with the comparison of process-of-care variables and outcomes in home versus hospital births. Thus, conclusions concerning the safety of nonhospital births cannot be drawn from this study.

Fedrick et al. (1978) examined data from the 1958 British Perinatal Mortality Survey (see Butler and Alberman, 1969; Butler and Bonham, 1963). Women aged 20 to 34, who delivered at term and had normal pregnancies (except for hypertension), were studied by place of booking and place of delivery (i.e., where the delivery was originally planned to occur and where it actually took place). Although perinatal death rates were lower for women delivering out of hospital, the findings were reversed when booking status was examined. Perinatal death rates were statistically significantly lower for women booked for hospital delivery than for women booked for domiciliary or general practitioner unit delivery. This occurred despite the higher incidence of adverse obstetrical history and low socioeconomic status among hospital-booked births.

The authors discuss perinatal death rates by place of booking but not by place of delivery. Had they compared perinatal mortality rates by place of booking with those by place of birth and had they found a statistically significant difference, this could have indicated that the health system was functioning well. In other words, higher hospital rates would be explained by the transfer into the hospital of women originally booked for home delivery but whose risk status changed during pregnancy. However, the reported differences were not analyzed statistically, thus their significance levels cannot be ascertained. Also,

there were no controls for differences in sociodemographic characteristics and obstetrical history. Without such controls, it is not possible to draw conclusions from differences found between the groups. Furthermore, obstetrical practice and awareness of risk factors have changed in the 30 years since the data in this study were gathered. Thus, the findings of Fedrick et al. may no longer be relevant to maternity care. Yet, the data base provides information on a time when 35 percent of all births took place at home.

Mehl and his colleagues (1975, 1977) reviewed the medical records of 1,146 home births attended by five home delivery services in northern California between 1970 and 1975. These investigators provided detailed descriptions of demography (e.g., urban or rural), attendants, population served, process of care, outcomes, and complications. The incidence of various events among home births was compared to the incidence of similar events in the birth population of the state of California or as reported in the literature. No maternal deaths were noted, and the perinatal mortality rate of 9.5 per 1,000 births was lower than the California average. No control group was used in this self-selected study population; thus, the descriptive information does not allow conclusions to be drawn about the relative safety of home births.

Mehl and Peterson (1976) compared medical records for 1,046 home births in northern California and in Madison, Wisconsin, to an equal number of births from two community hospitals in Madison, Wisconsin. The two groups were pair-matched on maternal age, education, parity, gestational age, major risk factors, and total risk score. Both populations were from the upper middle class and were 98 percent Caucasian. No significant differences were found between the two groups on neonatal and fetal mortality, number of neurologically abnormal infants, and incidence of low birth weight infants. Hospital-birth women received significantly more intravenous oxytocin, anesthesia, and analgesia, and had more low- and mid-forceps deliveries, more cesarean sections, more episiotomies, and more lacerations. Among labor and delivery complications, fetal distress, elevated blood pressure, meconium staining, shoulder dystocia, and postpartum hemorrhage occurred more often in the hospital births. Bleeding during labor and posterior delivery occurred more often among the home births. Birth injuries, total oxygen administered, and respiratory distress syndrome were observed more often among the hospital births.

This study was carefully planned and executed, and the investigators paid attention to the variables known to be associated with pregnancy outcomes. They were also aware of the possibility that the results could be influenced by the limitations inherent in a study based on a review of medical records and on patients who had selected their own birth settings. However, the need for further analysis of the data is given only cursory attention. This is a major limitation because no attempt is made to link obstetrical procedures and outcomes in the two groups or to compare this relationship between the two groups. A multivariate analysis of differences in outcomes between the home and hospital births, controlling for differences in procedures and characteristics of women, would have provided additional information.

CONCLUSIONS

The study and evaluation of the quality of maternity care need improvement in several areas. To accomplish this, a number of study designs can be used to investigate different aspects of maternity care. Attention must be paid to including, defining, and measuring psychosocial variables and to assessing their impact on pregnancy outcomes. Outcomes other than morbidity need to be identified, defined, and measured quantitatively. Variables measuring the process of care must be explored in relation to population characteristics as well as to outcomes. Studies should be conducted to evaluate maternity care in different locations, with a variety of providers, and for different populations, i.e., mere reports of experiences in a single institution are not evaluative studies. Innovative investigations should provide the necessary information for the rational selection of high-quality maternity care.

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APPENDIX B Research Issues Concerning Reimbursement for Childbirth Services

William B. Fullerton

This paper describes reimbursement/financing issues related to birth settings and some of the advantages and disadvantages of different reimbursement methods. There is also a discussion of some possible research strategies for gaining information that would be useful in making rational choices among the alternatives. Implicit is the recognition that final policy decisions are based as much on value judgments, interpretations of past research, and consensus as they are on new research results. The final section of this paper contains information on the costs of different birth settings.

REIMBURSEMENT

Reimbursement/Financing Issues

There is one basic question pertaining to reimbursement for birth services: What third-party reimbursement methods would establish appropriate relative support for each of the major birth settings? Third-party payment or reimbursement refers to payment for care by some party other than the individuals receiving the care. Examples include private insurers such as Blue Cross and public insurers such as the Federal Goverment via Medicaid. Institutions and individuals potentially eligible for such reimbursement might include general practitioners, certified nurse midwives, obstetricians, hospitals, and birth centers. The effectiveness of the methods rests on decisions in four areas:

- Which facilities should be reimbursed and which should not because their quality is not acceptable?
- Which services should be reimbursed?
- What percentage of provider care should be reimbursed?
- If 100 percent of costs are not covered by the third party, how should reimbursement be divided between program and patient?

The acceptability of a service may depend not only on its inherent quality but also on its suitability for patients. Medical criteria, determined for example by risk assessment, may supersede individual

preferences for a particular birth setting. Thus, proper selection of patients eligible to receive the services of a facility may be made a responsibility of the providers. Penalties may then be imposed for faulty provider performance either by suspension from the program or by denial of payment for cases that were improperly selected.

Reimbursement policy may stipulate that payments can be made only to providers who are accepted for participation. However, third-party reimbursement policy may be supplemented by provisions worded to ensure that there is no financial incentive to patients to choose more expensive types of care, if all other medical criteria, such as safety, are equivalent. These provisions may be designed to make the system neutral with regard to choice and, thus, cost of care. They may also be designed, however, to create an incentive for patients to choose lower cost care. This would result in savings for the insurance program and the patients, either through continued low premiums or through a lower proportional charge for the patient choosing the lower cost service.

Conditions of Participation

When a third-party payer "purchases" health care facilities and services, it may make stipulations, called conditions of participation, that outline such items as quality standards and cost restraints. Conditions of participation may include decisions about whether a provider is qualified to receive reimbursement from a third party or whether facilities meet certain requirements pertaining to staffing, equipment, etc. Independent practitioners may normally be reimbursed by third parties only if they meet the definition of a covered practitioner (e.g., having received specific training and holding certain licenses) and provide services defined as covered. For example, a midwife may be reimbursed by a third party only if the rules of that party provide for including services of a midwife and only when the services involved meet the prescribed coverage definitions. Rules may stipulate that coverage be provided for services to the mother--including prenatal, birth, and postnatal care--but not for services provided to the child after delivery.

For birth facilities, one of the first questions to be addressed is: What types of facilities are acceptable for coverage? What conditions related to licensing and other legal requirements, to health and safety, and to administrative processes (e.g., accounting systems and contractual relationships with practitioners) must be met? Insurance contracts may exclude reimbursement for facilities that do not meet their conditions of participation, but they may pay smaller amounts to nonqualifying facilities selected by insured persons. These differentials in payment mean that the patient must pay a larger sum from personal resources for using a nonqualifying facility. Therefore, there is usually a financial incentive for the patient to select qualifying facilities.

Questions regarding coverage of independent practitioners are quite similar to those for facilities. For example, should insurers cover any practitioner performing legally authorized services in a given

state? Or should insurers adopt quality-assurance standards and perhaps other measures that go beyond specific state laws or regulations? A second issue is the degree to which the insurers can and should depend upon professional credentialling as opposed to establishing their own requirements for practitioners. These insurer requirements may extend beyond professional standards and deal with reimbursement considerations. For example, some types of personnel may be reimbursed only as employees or as contractors of a facility, whereas other practitioners may be reimbursed independently on a fee-for-service basis.

Reimbursement Considerations

If several birth settings meet eligibility criteria and are approved for coverage by the third party, the next step is to establish a reimbursement system. The system should provide the required financial support to each type of facility as well as appropriate financial differentials in payments based on patient need and service characteristics of the birth setting. Providing what may seem to be adequate financing for services in a class of facilities may not prove unbiased to the setting. The bias might develop, for example, if patients incur significantly greater out-of-pocket costs in choosing one setting as opposed to another. In other words, the financial consequences for both facilities (including practitioners) and patients must be taken into account when constructing a reimbursement plan. This becomes further complicated by medical criteria determining the characteristics of the population likely to use a particular facility--for example, low-risk women using freestanding birth centers.

One important step in forming a plan for payments for birth expenses is to consider what provisions are contained in existing third-party payment programs. These provisions are generally oriented toward conventional birth settings. A government-wide benefit plan contains a typical provision that provides for payment for "covered services and supplies in or out of a hospital prescribed or ordered by a physician and when billed for by a physician, hospital or other provider whose services are covered by this plan" (Office of Personnel Management, 1980). Hospital-based birth services performed by a physician are generally clearly covered, but coverage of other birth services is often doubtful if not clearly excluded. For example, the previously cited plan provides for coverage of maternity care as a basic benefit "when provided or ordered, and billed for by a physician." A subscriber who made arrangements for maternity care directly with a midwife would probably not be entitled to receive benefits covering the midwife's fee. However, such services would be covered if ordered by a physician and then billed by the physician or, perhaps, by the midwife. Nor is there any provision in this plan for reimbursing costs for a nonhospital birth center, either as a basic benefit without coinsurance or as a supplemental benefit subject to coinsurance. If the nonconventional services are covered as supplemental benefits and conventional services as basic benefits, the patient's out-of-pocket costs would be greater if she chose the lower cost service.

Amount of Facility Reimbursement

Alternative methods of reimbursement to a facility may be categorized into three types:

- reasonable cost
- usual charges
- incentives rate

Reasonable cost reimbursement is the approach now used by Medicare in paying hospitals, nursing homes, and home health agencies. This reimbursement method lets providers charge what the market will bear. Many Blue Cross plans and Medicaid programs use a similar approach in paying hospitals. Generally, Medicare pays the accounted-for costs of each facility up to a limit. For hospitals, this limit has been applied only to routine costs and is a multiple of the average cost for hospitals in group--currently 112 percent of the mean. The hospital limit is applied only to routine in-patient service costs because it is difficult to arrive at a limit on reimbursement for total services that takes into account cost variations arising from different patient populations using the institutions. The differences in the patient "mix" determine the types of ancillary services that are needed.

The patient mix issue would not arise in birth settings where the patients are screened for their high risk status. However, different patients with different levels of risk might well be admitted to different types of centers. The basic level of cost and the limit of reimbursement would depend heavily on what services were covered. Thus, not all the services of every participating birth center would necessarily be covered. Insurance programs generally cover only those services judged by consensus to have important medical value and to represent accepted obstetrical practice. Cost reimbursement, although often not generous, has generally been adequate (and workable) to assure the continued viability of the institutions whose services are covered.

Cost reimbursement might result in varying payments to different settings whose costs differ. This variation might be reduced by limiting payment to the level of costs at the more economical sites. If billing to the patient for costs in excess of the reimbursable limit is allowed, most patients would be required to pay the cost differential. As a result, there may be a gradual shift to lower cost birth settings, but the speed or extent of such a shift cannot be predicted. If high cost centers are reimbursed below cost and are prohibited from charging patients the difference, the political acceptability of the plan is dubious. If hospitals choose to close their maternity sections, patients may be seriously inconvenienced.

Charge reimbursements are made to all covered providers of health care by commercial health insurance companies; they are also made on a cost basis to physicians and other independent practitioners and suppliers by most plans that pay hospitals and other institutions. There are a number of safeguards intended to ensure that excessive charge reimbursements are not made. No more than the usual charge of the provider is paid, and there is normally a limit related to the fees

charged by local competitors. The intent is to pay no practitioner an amount exceeding that charged by others in the field.

To establish the amount payable for specific charges, there must be a clear understanding of services to be covered by that fee. If the content of the package is not carefully defined and understood, administrative control might be lost. For example, multiple bills could be submitted by a birth center. They could appear reasonable according to the limits established by the carrier, but the sum of the bills might be found unreasonable for the services performed. This could occur if physician consultations were included in the package charge of some centers but were billed fee-for-service by other centers. If the same package fee were paid in either case, there would be an incentive for all centers to remove the consultation services from the package and total costs would quickly rise. A related question is whether the same package fee should be paid for a patient receiving care from the first day of pregnancy as for those beginning in the sixth month. This is also germane to the issue of transferring patients from one birth program to another. In these instances, transfers must be handled so that payment to all parties is equitable, but not excessive. For example, if an obstetrician's hospital fee is paid for care of a patient who, late in her pregnancy, was transferred from a freestanding birth center, the payer might be unwilling to pay the original center most of its fee for covered obstetrical services.

Paying the average value of a comprehensive package of birth services rather than an individual fee for each item of service has the advantage that it avoids creating an incentive for overservicing. On the other hand, this payment practice may create an incentive for underservicing. The profits of a facility may increase if services are reduced or if the facility selects patients who require little service and transfers to another setting patients who are expected to require more specialized care.

To respond to questions about the inherent reasonableness of charges, Medicare some years ago limited increases in reimbursable charges. The limitations are based on an index derived from physician office costs and wages in the general economy. Imposing limits on charges has the same potential effects as imposing limits on cost reimbursement.

There has been concern that cost reimbursement and fee-for-service reimbursement might stimulate excessive increases in services and, accordingly, in health expenditures. For this reason, there has been considerable effort to identify reimbursement approaches that provide incentives for cost controls. Prospectively setting a level of reimbursement is a characteristic of such an approach. To be effective, the prospective rate should limit both price per unit and quantity of services and should be related to the cost incurred in an efficient operation. It has proved difficult to establish a prospective rate-setting system that performs as well as intended. For example, charge reimbursement has not had a cost-inhibiting result. However, a number of prospective rate plans have been exerting a favorable effect on cost increases (Rochester Area Hospitals Corp., 1980).

There is a current trend away from cost containment regulation to a system that relies upon economic market action and competition to contain costs. If large third parties continue to function in the open market as expected, they would still have to establish criteria for the services they reimburse. These criteria may take forms much like those used in government regulatory programs.

Amount of Practitioner Reimbursement

Another potentially important issue is whether practitioners should be reimbursed on a separate fee basis or as part of the birth center package payment. The latter approach would force the centers to weight carefully the amounts paid to such practitioners because higher payments would leave fewer funds for other purposes. The birth center payment to practitioners would not necessarily take the form of wages and salaries. Rather, the centers could make fee-for-service payments or use other forms of compensation.

If separate fee payments are adopted for nonphysician professionals, a system would need to be devised for developing data and setting standards for reimbursable fees. The difference in fees contingent upon the type of practitioner is one of the issues that would require consideration. If the conclusion is that a patient can receive equal care from either a physician or from another health professional, the question is whether different fees should be reimbursed. If the same fee limit is applied, should it be at the higher, physician level or at the lower, nonphysician level? If the limit is set at the lower level, physicians presumably would be permitted to charge their patients any difference between the allowed reimbursement and their total fees.

A technical issue that would need to be examined relates to what some critics of birth centers term "creaming." It is correct that most birth centers and midwives do not treat high-risk patients whose records and symptoms suggest the likelihood of complications requiring hospitalization and physician intrapartum care. Critics argue that when simpler cases are treated by birth centers and midwives, the average case handled by a physician would become more complex and an upward adjustment in physician fees would be justified.

Patient Cost Sharing

Reimbursement issues concern not only what payment the provider will receive but also how the payment is divided between the patient and the third party. Some patient payment requirements may be spelled out in cost-sharing provisions--deductibles and coinsurance. These provisions must be tailored carefully if the program is to avoid introducing inadvertent payment preferences among birth settings. Such a situation would occur if cost-sharing amounts established for hospital in-patient facilities and services are small or nonexistent while fees established for nonhospital facilities and services are comparatively higher.

In addition to cost-sharing provisions, the insurance program may set limits on how much (if anything) the provider may charge the patient after having received payment from the third party. These limits take a number of different forms. For example, if a service provider bills the Medicaid program for services, the patient may not be charged anything above the amount paid by the program.

Certain private insurance carriers require that participating providers do not charge patients insured for covered services anything in addition to what the program pays (other than allowed copayments). (When services are fully covered, they are called "service benefits.") Sometimes, only patients with less than a specified income are protected by the service benefit provisions. In Medicare, the service benefit concept is applied to all Part A services obtained from participating providers. In Part B of Medicare this concept is applied only to providers that accept program payment directly from Medicare.[1]

Again a financial preference for one birth setting over another may inadvertently be created if one setting has limits on patient payments but another does not. For example, hospital services may be subject to service benefit limits whereas nonhospital services may not.

Other financial questions should be considered. If a patient selects a less costly type of birth setting, should adjustments be made to compensate for the patient's contribution to program savings, the perceived or actual risk incurred by the patient, or the rejected hospital services for which the patient may need to make alternative arrangements?

Take the last example of forgoing a hospital setting for a nonhospital setting in which the average stay is usually only a few hours. If the birth takes place at home, the care provided continues only briefly. On the other hand, the hospital stay for a normal birth may extend as long as three or four days. The patient at home during those same three or four days may need to make arrangements for her own care and the care of the newborn child. The family may need to pay for this care or may suffer an added inconvenience. Reimbursement of costs of home care or a lump sum allowance for the patient to use as desired might be considered in order to reduce or avoid some of the out-of-pocket costs for postpartum home care, thereby avoiding an incentive to obtain services through the more expensive hospital route.

Transitional Issues

If the decision is made to design reimbursement to encourage a shift from conventional hospital to nonconventional birth settings, careful attention should be given to potential problems. The existing capacity to provide nonhospital birth services seems very limited. In 1978, live births totaled 3,333,000 and those in hospitals surveyed by the American Hospital Association (1980) totalled 3,263,000. Apparently,

[1]Part A of Medicare pays for the cost of hospital care; Part B pays for physician services out of hospital.

only about 70,000 births occurred outside of hospitals. The speed at which nonhospital capacity could grow and would be used, even if strong incentives were provided for the use of nonhospital arrangements, is not known.

The primary problem is probably not one of financial disruption to hospitals caused by a shift in the locus of service (although teaching costs would have to be taken into account if the needs of tertiary care centers are to be met). Hospitals adapted rapidly to outpatient abortion services, for example, without apparent serious financial difficulties. Furthermore, birth practices at hospitals could also be modified if the proper incentives are provided. The degree of the shift would depend on the percentage of mothers and newborns that should be served in nonconventional settings.

Rather, the more important questions relate to the changes in provider and patient attitudes that would be needed and how such changes should be effected. Also important would be how to avoid creating an excessive financial hardship for patients during a period when incentives to use less costly services are offered but before those services become widely available.

RESEARCH POSSIBILITIES

A wide range of research topics may be explored to enhance the decision-making process in formulating a policy for financing birth centers. However, many of the research areas cannot yet be addressed adequately. First, preliminary statements of policy options must be developed so that hypotheses can be tested against appropriate data.

These possibilities for future research include:

1. Conditions of participation

   - What are the characteristics of existing birth centers? How do these characteristics relate to the quality of care rendered? What types of clients do their qualifications entitle them to serve?
   - What are the types of independent practitioners who render birth services, and what are the types of clients their qualifications entitle them to serve? What credentials or licenses are sufficient evidence of competence? What supervision or relationship with physician, center, or hospital does each require?
   - What recordkeeping is required? What is now done? What are the capabilities of various types of centers to provide it? What quality-assurance mechanisms or programs should be required?
   - What problems would be created if some facilities were not reimbursed for failing to meet qualifications?

2. Service coverage

   - What are the specific services to be covered as birth services, and what services are now provided as such? In hospitals? In other centers?

- What packages of services have been or might be established?

3. Reimbursement factors

- What are the costs of and charges for packages of services in different birth settings?
- What are the existing third party reimbursement arrangements for birth settings?
- What would be the effect on out-of-pocket patient payments and on provider participation if limits were set on reimbursement for costs of birth services?
- What would be the effects of establishing different types of reimbursement systems, e.g., cost versus charge versus various possible incentive reimbursement systems?
- What reimbursement methods are now used to pay independent nonphysician practitioners, and what are their effects on quality of care, costs, and utilization of facilities and services?
- How is facility reimbursement level now established, and what are the effects of alternative prices and price-setting methods?

4. Client/patient cost sharing

- What do patients or clients now pay for birth services under various circumstances?
- What is the effect of patient cost sharing (or savings resulting from the selection of lower cost settings) at various cost levels and under various cost-sharing approaches?

Costs in Unconventional Birth Settings

Data on birth costs do not provide reliable indicators of the cost differences that would occur if a new policy were developed to encourage a shift of normal deliveries from conventional settings and from primary professional attendance by physicians. The inadequacies of the data include the following:

1. Present costs are a function of existing policy and practice; a change in policy, even with no change in birth site or services, might change costs considerably.
2. Birth costs vary considerably by geographical area, type of institution, practices, personnel, and characteristics of the patient. Durations of hospital stays for labor and delivery vary substantially among and within areas. Both hospital costs and physician charges for maternity care vary as well. There are differences in costs between the wealthy and the poor, the latter often being served by resident or salaried physicians. There are cost differences, too, depending on whether midwives or physicians provide the services and on whether a salary or fee-for-service reimbursement plan is used.

The Health Insurance Association of America (HIAA) publication, Surgical Prevailing Health Care Charges System (1976), provided information on total obstetrical fees in selected metropolitan and nonmetropolitan areas. The lowest median fee shown was $248 in the Minneapolis-St. Paul area and the highest was more than double that figure--$650--in Manhattan. Within a given area, the 90th percentile of charges was approximately 30 percent higher than the median. Thus, variations within a given area also are considerable. This variability should be considered when studying a widely cited HIAA table showing total birth costs of $1,400 in 1977, $351 of which was the attending physician's charge. The report of the Select Panel for the Promotion of Child Health (1981) indicated that the physician charge in the private sector of Jacksonville, Florida in 1972 was $350, and in the public sector it was $122, approximately one-third the private sector level. A report of a study conducted in Indiana quotes a midwife's professional fee of $200, compared with $400 for a physician (Pragmatics, Inc., 1978).

In the study of obstetrical services it conducted for the state of Indiana, Pragmatics, Inc. estimated that birth center charges range from 20 percent to 50 percent less than those for similar services in conventional obstetrical units. In Chicago, based on a two-day hospital stay, charges (excluding both physician and midwife charges) were 50 percent less in a birth center. However, the data did not reflect costs to the family for care or postnatal visits at home.

British experience with costs in various settings seems to show considerably fewer differences in costs among the settings. However, this reflects more extensive use of midwives (and other practices different from those in United States) whether or not hospital confinement was part of the care. The cost comparisons in Britain took into account costs to the family when births occurred in various settings (Ashford, 1978).

The Maternity Center Association (1979) reported that 1979 charges in its Childbearing Center were $1,000; it cited a Blue Cross/Blue Shield audit that found the center's costs to be about equal to its charges. The Maternity Center Association report estimated that Medicaid costs for hospital birthing ranged from $1,650 to $2,230 for a normal birth, including a three-day hospital stay. Charges were approximately $600 for pre- and postpartum outpatient visits (apparently assuming no physician fee was reimbursed in Medicaid cases). If a physician fee were paid, it would be offset in part by eliminating outpatient charges assumed in the report. The birth center provides nurse midwife services as part of the care included in its $1,000 fee.

The Maryland Health Services Cost Review Commission, through the courtesy of its staff director Harold Cohen, provided data on the variation among hospital delivery charges in Maryland during 1981. The data do not show physician charges if submitted separately to patients, but include those for house staff, which may be used quite extensively by poor patients for whom no additional physician charge would be made. In Baltimore such patients may receive prenatal care services without charge. In such cases, physicians are paid on an hourly basis for performing physical examinations and rendering professional advice, but most patient contacts are with public health nurses.

The state statistics for 1980 provided by the Maryland Commission show that the average length of a hospital stay for normal deliveries was 2.98 days and that the average charge was $933 (State of Maryland, 1981). For deliveries with complications, the comparable figures were 4.37 days and $1,355. For normal births, the length of average stay varied among hospitals from a low of 2.35 days at Memorial Hospital in Easton to a high of 3.49 days at Maryland General Hospital in Baltimore. Charges varied from $565 in Garrett County Hospital to $1,350 at University Hospital in Baltimore. After controlling for differences in wages, other costs, and environmental factors, the length of stay varied from a low of 2.63 days at Baltimore City Hospital to the previously mentioned high of 3.49 days at Maryland General. Charges varied even more--from $864 at Mercy Hospital to $1,350 at University Hospital.

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APPENDIX C Freestanding Birth Centers

Anita B. Bennetts and Eunice K. M. Ernst

A DESCRIPTION OF THE ADMINISTRATION AND SERVICES OF ELEVEN BIRTH CENTERS

As of February 1982 there were 130 freestanding birth centers (FBCs) in the United States in which primary care was provided by certified nurse midwives (CNMs). How many additional such facilities exist in the United States is not known. Description of 11 of the freestanding birth centers is provided below. This information was obtained from a survey of FBC directors conducted by Ernst in 1979 and then broadened and updated by Bennetts in 1980 (Bennetts, 1981). At these centers low-risk obstetrical clients received care primarily from CNMs. Physicians and hospitals provided backup services for medical emergencies.

Five criteria were used to determine the eligibility of the centers for inclusion in the study. Each center was required to have:

- nine "study-eligible labors," i.e., nine women who had begun labor in the center by December 15, 1979 (labor is defined as the onset of regular contractions as noted by the patient)
- structural and administrative separation from a hospital
- only patients at lowest risk for obstetrical or neonatal complications, as defined by criteria similar to those described by Lubic (1980)
- primary care provided by CNMs with physician and hospital backup
- a philosophy of minimal obstetrical or neonatal intervention, such as not using either forceps or oxytocin induction or augmentation of labor

Tables 1 and 2 indicate the basic services provided and the obstetrical technologies available within each center.

This Appendix also contains a review of the literature on freestanding birth centers and suggests the types of information that should be obtained if useful comparisons are to be made among freestanding birth centers and other types of birth settings.

TABLE 1 Services Offered by Childbirth Centers (Care is Provided by Certified Nurse Midwives)

Entry No.	Childbirth Center	Routine Care	Pregnancy Test	Prenatal Care	Prepared Childbirth	Self-Care	Postpartum Follow
(1)	Su Clinica Familiar Raymondville, Tex.	+	+	+	+	-	+
(2)	Southwest Maternity Center Albuquerque, N.M.	+	+	+	+	±	+
(3)	Birth Center Lucinia Cottage Grove, Oreg.	+	COM	+	+	+	+
(4)	Birth Center Meleah Harrisburg, Oreg.	+	COM	+	+	+	+
(5)	The Birthplace Seattle, Wash.	COM	+	+	+	+	+
(6)	Childbearing Center (Maternity Center Association) New York City	COM	COM	+	+	+	+
(7)	Stork Stop Jacksonville, Fla.	±	+	+	COM	+	+
(8)	Childbirth Center of Daytona Daytona Beach, Fla.	+	+	+	COM	±	+
(9)	The Birthplace Gainesville, Fla.	+	+	+	+	+	+
(10)	Rhoads Family Health Services Quarrysville, Pa.	+	+	+	+	+	+
(11)	McTammany Nurse-Midwivery Center Reading, Pa.	+	+	+	+	+	+

NOTE: + = yes, by certified nurse midwife; COM = services available in the community; ± = yes, but limited; PNP = pediatric nurse practioner; - = not offered by CBC; MD = doctor of medicine; +( ) = yes, by care provider listed in parentheses; PHN = public health nurse.

[a]WIC = Women, Infants, and Children--a federal nutritional program.
[b]Up to and including 6-week examination.

SOURCE: Bennetts, 1981.

CHARACTERISTICS OF STUDIES EXPLORING FREESTANDING BIRTH CENTERS

The freestanding birth centers examined in the studies summarized below all fulfilled certain criteria: They were all homelike facilities in which five or more births occurred each year, and they had no administrative or physical connections to a hospital (other than the possible provision of backup services).

The studies fall into four categories:

Entry No.	Adolescent Program	Social Services	General Counseling	The WIC[a] Program	Family Planning	Routine Infant Care[b]	Home Visiting	Home Births	Parenting Classes	Routine Pediatric Services
(1)	-	+	+	+	+	+	+	COM	+	±
(2)	-	COM	+	COM	±	+	±	COM	+	+(PNP)
(3)	-	COM	+	+	+	+	+	+	+	COM
(4)	-	COM	+	+	+	+	+	+	+	COM
(5)	COM	COM	+	COM	+	COM	+	COM	+	COM
(6)	-	+	+	COM	+	COM	(+PHN)	COM	±	
(7)	-	±	+	COM	±	+	+	COM	+	COM
(8)	-	COM	+	COM	+	+	+	COM	COM	+(MD)
(9)	-	+	+	COM	+	COM	+	COM	+	COM
(10)	-	COM	+	COM	+	+	+	+	±	+
(11)	-	COM	+	COM	+	COM	+	+	COM	COM

- descriptive case studies of patients receiving FBC care (Bennetts, 1981; Faison et al., 1979; Lubic, 1977, 1980; McCallum, 1979; Murdaugh, 1976; Neilson, 1977; Scott and Pittenger, 1981; Van Aalten, 1979)
- studies of freestanding birth centers: hospital and FBC versus home birth case-comparison studies, with and without controls for various intervening factors (Bennetts 1981; Bennetts and Lubic, 1982; Berman and Berman, 1978; Halle, 1980; Shy et al., 1980)
- out-of-pocket cost analysis of FBC care (Lubic, 1979)

TABLE 2 Obstetrical Technology Available at Various Childbearing Centers[a]

Childbearing Centers	Narcotics on Premises	Forceps on Premises	Vacuum Extractor on Premises	Electronic Fetal Monitor	Antepartum Oxytocin, IV[b] or Oral	Infant Resuscitation Equipment
Su Clinica-Familiar, Raymondville, Tex.	Yes	Yes[c]	No	No	Yes[c]	Yes
Southwest Maternity Center, Albuqurque, N.M.	Yes	No	No	No	Yes[c]	Yes
Birth Center Lucinia, Cottage Grove, Oreg.	No	No	Yes	Yes	No	Yes
Birth Center Meleah, Harrisburg, Oreg.	No	No	Yes	Yes	No	Yes
The Birthplace, Seattle, Wash.	Yes	No	Yes, but never used	No	No	Yes
Childbearing Center (Maternity Center Association), New York, N.Y	Yes	No	No	No	No	Yes
Stork Stop, Jacksonville, Fla.	No	Yes[c] (by M.D. only)	Yes, but never used	No	IV with M.D. present	Yes
Childbirth Center of Daytona, Fla.	Yes	Yes[c] (by M.D. only)	Yes, but never used	No	IV with M.D. present	Yes
The Birthplace, Gainesville, Fla.	Yes	No	No	No	No	Yes
Rhoads Family Health Services, Quarrysville, Pa.	Yes	No	Yes, but Never used	No	No	Yes
McTammany Nurse-Midwivery Center, Reading, Pa.	No	No	No	No	No	Yes

[a]From Bennetts, 1981.
[b]Intravenous.
[c]Extremely rare, used in less than 2 percent of all cases and primarily in early years of operation.

• studies of situational and attitudinal variables related to choice of birth site (Fullerton, 1982; Mather, 1980).

All of these studies have limitations, but each one has contributed to our understanding of the maternity care option called the freestanding birth center.

The formats of these studies are summarized in Table 3 and are organized by category, type of study, primary care provider, and year of study completion.

HOW ROUTINE DATA COLLECTION CAN AID MEDICAL, SOCIODEMOGRAPHIC, AND ADMINISTRATIVE COMPARISONS OF BIRTH SETTINGS

The following observations and suggestions for research on birth settings are based on a review of the literature on freestanding birth centers. These comments derive as much from the types of data an FBC collects as from the types it fails to collect. There is considerable variability in data collection procedures across the FBCs studied. The same variability might be found for hospital units as well. Nevertheless, without some uniformity, even the most basic descriptive studies within and across different types of birth settings will be impossible.

In the 11 FBCs examined by Bennetts (1981) certain variables were routinely recorded. For comparative rather than descriptive studies, the following demographic and medical information should be considered as providing potential research variables:

a. Demographic
    1. patient age
    2. patient race
    3. marital status at initial visit
    4. patient education
    5. patient occupation at initial visit
    6. age of baby's father
    7. primary payment method
    8. patient address with zip code
b. History of previous pregnancies
    1. gravidity
    2. parity
    3. number of live births
    4. number of children now alive
    5. number of stillbirths
    6. number of infant deaths
    7. number of spontaneous abortions
    8. number of induced abortions
    9. number of small-for-gestational-age infants
    10. number of low birth weight infants
    11. number of preterm infants
    12. month of last delivery
    13. year of last delivery
    14. month of last stillbirth

TABLE 3 Characteristics of Studies on Freestanding Birth Centers

Reference	Type of Study	Primary Care Provider	Location	Study Period	Sample Size	Sample Description and Method of Selection	Types of Variables
Murdaugh, 1976	FBC descriptive case study	Certified nurse midwife	Raymondville, Texas	July 1, 1972, to June 30, 1976	754	754 births occurring during study period	Medical-obstetrical
Nielson, 1977	FBC descriptive case study	Certified nurse midwife	Cottage Grove, Oregon	May 21, 1976, to spring 1977	152	100 percent of women registered for care	Medical-obstetrical
Lubic, 1977	FBC descriptive case study	Certified nurse midwife	New York City	1975 to 1977	All women using center	100 percent of women registered for care	Demographic, medical-obstetrical, patient satisfaction
Faison et al., 1979	FBC descriptive case study	Certified nurse midwife	New York City	October 1, 1975, to April 30, 1978	714	100 percent of women registered for care	Medical-obstetrical
Lubic, 1980	FBC descriptive case study	Certified nurse midwife	New York City	October 1975, to July 1, 1979	1,166	100 percent of women registered for care	Medical-obstetrical
Bennetts, 1981	Descriptive case study of 11 FBCs	Certified nurse midwife	See Table 1 this Appendix for centers and locations	May 1, 1982 to December 15, 1979	1,938	Stratified systematic sample of all "study-eligible labors" occurring in 11 selected centers during study period	Demographic, medical-obstetrical
Van Aalten, 1979 (unpublished)	FBC, home, and hospital descriptive case study	Lay midwife, physician	Zaan District, the Netherlands	October 1969 to December 1972	2,277	First 2,277 women registered for care with gynecologist in Zaan District	Medical-obstetrical
McCallum, 1979	FBC descriptive case study	Lay midwife	El Paso, Texas	August 1976 to December 1978	560	First 560 women who registered for care at FBC	Medical-obstetrical
Scott and Pittenger, 1981 (unpublished)	FBC, home, and hospital descriptive case study	Certified nurse midwife, physician	Swiss Home, Oregon	1976 to 1981	300	First 300 births at center	Medical-obstetrical
Berman and Berman, 1978	FBC and hospital comparative study	Nurse, physician	Los Angeles, California	1974 to 1976	FBC = 160 hospital = 122		Medical-obstetrical

Halle, 1980 (unpublished)	FBC and hospital prospective matched comparison study	Certified nurse midwife, physician	Los Angeles, California	January 1978 to March 1978	FBC = 43 hospital = 43	100 percent of women registered for FBC. Hospital computer printout used for controls July-Aug. 1978 and Feb. 1979	Medical-obstetrical
Shy et al., 1980	FBC, home, and hospital comparative study	Varied	Washington State	1975 to 1977	FBC = 1,247 home = 1,614	100 percent infants born outside hospitals in Washington State	Demographic, medical-obstetrical
Bennetts, 1981	FBC and hospital controlled case comparison study	Certified nurse midwife	See Table 1 of this Appendix for centers, location, and description	May 1, 1972, to December 15, 1979	FBC = 1,938 hospital = 4,790	Stratified systematic sample of all "study-eligible labors" occurring in 11 selected FBCs and for the comparison group: 1972 U.S. birth certificates and follow-back questionnaires	Medical-obstetrical
Lubic, 1979	Out-of-pocket cost comparison of FBC to local hospitals	Certified nurse midwife	New York City	1979	Not applicable	Not applicable	Fee for services rendered
Fullerton, 1981	Ex post facto analytical descriptive study (unpublished)	Certified nurse midwife	Reading, Pennsylvania	1978	Home/FBC = 33 hospital = 33	Convenience samples of prenatal women, i.e. those actually registering for a home/FBC or hospital birth	Attitudinal variables related to choice of birth site
Mather, S. 1980	Field Survey	Not applicable	Salt Lake County, Utah	Late 1978	100	Random cluster sampling of women 15-39 years intending to become pregnant within the next 10 years. Fifty of the women selected had previous birth experience	Importance and value of childbirth options about procedure and site

15. year of last stillbirth
16. month of last spontaneous abortion
17. year of last spontaneous abortion
18. month of last induced abortion
19. year of last induced abortion
20. month when last small-for-gestational-age infant was delivered
21. year when last small-for-gestational-age infant was delivered
22. month when last preterm infant was delivered
23. year when last preterm infant was delivered

c. History of current pregnancy
   1. week of gestation when first antepartum visit was made
   2. number of antepartum visits
   3. weight gain during current pregnancy based on reported weight prior to pregnancy
   4. childbirth education course taken during pregnancy
   5. tobacco use during current pregnancy
   6. list of antepartum conditions
   7. hospitalization required during pregnancy before onset of labor
   8. rupture of membranes: how and when in relation to delivery
   9. method of initiation of labor: with or without the use of drugs or artificial rupture of membranes
   10. type of fetal presentation during delivery
   11. drugs administered to induce labor
   12. episiotomy; if so, type
   13. method of delivery
   14. month of delivery
   15. day of delivery
   16. year of delivery
   17. weeks of completed gestation at birth
   18. day of last menstrual period
   19. month of last menstrual period
   20. year of last menstrual period
   21. perineal state following delivery
   22. list of intrapartum conditions
   23. length of first stage of labor in hours
   24. length of second stage of labor in minutes
   25. length of third stage of labor in minutes
   26. type of attendant at delivery; if none present, so state

d. Neonatal and postpartum data
   1. birth weight in grams
   2. sex of infant(s) born at this delivery
   3. birth order and type of gestation
   4. Apgar score at 1 minute
   5. Apgar score at 5 minutes
   6. list of postpartum conditions
   7. list of fetal/neonatal conditions
   8. infant status at 28 days of life: if dead, how many hours after delivery did death occur and why, including autopsy findings

9. transfer data: was mother ever transferred?
10. transfer data: if mother transferred, when?
11. transfer data: was infant ever transferred prior to FBC discharge?
12. method of infant feeding at discharge
13. postpartum visit kept?
14. infant supervision visit kept?

Some potentially important information was not routinely recorded by most of the FBCs studied as well as some hospitals:

a. transfer data: who, when, where, why, before or after discharge from FBC or physician-hospital up to four to six weeks postpartum
b. variables reflecting innovations in delivery of maternity care

To allow valid comparisons, the obstetrical and medical risk status of patients at the onset of FBC and physician-hospital care should be similar and well defined. The use of a published risk screening instrument to define risk is suggested--e.g., Maternity Center Association's (MCA) Risk Screening Tool (Lubic, 1980) or Hobel's Problem-Oriented Perinatal Risk Assessment System (Hobel et al., 1973). MCA's Risk Screening Tool is widely used with and without modification in many FBCs today. Throughout the United States, the populations used to establish obstetrical and medical risk screening criteria may be too restricted to warrant generalizing the use of risk screening instruments or weights to all individuals receiving hospital care.

Similarly, socioeconomic and demographic status of comparison groups should be similar. In particular this includes:

a. race
b. neighborhood by zip code
c. length of the interconceptual interval
d. family income

The length of the observation period(s) during which subjects are compared should be similar within and among FBCs and hospitals.

Complete follow-up data on patients transferred from FBCs (when, where, why, outcome) should be obtained. Currently, data on transfers are available only for FBC patients transferred after the onset of labor.

Care providers may improve with experience. Likewise, consumers may, with exposure to the FBC in the community, improve their general health-oriented behavior. Thus, FBCs being compared should have been in operation for the same length of time.

The availability of technology may vary disproportionately over time and thus may influence the transfer rate from FBCs to a hospital setting. Therefore, data on FBCs being compared should all have been collected during the same calendar year.

To make valid assessments of health care delivery across FBCs, one must have access to accurate data within the FBCs. Care should be taken to ensure that no counts are duplicated. Whether collected for a

calendar year or for year of operation, the following data are necessary:

a. number of patients who registered for care (demand for service)
b. number of patients who withdrew
c. number of patients who terminated care antepartum due to pregnancy loss
d. number of patients who were transferred to hospital antepartum before labor onset
e. number of patients who were transferred to hospital intrapartum
f. number of mothers who were transferred to hospital from FBC before discharge
g. number of patients satisfied with care per total number of patients served (a standard patient satisfaction instrument or scale should be used)
h. number of patients seen for well-women gynecological services
i. number of patients seen for routine infant care exclusive of postnatal infant examination
j. number of women breastfeeding four to six weeks postpartum

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APPENDIX D Research on Childbirth Settings: The Assessment of Psychological Variables

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At present there is a great deal of interest in conventional and nonconventional birth settings. The incidence of home delivery is believed to be increasing (Mehl et al., 1977), and alternative birth settings such as nonhospital childbearing centers, are becoming increasingly prevalent (Faison et al., 1979; Pragmatics, Inc., 1978). Although opponents of alternative birth settings stress the medical risks involved, advocates emphasize the psychological advantages of nonhospital environments and the freedom they provide from excessive medical intervention. Unfortunately, there is little objective evidence to support any of these claims (see Appendix A). A recent review of research on home and hospital birth settings emphasized that "this lack of data has been a major factor preventing effective and reasoned dialogue among health professionals and lay people, especially those holding widely divergent views" (Adamson and Gare, 1980).

In coming years, more research should be directed toward studying both hospital and nonhospital birth settings. To date, the limited research on this topic has focused on medical outcomes such as fetal and neonatal death rates. This paper discusses the assessment of psychological variables in research on birth settings. The boundaries of this field have yet to be established, and the terrain remains virtually unmapped. The research findings suggest that many opportunities exist for productively using existing psychological concepts, constructs, and theories. Thus, explorations of the psychological aspects of childbirth settings might reward those who can overcome the substantive and methodological obstacles to conducting research in this field.

After a review of the evidence regarding the importance of psychological variables in the birth process, this paper discusses some methodological issues concerning the assessment of psychological variables. These include: (1) the timing of assessment, (2) the need to assess background and setting variables that may influence psychological variables, (3) the importance of longitudinal research (studying research participants over several points in time) and long-term follow-up (assessing the effects of a treatment or procedure at one or more points in time), (4) the importance of assessing psychological variables through multiple modes (e.g., objective observation and self-report), and (5) the need for multivariate approaches to psychological variables.

This discussion is followed by tables listing specific psychological variables likely to influence the birth process. For ease of presentation they have been organized by the target of assessment (e.g., mother, father, infant, mother-father, mother-infant) and by the time of assessment (e.g., during pregnancy, during labor or delivery, just after birth). The tables also provide information regarding whether these variables have been assessed in prior research on the birth process, and if so, how this assessment was made. Instruments that are currently available for assessing these variables are described and evaluated, and areas where new scale development is necessary are discussed.

RATIONALE FOR INCLUDING PSYCHOSOCIAL VARIABLES IN RESEARCH ON BIRTH SETTINGS

In the past, most studies evaluating birth settings have focused on mortality and morbidity data (Adamson and Gare, 1980). Because maternal mortality has become such a rare event, fetal and neonatal death rates are the common indicators used in such research. In some studies, investigators have taken into account the medical procedures used in a particular setting--such as the use of analgesia, oxytocin, low- or mid-forceps delivery, or episiotomies. Others have assessed the rate of such intrapartum and postpartum complications as meconium stain, hemorrhaging, or cesarean delivery (Barton et al., 1980; Goodlin, 1980; Mehl et al., 1977; Shy et al., 1980). Indicators of the infant's health status, such as birth weight and one- and five-minute Apgar scores, have also been recorded in a few studies (e.g., Chalmers et al., 1976a, 1976b, 1976c; Faison et al., 1979; Mehl et al., 1977). However, the assessment of such psychological variables as parents' anxiety and emotional distress or parents' bonding to the infant has been notably absent in these studies.

Advocates of home birth settings have emphasized the psychological advantages that they believe are conferred on the parents and the newborn infant. Some home birth advocates have argued that the woman's psychological well-being is jeopardized in hospital settings, where physicians are often perceived as authoritarian and impersonal (Arms, 1975). Others have maintained that the bonding between the baby and its parents is facilitated when labor takes place in a familiar, relaxed environment with supportive attendants (Stewart and Stewart, 1977). Still others have stressed the advantages for the other siblings and the positive effects on relationships in the family (e.g., Kitzinger and Davis, 1978). Many of these proponents believe that although risk factors can never be foreseen and eliminated in all cases, the positive aspects of home births outweigh the risks involved. For these reasons, research on home birth settings that does not include psychological variables may be dismissed as irrelevant by those sympathetic to the home birth movement.

Although advocates of nonconventional birth settings have firm beliefs regarding the psychological superiority of these settings, virtually all of the evidence in support of their position is anecdotal

(see, e.g., Kitzinger and Davis, 1978). Because home birth is considered unsafe and there are few rigorous empirical data supporting the purported psychological benefits, many physicians have not been receptive to the arguments. The lack of sound empirical data also makes it difficult for potential parents or consumers to make a reasoned judgment regarding the birth setting that would be best for them. Well-designed, methodologically sophisticated studies that include measurement of relevant psychological variables could be effective in stimulating a dialogue among advocates of different settings.

Evidence that psychological factors can influence birth outcomes provides a second reason for including these variables in research on birth settings. For example, the results of numerous studies have suggested that psychological events or conditions during pregnancy can affect the progress of labor and delivery. It also appears that the psychological climate during labor and delivery can influence the course of labor and fetal outcome. Some preliminary research even suggests that the psychological environment during delivery can influence maternal and infant behavior for years to come. Evidence for these assertions is discussed below in more detail.

Evidence Relating Psychological Factors to Labor Outcome

In several prospective studies, investigators have noted a relationship between the woman's psychological state in pregnancy and outcome in labor and delivery. Zuckerman et al. (1963) reported that anxiety, as assessed by an adjective checklist given during pregnancy, was directly related to the amount of analgesic required during labor and delivery. Davids et al. (1961) found that compared to women who experienced a "normal" delivery, women who experienced complications in the delivery room or who gave birth to children with abnormalities scored significantly higher on a scale measuring anxiety that had been administered during pregnancy. Although the evidence is not entirely consistent (Beck et al., 1980; Burnstein et al., 1974), numerous studies have suggested that maternal anxiety in pregnancy can affect both maternal and fetal outcomes (Crandon, 1979a, 1979b; Erickson, 1976; Gorsuch and Key, 1974; Pilowsky, 1971). For example, Erickson (1976) found that women who experienced uterine inertia, a prolonged first stage of labor, rotation of the infant's head, low forceps delivery, or whose infant's Apgar score was less than five, had previously scored significantly higher on a scale measuring "fear for self" than women who did not experience these complications. Women with any one of the first four of these complications also scored higher on a "fears for baby" inventory than women who did not experience complications. These complications were highly correlated with one another. For example, prolonged first stage of labor was associated with an increased risk of uterine inertia. On the basis of these data, the investigator concluded that "psychological stresses during pregnancy may initiate a sequence of complications which directly affect both the mother and the infant" (Erikson, 1976).

Several significant associations were found in a prospective study conducted to determine the relationship between several psychological variables in pregnancy and progress in labor (Lederman et al., 1979). During the second stage of labor, both acceptance of pregnancy and identification with the motherhood role were associated with epinephrine (a hormone that stimulates the sympathetic nervous system), Montevideo units, and length of labor. Each of these psychological variables was also related to the length of labor during stage three, and to the type of delivery (e.g., whether the delivery was forceps-assisted). In fact these investigators also found significant negative correlations between the infant's Apgar score at five minutes and two variables assessed during pregnancy--conflict in accepting pregnancy and fear of loss of self-esteem during labor (Lederman et al., 1981a). In a larger prospective study conducted with 8,000 gravidas, Laukaran and van den Berg (1980) examined the relationship between maternal attitude and pregnancy outcome. The proportion of women with postpartum complications (infections or hemorrhage) was larger in the negative attitude group than in the group of women holding favorable, moderate, or ambivalent attitudes. Even more striking was the finding that the pregnancies of women with negative attitudes resulted in a prenatal death or a live-born infant with a severe congenital anomaly more often than the pregnancies of women with the other types of attitudes.

Studies in Animals Numerous studies, including those using infrahuman species, have suggested that anxiety and disturbance during labor can result in protracted labor and poor fetal outcome (for reviews, see Myers and Myers, 1979; Newton, 1977). An advantage of such research is the ability to assign the animals randomly to different labor disturbance groups. In one study (Newton et al., 1966a) mice were gently cupped in the experimenter's hands for one minute at various times during labor. In these mice there was a 65 to 72 percent slowing of labor in comparison to the undisturbed controls. In another experiment on the effect of environment on labor, mice randomly assigned to an unfamiliar environment for the duration of their labor delivered their first pup significantly later. Also, they delivered approximately 54 percent more dead pups than did mice placed in a familiar environment or rotated between a familiar and an unfamiliar environment (Newton et al., 1966b).

More recently, a number of investigators have examined the impact of maternal distress during labor on various physiological indices of the mother and the fetus. For example, causing stress in maternal monkeys by shining a bright light in their faces resulted in a decrease in fetal oxygenation and an increase in acidosis in the fetus (Morishima, 1978). Similarly, the presence of strangers standing in front of the cage of pregnant monkeys resulted in a drop in fetal heart rate, blood pressure, pH (acidity/alkalinity), and oxygen levels, and a rise in carbon dioxide levels. In some cases the investigators observed fetal asphyxia approaching fetal demise (Myers and Myers, 1979).

Studies in Human Beings In a number of studies, investigators have found a relationship between maternal anxiety during labor and subsequent outcome. In one study, maternal-state anxiety (a temporary episode, rather than an underlying "trait" of anxiety) on admission to the labor room was predictive of labor length (Beck et al., 1980). In another study, anxiety assessed during the beginning of second stage labor was related to type of delivery, e.g., forceps-assisted or not (Lederman et al., 1979). The physiological basis for such findings has been explored in studies relating maternal anxiety and various physiological indices (Lederman et al., 1978, 1981a). For example, anxiety reported by the patient at the onset of second stage labor was significantly associated with endogenous plasma epinephrine (Lederman et al., 1978). Higher epinephrine levels were found to be significantly correlated with decreased uterine contractile activity and longer second stage labor. In a subsequent study (Lederman et al., 1981b) patients' self-reports of anxiety during labor were significantly correlated with plasma epinephrine levels. Both anxiety and high levels of epinephrine were associated with changes in the fetal heart rate in the third stage of labor. The fetal heart rate pattern was also correlated with Apgar scores at one and five minutes. The association between maternal anxiety and plasma epinephrine is especially interesting in light of the evidence that catecholamines (a group of compounds that affect the sympathetic nervous system) may decrease the blood supply to the placenta and prolong the first stage of labor (see Levinson and Shnider, 1979, for a review).

There is also evidence that characteristics of the labor setting, which would presumably influence maternal anxiety, can affect the labor process. For example, in a study of 49 women in a childbirth education group, women whose husbands were unable to attend the sessions reported higher levels of pain during labor (Henneborn and Cogan, 1975). In this study the direction of causality is difficult to ascertain: Husbands may have been less likely to attend the birth if they expected their wives to experience a great deal of pain. Therefore, it is notable, as will be described below, that investigators who have experimentally manipulated various aspects of the birth environments have produced similar findings.

In one such study, healthy Guatemalan women were randomly assigned to one of two experimental conditions (Sosa et al., 1980). The women in the "experimental" group were accompanied during labor and delivery by a previously unencountered but supportive lay woman. They were compared to women in the second group who labored and delivered as usual, without a support companion. There was a highly significant difference in the number of subsequent perinatal problems in the two groups (e.g., meconium staining, stillbirths, cesarean sections, oxytocin augmentation, and forceps delivery). In fact it was necessary to admit 103 mothers to the control group, but only 33 mothers to the experimental group, to obtain 20 in each group with uncomplicated deliveries. Only 12 women (37 percent) in the experimental group experienced complications as compared to 79 women (75 percent) in the control group. Even when mothers with complications were excluded, the length of time from admission to delivery was significantly shorter for mothers

in the experimental group than for those in the control group (8.8 versus 19.3 hours).

In the past, psychological variables have often been considered less important than indicators of physical well-being. The studies described above show that psychological variables play a central role in the birth process by exerting a strong influence on the progress of delivery and on the well-being of the mother and infant. Moreover, because these variables have been shown to influence such factors as the length of labor and likelihood of complications, they may also influence costs of health care.

The effects of the woman's psychological state during labor may not be limited to the course of labor itself. Dysfunctional labor may have an adverse effect on the infant's subsequent development. Although the data are not entirely consistent (Broman et al., 1975), there is some indication that protracted labor and instrument-assisted delivery are associated with abnormalities in the child's speech, language, and hearing at three years of age and a lower IQ at four years (Friedman et al., 1977). Moreover, the events that occur during labor may influence the infant's development indirectly. For example, some psychological factors such as anxiety or the presence of the woman's husband may influence the use of anesthesia and other drugs that can be transferred to the fetus and thereby influence the newborn's behavior. Borgstedt and Rosen (1968) have shown that sedative or narcotic drugs administered to the mother during labor can cause at least transient central nervous system depression in the newborn. Also, parents may show less interest or different patterns of care for an infant who is depressed, limp, or unresponsive at birth (Klaus and Kennell, 1976).

There is also some evidence that the psychological climate in which the birth takes place can directly influence subsequent parental behavior toward the offspring. Women randomly assigned to a group with a companion present during labor and delivery were more awake after delivery, and they also stroked, smiled at, and talked to their babies more than the control mothers did (Sosa et al., 1980). Similarly, women who were randomly assigned to groups receiving 16 hours of extra contact with their infants shortly after birth behaved differently toward these infants at a follow-up visit one year later (Kennell et al., 1974). Extra-contact mothers were more preoccupied with their infants, more likely to soothe the child when it cried, and more likely to kiss the baby. In a follow-up of this group of mothers and infants after two years, significant differences were found in the speech patterns of mothers previously assigned to extra contact. While addressing their two-year-olds during informal play, those mothers given extra contact asked significantly more questions and used more adjectives and words per preposition, but fewer commands, than did control mothers (Ringler et al., 1975). These studies are very relevant to the study of birth settings because the variables found to be important (e.g., presence of a supportive companion and immediate postpartum contact with infant) are likely to differ as a function of birth setting.

Given the profound effects shown to result from psychological factors, it may be important to assess such variables not only in studies on birth location but also in research on other aspects of the process

as well. For example, several randomized studies have recently been conducted to examine the impact of electronic fetal monitoring. Most of these have shown an increased rate of cesarean section for the monitored group (Sosa et al., 1980). However, it is very likely that the control group of patients received more time, more emotional support, and more physical contact from the nursing staff. Thus, control patients may have felt less anxious than the monitored group and therefore may have had a lower rate of cesarean section. In future studies of labor interventions, every effort should be made to ensure that the groups are equated on the relevant psychological variables.

Including psychological variables in research on birth settings should also be helpful in uncovering the underlying biobehavioral processes that influence labor and delivery outcomes. For example, what process can account for the superior outcomes among the women who had a supportive companion present? If Sosa et al. (1980) had noted the anxiety and plasma epinephrine levels in the women, we could begin to speculate about the underlying process involved.

METHODOLOGIES IN THE ASSESSMENT OF PSYCHOLOGICAL VARIABLES

To assess psychological variables in studies on alternative birth settings the investigator must consider numerous methodological issues. For example, when should such assessments be made and what types of experimental designs should be used? Unless psychological variables are assessed with considerable methodological sophistication, the results are unlikely to advance our knowledge about the birth process. Some of the most common concerns are explored below.

The Timing of Assessment

It is important to assess psychological variables as early as possible so that antecedents and consequences can be clearly distinguished. Some investigators have examined such variables during labor or in the postpartum period. However, there are many advantages in assessing psychological variables at earlier stages of pregnancy. As suggested in the literature reviewed above, the woman's psychological reactions during pregnancy can have an independent influence on labor and delivery outcome. Women who have negative attitudes toward their pregnancy or who do not accept the mothering role have been shown to have more complications than women with more positive attitudes. Investigators who are interested in examining the effect of the birth setting on these same outcome variables will be able to conduct more sensitive analyses if the effects of earlier attitudes or anxiety patterns can be statistically partialled out or held constant.

Assessing psychological variables before labor and delivery would be particularly important in nonrandomized clinical trials comparing different birth settings. Women who choose nonconventional birth settings are likely to differ with respect to important psychological variables, and these alone may influence outcomes. For example, women who

decide on home births may, as a group, be less anxious than those who decide on hospital deliveries. In a study comparing women who selected different birth alternatives, Cohen (1981) found that there were widely different attitudes toward desired involvement in the birth, toward pain, and toward hospital personnel. Even more importantly, women who opted for nonhospital care were likely to be involved in supportive social relationships (Cohen, 1981). In contrast, approximately one-third of the hospital patients in this study could name no genuinely supportive person. In several of the remaining instances the woman opting for a hospital birth regarded her mate as ambivalent or uninvolved in the childbirth experience. If the amount of social support available to the mother were not assessed prior to delivery, a number of mistaken inferences might be drawn. Differences in social support, rather than the birth setting per se, could result in improved outcomes for the mothers who have nonhospital births.

A second reason for early assessment of psychological variables is their possible interaction with birth setting variables to influence birth outcomes. Clearly, no one type of birth setting is ideal for everyone. Some mothers want to be actively involved in the birth, whereas others want to be taken care of and are willing to "accept what may sometimes be impersonal, discontinuous, and routinized care while they relax and prepare themselves for the vicissitudes of the first weeks and months at home" (Cohen, 1981, p. 11). However, "extra contact" may be a disaster for mothers with an unwanted pregnancy (de Chateau, 1977). In fact, some of these mothers have refused extra contact with their infants when it was offered. Investigators studying the effect of electronic fetal monitoring have also found divergent reactions dependent on the woman's personality characteristics and past experiences with pregnancy. Although some women judged the electronic fetal monitor to be reassuring, others found it upsetting (Starkman, 1976). In short, because women's reactions to a particular birth setting may be dependent on psychological variables such as attitudes toward the pregnancy or personality disposition, it is important to assess such variables.

Assessing Background and Setting Variables

A woman's attitudes toward pregnancy or feelings of anxiety during pregnancy may be influenced by such medical background factors as whether the pregnancy was planned or whether the mother had complications during a previous childbirth experience. Similarly, a woman's feelings of anxiety during labor and delivery are likely to be affected by characteristics of the setting, e.g., the behavior of medical personnel, the familiarity of the location, and the specific medical procedures used.

These studies have implications for the design of research to assess various birth settings. Not only are there substantial differences in the attitudes of, and social support available to, women who select different settings, but the settings themselves are likely to differ in many ways (Cohen, 1981). The woman's position during labor, the medical

procedures performed, the supportiveness of attendants, the familiarity of the surroundings, and the amount of subsequent postnatal contact with the infant are just a few of the variables among birth settings. For this reason, investigators who compare the various settings and simply report differences in outcomes for mother and infant will shed little light on the birth process. Given the many differences among the settings, it will be difficult to ascertain which variables are responsible for any differences in outcome.

By including careful assessments of background and setting variables in studies of alternative birth settings and by examining a large number of such studies, it may be possible to make some preliminary judgments about the background and setting variables that are most important. Ideally, research in which various settings are compared should be paralleled by studies in which just one setting variable is manipulated while others are held constant. It is much easier to examine the effects of individual characteristics of the setting than the effects of the birth environment as a whole because discrete parameters of the setting (e.g., personnel, practices, clients, place) lend themselves more readily to randomized experimental designs.

One might be skeptical about the use of randomized clinical trials in research on the birth process. However, there are a large number of studies that have effectively employed such sophisticated designs. In previous studies, randomized clinical trials have been conducted to examine the effect of such variables as the position of the mother during delivery (Humphrey et al., 1973); the presence of a supportive lay person during delivery (Sosa et al., 1980); whether electronic fetal monitoring was used (Kelso et al., 1978; Renou et al., 1976); whether the Leboyer approach was used (Nelson et al., 1980); whether the mother received extra contact with the infant (Kennell et al., 1974; Ringler et al., 1975) or was allowed "rooming in," a situation in which the baby stays with the mother the entire time (Greenberg et al., 1973); whether initial contact occurred immediately postpartum or was delayed 12 hours (Hales et al., 1977); and whether the initial contact was made with a wrapped infant or skin-to-skin (Curry, 1979). The underlying processes are more likely to be elucidated by knowledge regarding the impact of specific variables on birth outcomes than by comparisons of birth settings. Moreover, such knowledge may be extremely useful in modifying birth environments to improve outcomes for the mother, child, and family.

Prospective, Longitudinal Research

Prospective, longitudinal studies are highly desirable in research on the birth process. If psychological variables are assessed only once and then found to be associated with outcome variables, the direction of causality is impossible to determine. For example, how should a positive association between maternal anxiety and labor difficulties be interpreted? Just as maternal anxiety may result in protracted labor, labor difficulties may enchance maternal anxiety. By assessing anxiety prior to labor, it is possible to draw inferences about the direction of casuality among the variables.

Many relationships among variables could be illuminated by using relatively short-term time lags between assessments (Walters and Walters, 1980). During labor, for example, women who do not receive support may be more likely to experience pain and express their discomfort. Alternatively, those women who express pain and discomfort may receive different treatment from medical personnel than women who appear to be coping well. Assessments of women's emotional reactions and the supportive behaviors of health care providers at several points during labor should make it possible to determine the causal relationships among these variables.

Long-Term Follow-Up

Many advocates of home or other nonconventional birth settings have maintained that settings can influence such long-term outcomes as the child's emotional development or the relationship of the child to siblings. However, the evidence for these assertions consists almost exclusively of anecdotal evidence and case-study reports. As Cohen (1981) has noted, "There are indeed few, if any, long-range studies that support any claims at all. The time has come for behavioral scientists [to explore the] childbirth experience as [it] relates to the development of the child."

Long-term assessment of psychological variables can determine whether outcomes initially appearing desirable prove to be detrimental in the long run. For example, mothers randomly assigned to a "rooming in" condition judged themselves as more competent in the infant's care and were also less likely to think they would need help with child care at home than mothers who were not provided a rooming-in option (Greenberg et al., 1973). Although the authors concluded that the impact of rooming in was positive, it would be interesting to know how these mothers reacted to the full-time demands of child care once they returned home. Rooming-in mothers may have been less likely to arrange for help during the postpartum period and may subsequently have become more fatigued or experienced more strain in adopting the maternal role. Similarly, mothers who were given a few hours of extra contact with their child during the postpartum period were more likely to stand near their child during a physical examination or soothe the child if he or she cried (Kennell et al., 1974). These mothers also seemed much more preoccupied with their babies than were the mothers in the regular-contact condition. Extra-contact mothers were more likely to indicate that they thought constantly about the baby when they went out than mothers in the regular-contact condition. In fact, of those who had returned to school or work, five of the six extra-contact mothers (as compared to one of six control mothers) reported that they worried about or greatly missed their baby while away. Although the effects of extra contact appear to be beneficial in the short run, extended contact may intensify role conflict or distress over a longer sum period, especially among women who return to work.

Given the considerable expense involved in long-term follow-up studies, one might ask whether the benefits of such research are likely

to justify the costs. Extended follow-up studies are rare. Some have provided data indicating that significant effects from birth-associated variables were still apparent years after the birth (Kennell et al., 1974). Several investigators have found differences in maternal behavior toward their child two years later as a result of extra contact at birth (Ringler et al., 1975). Similarly, protracted labor, which may be more likely to occur in some birth settings than in others, is associated with differences in speech, language, and I.Q. as long as four years after the birth (Friedman et al., 1977). One study showed a significant relationship between a mother's attitude toward her baby at one month (a variable that could presumably be influenced by the type of birth experience) and the child's behavior more than four years later (Broussard and Hartner, 1971). In this study babies judged by their mothers as worse than average at one month of age were significantly more likely to require "therapeutic intervention" as determined by an independent clinical assessment at age 4.5. Although it will be difficult and expensive to conduct some of these long-term studies, their information will be critical to uncovering psychosocial differences due to aspects of different birth settings.

Multiple Methods of Assessment

In assessing psychological variables such as the mother's emotional state during childbirth or the social support available to her, it is extremely important to use multiple methods of assessment. As other investigators have noted, any one means of assessing a construct is necessarily imperfect (Campbell and Fiske, 1959). For example, if nurses or doctors are asked to assess a woman's emotional state during labor, their role as providers may make it objectively difficult for them (Standley and Nicholson, 1980). Similarly, data taken from medical records may be incomplete and inaccurate. By measuring a given construct in several different ways, however, an investigator can increase the likelihood of demonstrating its validity. In assessing reactions to pain, for example, the investigator may get a more complete picture by examining a combination of self-report measures (e.g., subjective distress or anxiety), attendants' observations of the client's behavior, (e.g., observers' judgments of the woman's distress), and physiological indicators (e.g., frontalis muscle tension and breathing irregularities).

Multivariate Data Analysis

When assessing a large number of variables, a multivariate approach should be considered. In a recent study on the effects of extended contact, 35 different mother-infant interactions were recorded 36 hours after birth (de Chateau, 1976). At a 6-month follow-up, 61 behaviors were scored during a mother-infant play session. Three statistically significant effects were found at 36 hours and 4 at the 6-month assessment. Given the large number of analyses conducted, it is important

not to overinterpret the findings. If the investigator had used a multivariate approach to the data analysis, it would have been possible to make a judgment regarding the overall significance of the results.

MEASURING PSYCHOLOGICAL VARIABLES

Important Variables and Available Instruments

Once a decision has been made to examine psychological variables in studies assessing characteristics of birth settings, the investigator is faced with the following questions: Which variables should be measured? What scales or measuring instruments are available to assess the variables? Are there some variables for which scales or measurement instruments have not been developed or refined? To provide some preliminary answers to these questions, we have attempted to delineate the major important variables and to summarize information regarding the best way to assess them. This information is presented and summarized in the tables at the end of this paper.

The list of variables delineated in the tables was drawn from the literature on the birth process. The tables include both psychological variables (e.g., emotional reactions during labor and postpartum adjustment), and background and setting variables that are likely to influence psychological reactions (e.g., obstetrical history, previous childbirth experiences, and characteristics of the birth setting). Some of these variables, such as maternal anxiety and attitudes toward pregnancy, were added because they have been shown to influence birth outcome. Other variables, such as the woman's judgments concerning labor room personnel, have not yet been systematically examined. They were added because the literature contains evidence suggesting that they may be important.

For ease of presentation, the variables are organized according to the target of assessment. Targets include the mother, mother-infant, mother-father, father, father-infant, and infant. Variables are also grouped according to time of assessment: (1) antecedent variables that presumably influenced the mother and/or father before pregnancy (e.g., background factors such as age and socioeconomic level; personality characteristics such as self-esteem, sex role orientation, or trait anxiety), (2) variables that occur during pregnancy (e.g., maternal attitudes and feelings during pregnancy; preparation for labor or for birth), (3) variables that are relevant during labor and delivery (e.g., reactions to pain; judgments about labor room personnel), (4) variables relevant to the peripartum period (e.g., maternal behavior toward the infant; satisfaction with the infant's appearance), and (5) variables that are relevant in the subsequent period (e.g., caretaking skills; postpartum adjustment).

Information regarding both the target and the timing of the assessment is provided in the titles of each table. Each target is considered for each time period that is appropriate. For mothers, fathers, and mother-father interactions, this includes all assessment periods. Of course, variables focusing on the infant are only considered for assessment periods after birth, as are variables focusing on mother-infant and father-infant interactions.

Each page of each table is divided into seven columns. The first column lists the psychological variable. The second column indicates alternative times when the variable might be assessed. For example, the woman's emotional reactions to the birth experience might be assessed during the birth itself, or just after the birth. If assessment of the variable has been discussed in a report on the birth process, the reference is provided in the third column. The fourth column lists the name of the assessment tool, if any. The fifth column indicates the type of tool (e.g., self-report or observer rating). A brief description of the assessment tool is included in the sixth column. The last column contains information about the instrument's reliability (consistency of test results) and validity (the capacity of a measure to predict what it was designed to predict).

Although this list of variables and assessment tools is not exhaustive, it provides a reasonably comprehensive list of the types of variables that might be included and the assessment tools that are available. The variables occuring prior to and during pregnancy can be regarded as independent variables. As noted earlier, these variables should be assessed because they are likely to exert an independent influence on birth outcomes or interact with birth setting variables to determine birth outcomes. The variables occurring during labor and delivery or after the birth might be thought of as dependent or outcome variables because they are likely to differ as a function of birth setting. Specific variables, such as the behavior of attendants or the father's involvement in the birth, may be important in their own right, but they may also mediate other outcomes such as subsequent maternal feelings or father-infant interaction.

Gaps in the Literature on Assessment of Variables

The Target of Assessment Organizing the literature on assessment of psychological variables by target and time of assessment shows which areas have been most thoroughly studied (see tables). Most studies on the target of assessment have been focused on the mother. The second highest number of studies have been devoted to describing instruments for assessing infant behavior. There are relatively few instruments for examining the father's psychological reaction to the birth, although there has been growing interest in the father in recent years. There have been no studies to assess psychological variables among siblings or extended family members. This is unfortunate because one of the advantages claimed for home birth is a beneficial effect on the siblings. At this point, no instruments have been used on birth practices to examine such factors as the siblings' attitudes toward the newborn or the quality of their subsequent relationships.

There also have been few studies of the birth process that have described tools for the assessment of the marital relationship. Advocates of nonconventional birth settings have maintained that such births can exert a positive influence on the subsequent relationship of the husband and wife. Yet no research instruments have been developed in this literature with the exception of a few that assess the marital

relationship from the woman's point of view. However, these instruments have not been validated and are likely to provide a one-sided view of the marital relationship.

Although they have not typically been used in research on the birth process, several scales have been developed to assess the quality of marital relationships (Spanier and Lewis, 1980). Such scales could easily be used in studies on alternative birth settings. One such instrument is the Dyadic Adjustment Scale developed by Spanier (1976, 1979). This 32-item, self-report instrument can be used with either married or unmarried cohabitating couples. The scale not only provides an overall measure of dyadic adjustment, but also contains separate subscales to assess dyadic satisfaction, consensus (i.e., agreement concerning various issues that arise in the relationship), and expression of affect. Moreover, this scale has been carefully validated. In one step of the validation process, for example, Spanier (1976) administered the instrument to both divorced and married samples and found that for each of the 32 items, the two samples differed significantly at the $p < .001$ level. These processes have been discussed in detail by Spainer (1976, 1979). This scale could be profitably used to examine changes in the quality of the marital relationship as a function of the birth setting.

Some studies of the birth process have described procedures for assessing interaction patterns among the family as a whole. For example, assessment tools have been developed to quantify various aspects of the mother-infant relationship, and one or two studies have discussed how father-infant interaction might be measured (Clarke-Stewart, 1973; McDonald, 1978; Standley and Nicholson, 1980).

Clarke-Stewart (1978) has stressed that studies that focus only on mother-infant or father-infant interactions are likely to be misleading. Research has demonstrated that mothers behave differently toward a young child if the father is present (Clark-Stewart, 1978; Parke and O'Leary, 1975). Techniques should be used to categorize the behavior of all the relevant family members, especially because home birth advocates have maintained that a home birth experience can improve and strengthen family relationships. Appropriate techniques have been developed and used in research on other topics (Conger and McLeod, 1977). A review of observation methods or assessment tools that consider the family as a whole and a discussion of how such tools might be applied to research on alternative birth settings would be very useful.

<u>The Timing of Assessment</u> The tables show that most assessment tools have been designed only to record maternal reactions during pregnancy. Several different instruments can be used to assess maternal feelings, adjustments, and behaviors during pregnancy. In contrast, far less attention has been focused on the assessment of psychological variables at other time periods.

Although the features of the birth setting and a woman's reactions to them are most likely to differentiate the hospital from the home birth experience, almost no attention has been paid to the assessment of relevant variables during labor and delivery. One notable exception

is the development of an observational system that enables an investigator to record observable features of a woman's physical state as well as her interactions with others in the labor room (Standley and Nicholson, 1980). On the basis of recorded observations, ratings can be given to important components of the labor and delivery experience such as the physical intimacy of the mother-father relationship and the effectiveness of nursing and physician care. The authors have also developed an instructional videotape to describe their coding of scoring procedures and to increase validity through informal observers.

Despite the availability of this assessment tool, there are still several important aspects of the labor/delivery experience that have received little attention. Foremost among them is the mother's subjective reactions to the experience. What emotional reactions, both positive and negative, are experienced? What are the woman's judgments regarding the various medical personnel and procedures to which she is exposed? To what extent are these procedures expected or unexpected? To what extent does the woman believe that she can influence or control the events that are occurring? What coping strategies does she use to deal with the pain that is experienced or with complications that arise? Because variables such as these are regarded as very important in research on alternative birth settings, an effort has been made to provide a full list of them in Table 1, which focuses on the mother during labor and delivery.

The few studies that have assessed the infant's development or the relationships between various family members have been designed for use within a relatively short time after the infant's birth. Longer-term measures would be very important in the assessment of psychological variables; thus, it would be highly useful for researchers to have a review of the assessment tools used by developmental psychologists and a discussion of their potential applicability to research on birth settings.

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TABLE 1 Psychological Research on the Mother

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
PRIOR TO PREGNANCY						
Background characteristics						
Age						
Parity						
Menstrual history						
Obstetrical history, including contraceptive use, miscarriages, etc.						
Other risk factors (e.g., history of genetic abnormalities)						
Socioeconomic status						
Cultural background						
Social support						
Marital closeness						
Stressful life events, past or present						
Evaluation of prior childbirth experiences						
Psychiatric history						
Personality characteristics						
Self-esteem						
Sex role orientation						
Response to pain (pain tolerance)						
Locus of control						
Health locus of control						
Desire for control						
Trait anxiety						
Depression						
Psychiatric symptoms or problems						
Coping style						
Repression-sensitization						
DURING PREGNANCY						
Was pregnancy planned?						
Did woman's attempt to conceive proceed as planned or were there disruptions (e.g. difficulties in conceiving, conception delayed longer than anticipated)?						
Perceived choice/control/ responsibility for conceiving						

TABLE 1 Continued

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
Did woman have amniocentesis, ultrasound?						
Psychological factors in pregnancy		Lederman and Lederman, 1979	Prenatal Self-Evaluation Questionnaire	Self-report. Objective rating scale with 79 statements, designed to measure 7 variables. Takes 20 minutes to complete	Scales include: • concern about the well-being of self and baby • degree of acceptance of the pregnancy • extent of identification with motherhood role • preparation for labor, or extent to which woman feels prepared for labor • fear of pain, helplessness, and loss of control • quality of woman's relationship with her mother • quality of woman's relationship with her husband	Interitem reliabilities range from .75 to .92
Attitudes toward pregnancy and childbirth		Nelson et al., 1980	A revised version of the Dimensions of Perinatal Adjustment inventory originally developed by Schaeffer and Manheimer in 1960	Self-report	Provides scores on such scales as Fears for Self, Fears for Baby, Irritability and Tension, Depression and Withdrawal, and Lack of Health during Pregnancy. Instrument available from NAPS (Document #03588), Microfiche Publications, P.O. Box 3513, Grand Central Station, New York, NY 10017	None provided
Attitudes and feelings during pregnancy		Pilowsky, 1972	The HIP Pregnancy Questionnaire, originally published by Grimm and Venet, 1966	Self-report	The test provides scores on 7 scales including neuroticism, concern over labor and delivery, desire for pregnancy, worry about the baby, satisfaction with husband or life in general, dependent/independent attitudes, extent of somatic symptoms	None provided
Attitudes toward pregnancy		Blau et al., 1964	Maternal Attitudes Toward Pregancy Instrument (MAPI)	Self-report inventory with 45 items	Items were subjected to factor analysis, and four factors emerged: feelings of well-being during pregnancy and acceptance of pregancy without fear, pride in pregnancy and positive maternal feelings, a desire	Reliability coefficients of separate factors range from .51 to .78

					for active participation in delivery, and positive attitudes to the baby and lack of undue concern regarding its sex and normalcy	
Woman's image of and feeling toward the fetus Preference for girl or boy baby Hopes and expectations for the baby	Prior to pregnancy During labor/delivery; just after birth; subsequent postpartum period					
Contact with others who have had complicated or difficult pregnancies	Prior to pregnancy					
Expectations regarding labor and delivery		Levy and McGee, 1975	Anticipated Evaluation of Labor and Delivery	Self-report, semantic differential scale	Subjects were asked to check a point on a 6-point scale for the following attributes: good-bad, pleasant-unpleasant, happy-unhappy, comfortable-uncomfortable, and healthy-sick. Subjects completed these items for the concept, "What my labor and delivery will be like"	None reported
Realism of expectations about the impact of a baby on one's life	Just after birth					
Mother's prenatal attitude toward childbirth participation		Humenick and Bugen, 1981	Prenatal Attitude Toward Childbirth Participation Scale	Self-report. Consists of 10 statements to be rated by the woman on Likert-type scales	Items focus on such things as desire to be in charge of planning care during childbirth, woman's belief in her ability to control pain	Interitem correlation of .84
Expectations of control regarding labor/delivery (e.g., extent to which woman expects to know in advance what is done to her, or have a say in what procedures she has) Desire for control (e.g., extent to which woman <u>desires</u> to know in advance what is done to her, or have a say in what procedures she has) Preparation Preparation for labor/delivery Extent to which womsn has played an active role in investigating alter-						

TABLE 1 Continued

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
native doctors, prenatal classes, labor/delivery settings						
Extent to which woman has sought information about prenatal care, pregnancy, labor, delivery						
Type of classes attended, if any. If so, whether exercises are performed regularly						
Preparation for arrival of infant (e.g., selected name, read books or took classes on parenting, bought things for the baby, prepared a room for the baby)						
DURING LABOR AND DELIVERY						
Quality of relationship with health care providers						
Satisfaction with husband's attitude toward and involvement in the pregnancy.						
Timing of labor/delivery (e.g., extent to which labor occurs early vs. late; extent to which mother has been able to plan for such things as the care of siblings; extent to which mother feels prepared for the labor/delivery; extent to which timing has implications for such things as whether the woman's husband or doctor is present, and whether the woman feels pleased or upset regarding the timing)						
Woman's behavior during labor		Standley and Nicholson, 1980		Observer rating	Observable features of the woman's physical state, identity and interactions of persons in the labor room, medical interventions, and	Better than 90% agreement has been obtained

					verbal behaviors are time-sampled every 30 seconds. In addition, observers complete rating scales judging: • the physical intimacy of the mother-father relationship • the quality of this relationship • its effectiveness in comforting the mother • the effectiveness of nursing care • the effectiveness of physician care • attempts by woman to cope with labor • the ability by woman to cope successfully with labor A videotape appropriate for training is available from the author	
Laboring woman's behaviors directed toward other people		Richardson, 1979		Observer rating	Observers note four types of interaction modes: visual (gazing, glancing, ignoring), verbal (requesting assistance, sharing information, opposing activites, or verbally resisting another person's actions), postural (accepting care, enduring care, or resisting care), and tactual (woman's hand movements; holding on, reaching for, or repelling)	Interrater agreement was 86% for visual behaviors, 100% for verbal behaviors, 67% for postural behaviors, and 50% for tactual behaviors (one of the observers was occasionally blocked from seeing the woman's hand)
Mother's subjective judgments about childbirth experience	During labor/ delivery; subsequent postpartum period	Humenick and Bugen, 1981	Childbirth Experience Ratings	Self-report. Objective ratings completed by the mother. Consists of three separate scales	The three scales include: • Labor/Delivery evaluation scale (10-item semantic differential scale) • Labor Agency Scale (assesses woman's perception of active participation in labor--9 items). • Delivery Agency Scale (assessment of active participation during delivery--10 items).	Interitem reliability: .91 Interitem reliability: .88 Interitem reliability: .89

TABLE 1 Continued

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
Feelings about labor and delivery	Just after birth; subsequent postpartum period	Davenport-Slack and Boylan, 1974	Childbirth description	Self-report	15-word adjective checklist, comprising such words as "fantastic," self-confident," "wonderful," and "terrified," each rated on a 5-point scale	
Tendancy to focus on pain; dependent vs. independent feelings		Davenport-Slack and Boylan, 1974	Childbirth testimony	Observer rating of woman's testimonial account	Woman's verbatim accounts of birth experience were recorded and scored by experimenters for ratio of pain-related to goal-related words and dependent to independent words	
Perceptions of and reactions to various attendants (e.g., physicians, nurses, midwives, and other health care professionals in attendance)	Just after birth					
Overall satisfaction with each attendant	Just after birth					
Judgment of each attendant as capable, competent, and responsive to physical needs	Just after birth					
Perceptions of care provided by each attendant as safe and secure						
Perception of each attendant as supportive; perception of each attendant as responsive to emotional needs; judgments that each attendant has reacted appropriately to the mother's pain or distress	Just after birth					
Judgments about whether each attendant engages in or uses specific types of social support, such as physical contact (e.g., holding	Just after birth					

the woman's hand), providing tangible aid (e.g., giving her more pillows or hard candies to suck on), providing encouragement (e.g., "You can do it"), providing reassurance (e.g., "You're doing fine"), and the woman's judgment about these strategies as helpful or unhelpful	
Judgments of each attendant's as behavior anticipated or expected in the setting; feeling that each attendant is behaving as anticipated or expected	Just after birth
Judgments that each attendant is providing sufficient information about specific medical procedures, sufficient information about how labor is progressing, and sufficient feed-back about the mother's performance; judgment of information or advice provided by attendants as consistent vs. conflicting	Just after birth
Judgments about each attendant that are relevant to the woman's feelings of mastery, control, and involvement in her own birth; for example: • Perceptions that each attendant was selected by the woman • Perceptions that particular attendants were necessary • Perception of each attendant as responsive to her suggestions or desires • Perception of certain attendants as too intrusive • Perception of particular attendents as unnecessarily restricting the woman's behavior or freedom of movement	Just after birth

TABLE 1 Continued

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
Perceptions of and reactions to various elements of the physical setting (e.g., judgments of the setting as safe and secure; judgment of the sounds and smells as familiar/unfamiliar, pleasant/unpleasant, disquieting/comforting; whether setting is perceived as controllable or uncontrollable--for example, can the woman elect to listen to music during early stages of labor?)	Just after birth					
Woman's reactions to specific medical procedure (e.g., administration of drugs, shaving, enema, or requests to remain in a particular position, such as a supine position with feet in stirrups):						
• Extent to which woman anticipates or expects procedure to occur						
• Extent to which woman judges the information accompanying the procedures as adequate						
• Extent to which procedure is regarded as chosen						
• Extent to which procedure is perceived as necessary						
• Extent to which performance of is judged to be competent						
Alertness or consciousness at each stage of labor and at the moment of birth						
Judgment of satisfaction regarding alertness						
Pain experienced during labor/delivery:						

• Psychophysiological indices of pain or pain reduction (e.g., frontalis muscle tension, and breathing irregularities)	
• Self-reported pain intensity in each stage of labor	
• Self-reported judgment of distress from the pain during each stege of labor	
• Requests for pain medication	
• Perceptions of pain as controllable	
• Perceptions of pain as anticipated, normal, or necessary	
• Extent to which coping strategies are used to reduce or control pain	
• Perceptions regarding own role in controlling pain	
• Satisfaction or feelings of mastery regarding own pain tolerance and/or ability to control pain	
Extent to which distorted perceptions and/or hallucinations are experienced during labor.	
Somatic symptoms experienced (e.g., nausea, back pain, dryness of mouth) and psychological reaction to symptoms (e.g., judgments of particular symptoms as expected, normal, or indicative of a problem)	Just after birth
Emotional reactions:	
• Fears, anxieties, and feelings of stress (e.g., fear concerning the baby's life; fear that something will go wrong, fear of dying; fear of particular elements in the situation, such as fear of anesthesia, fear that labor is taking too long, or anxiety that one will be unable to control pain effectively)	Just after birth

TABLE 1 Continued

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
• Anger	Just after birth					
• Depression	Just after birth					
• Helplessness/powerlessness	Just after birth					
• Joy	Just after birth					
• Happiness	Just after birth					
• Contentment	Just after birth					
• Fulfillment	Just after birth					
• Relief	Just after birth					
Feelings of fatigue or energy	Just after birth					
Perceptions of effort needed to complete labor/delivery						
Feelings of self-esteem	Just after birth					
Feelings of effectiveness and competence	Just after birth					
Behavioral reactions during labor and delivery		Huttel et al., 1972	Observer rating of complaints and tension	Woman's behavior observed and then scored on a 5-point scale for complaints and another for tension		None reported
Complications						
• For each complication that occurred, the woman's emotional reaction to the complication (e.g., anxiety)						
• Whether any coping strategies were used to deal with the complication or any emotional response that it engendered						
Attributions of causality and/or blame for the complication (e.g., extent to which mother blamed herself, her doctor, etc., for a particular complication)						

Length of each stage of labor and delivery. Psychological reaction to length and subjective judgment of length						
JUST AFTER BIRTH						
Postpartum feelings	Subsequent postpartum	Huttel et al., 1972		Observer ratings from women's verbatim answers to 9 questions	Assessments of wish for further children, mood, whether the birth was experienced passively or mastered actively, interest in the child, husband's interest, and willingness to nurse	Interrater agreement ranged from .52 to .88
Feelings about labor and delivery	Subsequent postpartum	Doering and Entwisle, 1975	Attitude Toward Childbirth	Observer ratings from women's verbatum responses to questions	Women were asked how they felt about the first conscious moment after birth, how they felt about their childbirth experience in general, whether they want another baby, and whether they would choose the same method of childbirth	Responses scored by independent raters with reliability coefficients of .83 to .88
Emotional reactions [Note: the same emotional reactions listed earlier in this table can be assessed here, but the mother's specific fears and anxieties are likely to be slightly different. At this stage, it would be important to assess the mother's fears regarding the infant--i.e., whether the infant is normal and healthy]						
Feelings of pride	During labor/ delivery; subsequent postpartum					
Feelings of satisfaction regarding one's own performance during labor/ delivery	During labor/ delivery; subsequent postpartum					
Judgments about whether the birth went according to plan	During labor/ delivery; subsequent postpartum					
Body-image; feelings of mutilation						
Dreams or nightmares about labor/delivery	During pregnancy; subsequent postpartum					

Table 1 Continued

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
Perceptions or feelings of control: • Ability to control amount of time spent with infant • Whether mother perceives herself as responsible for infant's care • Whether mother encounters difficulties if she makes requests that she believes are appropriate for her and her baby • Opportunity to sleep without interruption if desired						
SUBSEQUENT TO THE POSTPARTUM PERIOD						
Postpartum adaptation		Lederman et al., 1981b	The Post-Partum Self-Evaluation Questionnaire	Self-report inventory with 8 items. Takes approximately 20 minutes to complete	Scales focus on: • Quality of relationship with husband • Mother's perception of the father's participation in childcare • Mother's gratification from her labor and delivery experience • Mother's satisfaction with her life situation and circumstances • Mother's confidence in her ability to cope • Mother's satisfaction with motherhood and infant care • Support for the maternal role of parents • Support for the maternal role by friends and other family members	Interitem correlations range from .62 to .90

Retrospective maternal reactions and perceived paternal reactions to birth of child	Just after birth	Brantley and Clifford, 1980	"When My Child Was Born"	Self-report instrument; 32 items with multiple-choice format	Factor analsis revealed 3 factors: maternal positive affect, paternal positive affect, and parental anxiety	Test-retest reliability was .83
Adjustment of woman during postpartum period		Schaefer and Manheimer, 1960	Postnatal Research Inventory	Self-report	Contains 25 items on mother's health since delivery, 40 items on baby's health, and 91 items on attitudes and feelings. Dimensions of attitudes and feelings include: happiness, irritability, positive perceptions of others, fear or concern for baby, acceptance of role, intrapunitiveness, tendency to ignore distressing aspects of role, need for sharing experience, protectiveness, extrapunativeness, responsiveness to infant needs, denial, need for consultation, fears for self, confidence, need for reassurance, and depression	
Retrospective evaluation of negative and positive aspects of childbearing	Depending on phrasing, questions could be askad during pregnancy, during labor/ delivery, or just after birth	Westbrook, 1979		Interview, but could be easily adapted to self-report	Both negative and positive aspects were derived from multidimensional scaling. Respondents were asked to indicate the degree of stress experienced (on a 3-point scale) for each negative aspect. Negative aspects included rejection, problems in labor, fears of self, physical problems, problems concerning marriage, upsetting environments, disturbed way of life, worries, and problems concerning care of the baby. Positive aspects included feelings of well-being, satisfaction from the baby, wider family satisfactions, value satisfactions, satisfactions to the marriage,	None reported

TABLE 1 Continued

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
					future satisfactions, traditional role satisfactions, and growth or maturity	
Coping strategies used throughout childbirth experience		Westbrook, 1979		Interview, but could be adapted to self-report format	Women were shown descriptions of 6 different coping strategies, and were confronted with 9 negative aspects of childbearing. They were asked to indicate the coping strategy they would use to deal with the problem. Coping strategies, which were derived from multidimensional scaling, include: • Confrontation (e.g., take positive action) • Avoidance (e.g., become involved in other activities to keep mind off the problem) • Optimism (e.g., remember that things usually work out well) • Seek interpersonal help (e.g., ask someone to help or talk with friend) • Fatalism (e.g., accept that much of life is difficult) • Control (e.g., control your feelings, compromise)	None reported
Gratification from the parent role	Just after birth	Russell, 1974	Gratification checklist	A 12-item self-report instrument	Parents are asked to check "not at all," "somewhat," or "very much" to indicate the extent to which they have experienced 12 different gratifications, such as "pride in my baby's development" and "increased contact with neighbors"	Interitem reliability is .93
Degree of crisis as a result of parenthood		Hobbs, 1965, 1968; Russell, 1974		Self-report instrument	Contains such items as "worry about my personal appearence since the baby," "physical tiredness and fatigue," "baby increased money problems," etc.	

TABLE 2 Psychological Research on the Mother and Infant

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
JUST AFTER BIRTH						
Maternal behavior	Subsequent postpartum	Klaus et al., 1970		Photographs were taken every second of the first 10 minutes of mother's postnatal contact with her young (contact occurred 0.5 to 13.5 hours after delivery)	The following activities were recorded from the film: infant's movement, mother's fingertip or palm contact with infant, amount of smiling, amount of time encompassing or physically supporting infant	64% of interobserver reliability coefficients were greater than .90; 91% were greater than .80
Maternal behavior		Sosa et al., 1980		Observers watched mothers through a one-way mirror during first 22.5 minutes of contact. Mothers were watched and rated for 15 seconds at 45-second intervals	Variables assessed include amount of time talking to or smiling at their infants, amount of time spent "en face," in body-to-body contact, looking at baby, and nursing	Reliability coefficients: .88 to .98
Maternal behavior		Heles et al., 1977		Observers watched mothers through a window 36 hours after birth. Observations were made for the first 15 seconds of every minute for 15 minutes	Observers noted the location and state of both the infant and mother, and recorded affectional behavior (looking at baby, talking to baby, "en face," fondling, kissing and smiling at baby), proximity maintaining behavior (holding infant, location close to infant), and caretaking behavior (diapering, burping, or covering)	None reported
Synchrony of interaction					Could be adapted from videotape methodology developed by Brazelton, et al., 1974. Mothers were videotaped while interacting with their infants; certain dyadic phases were identified	

TABLE 2 Continued

Conceptual Variable	Other Poseible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
Whether mother has opportunity for comperison with other mothers and babies, and whether such comparisons are made	During labor/ delivery, subsequent postpartum					
Satisfaction with infant's appearance	Subsequent postpartum	Doering and Entwisle, 1975	"Reaction to the baby"		Mothers were asked what the baby looked like and responses (e.g., "ugly, with hair sticking up all over") were scored by interviewers. (The question used in the pilot study, "how did you feel about the baby" tended to produce only socially desirable reponses)	Reliability not reported
Awareness of distinctive features of the newborn	Subsequent postpartum					
Pleasure or enjoyment of contact with the infant	Subsequent postpartum					
Satisfaction with sex of infant	Subsequent postpartum					
Reection to infant's crying	Subsequent postpartum					
Willingness to let others care for the infant	Subsequent postpartum					
SUBSEQUENT TO THE POSTPARTUM PERIOD						
Maternal behavior		Kennell et al., 1974		Observer ratings, using a checklist, of mother's location and behavior every 15 seconds during physical exam of infant 1 year after birth and during free-play period following the exam	The number of behaviors rated was not indicated. Such behaviors as reactions to infant's behavior were recorded.	70% of interobserver ratings were greater than .85; 91% were greater than .80

Maternal behavior		Klaus et al., 1972 (see Curry, 1979, or Kontos, 1978, for similar observation measures)		Self-reported reaction to infant's crying. Self-reported response to going out since the infant's birth. Observation of mother during examination of infant; observer rating made on 3-point scale. Observer ratings of time-lapsed films of mothers feeding their infants (15 minutes were filmed, and each frame of the first 600 were rated)	25 specific activities were recorded, such as care-taking skills, fondling, and cuddling	Reported reliability coefficients are higher than .80
Maternal acceptance		Chamberlain, 1976	The Darbee-Michael Child Behavior Q-Sort; Darbee and Michael, 1970	Q-sort	The Q-sort consists of 54 statements about child's behavior. Mother sorts them into 11 piles according to the way she perceives her child to behave, and how she would ideally like her child to behave. A correlation between the two is then calculated	None reported
Mother-to-infant speech	Just after birth	Ringler et al., 1975		Observers analyzed taped conversations of mother and child during a "free play" situation. Transcriptions were divided into 3-minute intervals which were further divided into sequential units of mother and child speech	The sequence of utterances obtained in each spaech sample was classified according to a number of standard linguistic criteria (e.g., rate; length; variety of utterances; grammatical structure; form class; and type of sentence, such as question or command)	None reported

TABLE 2 Continued

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
Commitment to the infant	Just after birth					
Confidence in ability to mother the infant	Just after birth	Leiderman et al., 1973		Self-report	Mother asked to compare herself with 5 other caretakers (e.g., father, grandmother, experienced mother, pediatric nurse, and doctor) on each of 6 caretaking tasks (e.g., calming or feeding the baby). Percentage of instances in which she lists herself as most able caretaker is noted	None
Caretaking skill	Just after birth					
Whether the infant is provided with stimulation	Just after birth					
Preoccupation with infant (e.g., extent to which thoughts and concerns are dominated by infant; willingness to go out an leave the infant)	Just after birth					

TABLE 3 Psychological Research on the Mother and Father

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
DURING PREGNANCY						
The couple's pregnancy orientation, or the manner in which they coped with the pregnancy		Standley et al., 1978	Parental Pregnancy Orientation	Observer rating from interview data. The mother and father are interviewed separately. It is possible to derive separate maternal or paternal orientation scores or a combined score for the couple	The instrument includes conceptual clusters of items on pregnancy experience, psychophysiologic responses to pregnancy, marital relationship, social support, labor-delivery, expectations, and parenting expectations	The authors report that over 90% of the ratings were in agreement
DURING LABOR AND DELIVERY						
Father's behavior, physical intimacy with the mother, and quality of relationship with the mother	Just after birth; subsequent postpartum	Standley and Nicholson, 1980		Observer rating (see page 126 for a more complete description)		Better than 90% agreement
Father's involvemsnt in touching and supporting his wife, and apparent concern about her feelings	Just after birth; subsequent postpartum	Peterson et al., 1979		Observer ratings		Interrater reliability was .85
If father is present at delivery, the helping strategies he uses (e.g., I know you can do it," "You're doing fine," "It will soon be over")	Just after birth					
JUST AFTER BIRTH						
Time spent together after after delivery	Subsequent postpartum	Peterson et al., 1979		Observation of father's behavior		Interrater reliability was .85.
Quality of marital relationship	Prior to pregnancy; during pregnancy					
Quality of sexual relationship	Prior to pregnancy; during pregnancy					
Ratings of the baby as source of happiness in the marriage	Just after birth					

TABLE 4 Psychological Research on the Father

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
PRIOR TO PREGNANCY						
Background and personality variables (itemized in Table 1)						
DURING PREGNANCY						
Father's attitudes, feelings, and behaviors	Just after birth; subsequent postpartum	Wapner, 1976		Self-report inventory with 63 items. Some items (e.g., those on husband's physical symptoms and participation in childbirth classes)	The items were divided into separate scales: • Fears and attitudes about fatherhood • Feelings and attitudes about the pregnancy • Feelings and attitudes about the marital relationship (as influenced by the pregnancy) • Feelings and attitudes about sexual/physical aspects of the marital relationship (as influenced by the pregnancy) • Behavioral involvement in the pregnancy, • Incidence of husband's physical symptoms related to pregnancy	No interitem reliability coefficients reported for the separate scales

Father's prenatal attitude		Peterson et al., 1979		Observer judgments from interview data	Fathers questioned about their desire to have children, commitment to caring for the infant, current and projected levels of emotional satisfaction, and realism of expectations about parenting	Intercoder reliabilities of 85% were reached
DURING LABOR AND DELIVERY[a]						
Preparation (e.g., instructions in infant care, instructions regarding labor/delivery). See Table 1 for a complete list of preparation questions						
Hopes and expectations	During labor/delivery; just after birth; subsequent postpartum					
Preference for a boy or girl baby	During labor/delivery; Just after birth; subsequent postpartum					
SUBSEQUENT TO THE POSTPARTUM PERIOD						
Gratification from the parent role	Just after birth	Russell, 1974	Gratification checklist	A 12-item self-report instrument	See Table 1 for a more complete description	Interitem reliability of .93
Degree of crisis as a result of parenthood		Hobbs, 1965, 1968; Russell, 1974		Self-report instrument	See Table 1 for a more complete description	

[a]Many of the variables listed in Table 1 focus on the mother's reactions to labor/delivery and are equally relevant for the father. Variables such as perceptions of and reactions to various attendants; parceptions of and reactions to the physical setting; judgments regarding his wife's pain, her ability to cope successfully with the pain, and his own role in helping her cope; and emotional reactions, feelings of self-esteem, feelings of effectiveness and competence, and attributions of causuality and blame for complications might each be important. See Table 1 for a more complete list.

TABLE 5 Psychological Research on the Father and Infant

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
JUST AFTER BIRTH						
Father's behavior toward infant	Subsequent postpartum	McDonald, 1978		Direct observation of videotapes of father's behavior toward infant. Seven paternal behaviors were observed during three 3-minute intervals in the first 9 postpartum minutes	The following behaviors were scored: hovering, prolonged gazing, visual contact, pointing, face-to-face contact, fingertip contact, and palming contact	Observers obtained high agreement in identifying these behaviors (198), and moderately high agreement in scoring each paternal behavior during each 3-second interval (9 of 21 Kendal W values ranged from .51 to .84; 9 others ranged from .71 to 1.0)
Contact with infant	Subsequent postpartum					
Pleasure in or enjoyment of contact with infant	Subsequent postpartum					
Satisfaction with sex of infant	Subsequent postpartum					
Satisfaction with infant's appearance	Subsequent postpartum					
Awareness of distinctive features of newborn (e.g., appearance, cry)	Subsequent postpartum					
Father's engrossment with the infant	Just after birth	Blehar, 1979		Two self-report items	Fathers were asked what was the "nicest thing" about the days their wives were in the hospital, and the "nicest thing about the first few days at home." They were also asked why their marriage is happy. The number who spontaneously mentioned the baby in each case were noted	

Father's involvement in infant caretaking	Manion, 1977	"Baby's Typical Day"	Self-report	Contains questions on the father's participation in caretaking activities during an arbitrarily chosen time (e.g., how many times in the previous week he had bathed, diapered, rocked, and fed the baby)	Author noted that face and content validity had been established in a pilot study, but no details are given
Father's attachment to infant	Peterson et al., 1979		Obeerver ratings based on observation of father's behavior and responses to interview questions	Observers note extent to which father interacted and cared for infant, father's confidence in caring for baby, father's feelings of closeness to the baby, and father's tendency to interact with baby in a way that is pleasurable for both(e.g., causing both to laugh)	Interobserver agreements of .85 were obtained

TABLE 6 Psychological Research on the Infant

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
JUST AFTER BIRTH						
Neonatal behavior		Brazelton et al., 1974; Brazelton, 1976, 1978; Sameroff, 1978	Neonatal Behavioral Assessment Scale: Brazelton, 1973	Tests neurologic adequacy with 20 reflex measures and behavioral responses to environmental stimuli. Takes 20 minutes to perform, 10 minutes to score reliability. Designed for infants in the first month after birth; inappropriate for premature infants less than 37-weeks gestation. Scores the infant's "best" performance on the dimension in question	Behavioral items, two global dimensions (attractiveness and need for stimulation) are derived from and are rated on 4-point scales. The individual's interaction repertoire is then assessed on 27 specific behavioral items that are believed to reflect 4 behavioral dimensions: (1) interactive capacities (ability to attend to and process environmental events); (2) motoric capacities (e.g., ability to control motor behavior, such as bringing hands to mouth); (3) organizational capacities with respect to state control (how well infant maintains a calm, alert state despite increased stimulation); and (4) organizational capacities--physiological response to stress (e.g., how much infant is able to inhibit startles)	All researchers and clinicians who plan to use the scale are urged to visit one of three training centers for a 2-day reliability session. Brazelton (1978) reports that this system produces acceptable and high reliability, which can be maintained for 2 years without reexamination Although interrater reliability is high, test-retest reliability scores are moderate to low (see Sameroff, 1978, for further discussion). Also, the scale appears to lack predictive validity with respect to developmental outcome (see Sameroff, 1978, for further discussion)
Neonatal behavior		Horowitz, et al., 1978; Sullivan, 1977	Neonatal Behavioral Assessment Scale with Kansas Modifications (NBAS-K)	To encompass some of the observations many testers make during the exam, but which generally go unrecorded, Sullivan developed 5 new scales. One of these, Orientation to Inanimate Visual and Auditory Stimuli, is de-	The other four new scales are: • Quality of infant's alert responsivity • Examiner's persistence (e.g., how hard examiner has to work to elicit alertness from infant) • General Irritability of infant • Reinforcemsnt value of infant (e.g., how aversive or rewarding it is to interact with infant)	Reliabilities on all scales are higher than .90

				signed to parallel the NBAS scale on orientation to animate stimuli; the other scales are completely new. Sullivan made some minor modifications to the original scales and in methods for scoring them as well		
Baby's behavior state during the first hour of life		Nelson et al., 1980		Observer ratings	Ratings of behaviors ranging from deep sleep through quiet alert activity to irritable crying. Available through NAPS (Document #03588), P.O. Box 3513, Grand Central Station, New York, NY 10017	Mean interobserver agreement was .88
Baby's sucking behavior		Kron et al., 1966			Bottle was attached to instruments that measure the rate of feeding, pressure of sucking, and amounts	
Qualities of infant's cry	Subsequent postpartum	Zeskind and Lester, 1978		Describes how cries can be categorized according to objective judgments of pitch, latency, etc., as well as factors that elicit the cry and percentage of time spent crying. Also describes a self-report instrument for assessing subjective reactions to the cry	On the self-report instrument, cries can be rated according to how grating, "sick," urgent, distressing, piercing, discomforting, aversive, and arousing they are. A factor analysis of these ratings revealed two major dimensions: a "discomfort" factor and a second factor conveying the "sick" nature of the cry	Pearson correlations among ratings of the eight different cry qualities ranged from .73. to .91
Neonatal behavioral deficit		Graham, et al., 1956, Rosenblith 1961; Rosenblith et al., in press	The Graham/ Rosenblith Behavioral Examination for Newborns	Observer ratings of infant's behavior	The scale contains several subscales, such as muscle tension, vision, and maturation	Most interscore reliability coefficients are higher than .80

TABLE 6 Continued

Conceptual Variable	Other Possible Assessment Periods	Reference That Discusses This Variable	Name of Assessment Tool (if any)	Type of Instrument	Characteristics/Description	Information on Reliability and Validity
SUBSEQUENT TO THE POSTPARTUM PERIOD						
Infant temperament	Just after birth	Carey, 1970		Self-report inventory designed for babies 4-8 months old can be completed by the mother in approximately 20 minutes and scored in less than 10. The inventory has 70 statements, each with 3 choices	Items comprise 9 scales, including activity, rhythmicity, adaptability, approach, threshold, intensity, mood, distractibility and persistence. Questions focus on specific behaviors of infant (e.g., when already full, how does infant respond to feeding attempts	Several mothers were interviewed and completed questionnaires, the author reports the results were in agreement. Author reported high test-retest reliability (specific coefficient not provided)
Infant development		Bayley, 1969	Bayley Scales of Infant Development	Designed for 2-30 month children; the test is administered by an examiner and takes approximately 45 minutes to to complete	The scale contains 3 parts: (1) a Mental Scale, designed to assess sensory-perceptual acuities and discriminations, memory, learning, and problem-solving ability; vocalizations; early evidence of ability to form generalizations; (2) A Motor Scale, designed to measure degree of control of the body and coordination; and (3) An Infant Behavioral Record focusing on the child's social and objective orientations toward his/her environment as expressed in interests, emotions, energy activity, and tendencies to approach or withdraw from stimulation	(1) Split-half reliability coefficients ranged from .81 to .93 Test-retest reliability was 76.4, interobserver agreewas 89.4. (2) Split-half reliability coefficients ranged from .68 to .92. Test-retest reliability 75.3, inter-observer agreement was 93.4 (3) Not reported
Failure to thrive						

APPENDIX E Review of Obstetrical Risk Assessment Methods

Beatrice J. Selwyn

Thirty-three articles on obstetrical risk assessment methods reported in the literature are described in Table 1. The studies represent the use of 19 different scoring systems. Nine studies were published prior to 1973; the remaining 24 were reported in 1973 or later. A historical review of the risk assessment literature by Hobel (1976) included 7 of the systems in Table 1. In the pre-1973 era, 3 of the most widely used risk assessment methods were reported: Apgar (1953), Goodwin et al. (1969), and Nesbitt and Aubry (1969). In 1973, Hobel's method was first published (Hobel et al., 1973) and now joins the others as one of the most widely used methods.

ATTRIBUTES OF THE METHODS

The methodology used in the studies described in Table 1 varies from samples of highly selected groups of women (James et al., 1976; Kaminski et al., 1973) to collections of large numbers of consecutively sampled women (Coopland, et al., 1977; Hobel, et al. 1973; Nesbitt and Aubry, 1969). Methodology influences findings because the occurrence of an outcome in the study group is affected by the characteristics of the group chosen for study. The predictive accuracy of the system may also be affected by the generalizability of findings from one group to another.

Most of the methods require observations of the woman being scored, and a few require interviews with the woman (Hobel et al., 1973; Kaminski et al., 1973). The number of characteristics ascertained varies from method to method: 155 were assessed by Effer (1969); 126 by Hobel et al. (1973); 123 by Stembera et al. (1975); approximately 45 by Nesbitt and Aubry (1969); and approximately 21 by Goodwin et al. (1969).

The categories of factors assessed in all methods are similar. They include demographic data, socioeconomic data, data based on past pregnancies, medical history, present pregnancy and, in the more recent studies, data on fetal heart rate and uterine contractions from electronic monitoring. All authors have based their selection of factors on the existing information concerning variables associated

TABLE 1 Attributes of Obstetrical Risk Assessment Methods

Reference	Study Methods: Design	Study Methods: Data Sources	Study Methods: No. of Subjects	Risk Assessment Method: Title	Risk Assessment Method: No. of Factors	Risk Assessment Method: Factors Included	Risk Assessment Method: Stage When Collected: Prenatal	Risk Assessment Method: Stage When Collected: Intrapartum	Risk Assessment Method: Stage When Collected: Neonatal	Risk Assessment Method: Scoring: Manner of Scoring	Risk Assessment Method: Scoring: Outcome of Interest
Apgar, 1953	Consecutive births, infant delivery	Observation[a]	1,760	Apgar score	5	Heart rate, respiratory effort, reflex, irritability, muscle tone, color			1 minute after birth	Points given: 0 = bad 2 = good sum points, 10 is best, arbitrary	Acidosis; mortality
Prechtel, 1967	Sample 30% high-risk women, study group: infants born in hospital	Medical records[b]	1,378	Obstetrical Score	42 58	Obetetrical and socioeconomic (SES) variables, neurological signs	Yes	Yes	3 and 10 days after birth	1 point for each nonoptimal factor; sum points	Abnormal neurology
Larks and Larks, 1968	Consecutive births	Obeervation	2,028		54	Demographic characteristics, blood pressure of mother, bioelectrical measures	Yes			Multivariate score	Apgar score; mortality
Nesbitt and Aubry, 1969	Consecutive ward patients, care given without knowing score	Observation	1,001	MCH Care Index[c] (semiobjective grading system)	±45	Demographic characteristics parity, obstetrical history, medical history, socioeconomic status, emotional status	Only			Arbitrary weights: 0 = good 30 = bad; sum points and subtract from 100	Poor perinatal outcome
Wilson and Sill, 1973	Random sample of bookings; sample of deliveries; combined the two samples	Observation and records	148 150	MCH Care Index of Nesbitt and Aubry, 1969	21	Same	Only			Same	Same
Aubry and Pennington, 1973	Consecutive admissions to labor and delivery; mixed clinic and private patients	Obaervation and records	450	MCH Care Index of Nesbitt and Aubry, 1969 plus Labor Index	21 5	Same, with the addition of maternal, fetal, and placental factors	Yes	Yes		Same, but with Labor Index, sum, and subtract from 200	Same

Goodwin et al., 1969	Several study groups are combined: perinatal deaths, ward deliveries, and private cases	Observation and records	936	Antepartum Fetal Risk Score	±21	Baseline and obstetrical history, present pregnancy, gestational age at birth	Yes			Arbitrary and based on literature, weight factors 0-10 (0 = good), sum	Perinatal mortality
Hebb et al., 1980	All prenatal patients of various MDs in region	Observation	17,270	Antepartum Fetal Risk Score of Goodwin, et al., 1969	±21	Same, except no use of gestational age	Yes			Same	Same
Coopland et al., 1977	All women admitted to labor	Records	5,459	Modified Goodwin, and Thomes 1969	±21	Same, except some demographic factors	Yes			Weights are 0-3	Same
Yeh et al., 1977	Women monitored during labor	Records	266	Goodwin et al., 1969 plus fetal monitoring	±21	Same, plus fetal heart rate and uterine contraction	Yes	Yes		Weights are 0-4	Same
Morrison and Olsen, 1979	Deliveries in 80 hospitals	Observation	16,733	Goodwin et al., 1969	±21	Same	Yes	On admission in labor		Weights are	Same 0-3
Butler and Alberman, 1969	All births in 1 week in Great Britain; stillbirths and neonatal deaths for 3 months	Observation records, birth and death certificates	17,024 7,851	None	6	Age, parity, social class, height, pre-eclampsia, and smoking	Yes	Yes		Multivariate score for each factor and sum	
Alberman and Goldstein, 1970	From Perinatal Mortality Survey; identify children at 7 years with and without handicaps	Same	12,083 167 with handicaps	None	3	Parity 4+, adverse method of delivery, neonatal illness in 1st week of life	Yes	Yes	Yes	One point for presence of factor	Handicap
Effer, 1969	All admissions to high-risk pregnancy unit; random sample of those with standard care	Records	211 350	Prognostic Risk Score	155	Pathology, test results, demographic and SES, past and present obstetrical problems		Assigned at labor		Not clear, assume 1 point if present	Apgar

Table 1 Continued

Reference	Study Methods: Design	Study Methods: Data Sources	Study Methods: No. of Subjects	Risk Assessment Method: Title	Risk Assessment Method: No. of Factors	Risk Assessment Method: Factors Included	Risk Assessment Method: Stage When Collected: Prenatal	Risk Assessment Method: Stage When Collected: Intrapartum	Risk Assessment Method: Stage When Collected: Neonatal	Risk Assessment Method: Scoring: Manner of Scoring	Risk Assessment Method: Scoring: Outcome of Interest
Rantakallio, 1969	All births in one year	Records and interview	11,391	None	43[a] in 1st analysis; 27 in final	Biological factors, factors of mother, socioeconomic status	Yes			Discriminant function; Eigenvector weights given each factor	Poor neonatal outcome
Hobel et al., 1973	All women coming to clinic; screened, but attending MD did not know score	Interview and observation	725	Screening to predict high risk neonates	51 40 35	Prenatal, intrapartum, and neonatal	Yes	Yes	Yes	Arbitrary weights of 1 (good), 5 and 10; score prenatal as mean; score intrapartum as sum of points	Perinatal morbidity and mortality
Hobel, 1976	Same, update	Same	1,417	Hobel's modified	35	Same	Yes	Yes	Yes	Same	Same
	High-risk neonate matched with low-risk neonate	Same	60 52	Hobel's modified	35	Neonatal factors	Yes	Yes	Yes	Same	Morbidity in 1st 2 years of life
Hobel, 1979	Same sample	Same	1,417	Hobel's modified	21 18	Prenatal, intrapartum	Yes	Yes		Multivariate scores given	Same
Sokol et al., 1977	Consecutive deliveries	Interview and observation	1,275	Hobel's modified	49 36	Prenatal, intrapartum	Yes	Yes	Same	Same	
Sokol et al., 1979	Delivery with perinatal death; delivery without perinatal death	Same	143 5,235	Hobel's modified	36	Same	Yes	Yes	Yes	Same	Same
Chik et al., 1979	Consecutively delivered women with fetal monitoring; see Sokol et al., 1979	Interview and observation	4,500	Hobel's modified	36 17	Same, but with fetal monitoring factors	Yes	Yes		Discriminant function scores	Same

Winters et al., 1979	Black and Hispanic women having live infants	Interview and records	62	Nobel's	Same	Same	Yes	Yes	Yes	Same	Same
Kessner et al., 1973	Registered live births; link birth and death certificates	Records	142,017	Social-Medical Risk Score	6 4	Categories of medical-obstetrical Sociodemographic	Yes	Yes		1 point for each category present; if has at least 1 social and 1 medical, risk = high risk	Mortality
Kaminski et al., 1973	Selected group of multigravida married women, urban, and with live births	Interview and observation	4,008	None	13	Sociodemographic, previous pregnancy history	Yes			Multivariate scores for each factor; sum; weight of score varies with outcome	Morbidity
Donahue and Wan, 1973	Systematic sample of all live births	Records	1,716	Total Risk Score	9	Age, gravidity, past pregnancy history	Yes			Multivariate score for each factor; factor value for each factor; multiply score and value; sum	Prematurity
Haeri et al., 1974	All women delivered of a single fetus	Records	7,912	None	10	Sociodemographic, obstetrical history, height, and medical history	Yes			Arbitrary points; 3 different scoring systems; C most rigorous	Mortality
Halliday et al., 1980	Deliveries at small hospital, mostly Black	Records	1,268	Haeri's scoring system	36	Same	Yes			Arbitrary weights of 1-4 given	Prematurity mortality
Stembera et al., 1975	All deliveries with follow-up of infant	Observation	3,500	HPLN[f] Score H = history P = prenatal L = labor N = neonatal	123	Socioeconomic, past pregnancies, present pregnancy, and labor	Yes	Yes	Yes	Multivariate score based on frequency in poor outcome group multiplied by factor of seriousness; sum	Morbidity mortality

Table 1 Continued

Reference	Study Methods: Design	Data Sources	No. of Subjects	Risk Assessment Method: Title	No. of Factors	Factors Included	Stage When Collected: Prenatal	Intrapartum	Neonatal	Scoring: Manner of Scoring	Outcome of Interest
Coradello et al., 1975	Unknown; retrospective prospective	Unknown Unknown	1,067 230	None	41	Not specified	Yes	Yes		Not specified	Mortality
Als and Brazelton, 1975	Neurologically suspect infants followed for 7 years	Observation	53	Brazelton Exam	46	Behavioral, neurological, vigor and attention, motor activity, and tone autonomic response			Yes	Behavioral factors get 9 points, reflex measures get 4 points; sum	Neonatal morbidity
James et al., 1976	Women electronically monitored	Records	665	FHR-UP§ Monitoring Score	10	Characteristics of fetal heart rate and uterine pressure		Yes		Used Receiver Operator Characteristic Curve and clinical experience to weight factors	Neonatal morbidity
Fedrick, 1976	Cases = spontaneous preterm births	Unknown	283	None	10	Demographic, previous pregnancy history	Yes			Calculate relative risk for each factor; multiply relative risks for score	Prematurity
	Compeers sample of singleton births: retrospective		510								
Edwards et al., 1979	Women delivering consecutively in hospital	Observation	2,085	None	67	Demographic, obstetric, medical, and other	Yes	Yes		Arbitrary; based on importance to outcome; weights = 1 (good) to 7	Neonatal morbidity and mortality

[a]Observation = data collected by examination of the mother of the infant.
[b]Records = data collected through the use of existing records: medical, birth certificates, death certificates, etc.
[c]Maternal Child Health Care Index = MCH Care Index.
[d]Interview = the risk instrument requires data obtained directly from the other mother--more than what is routinely collected in hospitals.
[e]43 in first analysis, 27 in final analysis.
[f]HPLN = history, prenatal, labor, neonatal.
[g]FHR-UP = fetal heart rate, uterine pressure.

with outcomes such as perinatal mortality or morbidity, rather than on data concerning maternal mortality or morbidity.

The stage of pregnancy when factors are assessed can affect the accuracy of the prediction and the timeliness of intervention or prevention (Chng et al., 1980). Of the 19 systems, 15 require assessment of the woman prenatally; 8 require assessment of the woman only during the prenatal period, e.g., Nesbitt et al. (1969), Goodwin et al. (1969). Thirteen methods include intrapartum factors, and six assess the neonate. Two scoring methods are used solely for assessment of infants: the Apgar Score (Apgar, 1953, 1966) and the Brazelton Method (Brazelton, 1973). Hobel (1977, 1978), Hobel et al. (1973, 1979), Prechtl (1967), and Stembera (1975) provide for collection of information during the entire pregnancy, i.e., prenatally through labor and delivery, including assessment of the neonate's characteristics.

The manner of scoring each risk factor is handled uniformly by arbitrarily assigning a weight based on reports in the literature and on experience. Most of the scoring systems are easy to use; indeed, this characteristic is frequently cited as a criterion in developing the system. Even in systems in which scores were obtained by using a multivariate technique, arbitrary decisions were made at some point, e.g., level of seriousness of risk (James et al., 1976; Stembera et al., 1975). In some of the methods, attempts were made to accommodate weights to different outcome factors by using multiple regression techniques and discriminant function analysis (Donahue and Wan, 1973; Hobel, 1979; James et al., 1976; Rantakallio, 1969).

Biochemical measures and fetal monitoring are occasionally used together with existing risk assessment methods. Yeh et al., (1977) combined them with the suggestion of Goodwin et al. (1969); Chik et al. (1979) did the same with the Hobel (1973) method. James et al. (1976) developed a scoring system for fetal monitoring and uterine contraction data. Appropriate use of biochemical indices to predict outcome requires detailed knowledge of the biochemical process (Tulchinsky, 1980). A thorough understanding of findings concerning fetal heart rate and judicious decisions about their clinical importance are necessary for successful prediction of outcomes (Chik et al., 1979).

PREDICTIVE POWER OF THE METHODS

Evaluation of the ability of a screening test to predict an outcome successfully entails knowledge of the test's sensitivity, specificity, and predictive value as well as information on the frequency of occurrence of the outcome (Table 2). Many of the reports referenced in Table 2 did not contain the requisite information. Therefore, the screening parameters presented in the table were calculated from the data presented by the authors. In some instances numbers were extracted from graphs in which only percentages were displayed. An attempt was made to standardize all parameters for purposes of comparison. Lesinski (1975) has reviewed the risk assessment literature emphasizing the clinical elements in screening. The following comments are focused on

TABLE 2 Predictive Power of Obstetrical Risk Assessment Methods

Reference	Titles and Scores for Risk	Prevalence of Risk			Ability of High- and Low-Risk Scores to Predict a Given Outcome[a]																	
					Neonatal Complications						Low Birth Weight (LBW)						Perinatal Death					
		high (%)	medium (%)	low (%)	inci (%)	sens (%)	spec (%)	fal+ (%)	fal- (%)	% low-risk with problem	inci (%)	sens (%)	spec (%)	fal+ (%)	fal- (%)	% low-risk with problem	inci (%)	sens (%)	spec (%)	fal+ (%)	fal- (%)	% low-risk with problem
Apgar, 1953	Apgar Score: high = 0-2 med = 3-7 low = 8-10	6	18	76													1.2	92	77 (Neonatal only)	23	8	0.1
Prechtel, 1967	Obstetrical score: high = 7+ med = 2-6 low = 0-1	12	68	19	38	16	23 (Neurological only)	10	14	28												
Larks and Larks, 1968	No title: Multivariate scoring	Not known															R^2 for stillbirth = 41%[b] R^2 for death in 2 years = 41%					
Nesbitt and Aubry, 1969	MCH Care Index: high = 0-70 med = 71-84 low = 85-100	30	39	31	6	47	32	28	19	4	13	43	33	27	23	10	3	43	31	29	27	2.6
Wilson and Sill, 1973	MCH Care Index: high = 0-40 med = 41-89 low = 90+	8	72	20													17	6	22	8	15	13
Aubry and Pennington, 1973	MCH Care Index plus Labor Index: high = none low = none	21		79							8.4	63	82	17	37	4						
Goodwin, et al., 1969	Antepartum Fetal Risk Score: high = 7-10 med = 1-6 low = 0	7	69	24													15	46	28	0	0	0
Hebb et al., 1980	Antepartum Fetal Risk Score: high = 4+ med = 1-3 low = 0	10	75	15													2.6	86	15	8	1	0.2

Coopland et al., 1977	Antepartum Fetal Risk Score: modified highest= 7+ high = 3-6 low = 1-2 lowest = 0	Not known			% highest risk with it = 50% % lowest risk with it = 5%						% highest risk with it = 13% % lowest risk with it = 1%						% highest risk with it = 11.0% % lowest risk with it = 0.4%		
Yeh et al., 1977	Antepartum Fetal Risk Score, of fetal monitoring: high = 4+ low = 0-3	28		72	% high risk with it = 22% % low risk with it = 13%														
Morrison and Olsen 1979	Antepartum Fetal Risk Score: high = 3+ low = 0-2	19		81													1.9	70	82	18	30	0.7
Butler and Alberman, 1969	No title: Multivariate Score of 800 (high risk) to -800 (low risk)	Not known															Highest risk = 85/1,000 death rate Lowest risk = 8.9/1,000 death rate					
Alberman and Goldstein, 1970	No title: high = presence of any 1 factor	13		87	1.4	26	87	13	74	1.2												
					(Handicaps only)																	
Effer, 1969	Prognostic Risk Score: high = 51+ low = 0-50	(high risk group) 46 (Random group) 11		54 89	38 (1 minute Apgar only, high-risk group only)	55	62	38	45	31												
Rantakallio, 1969	Discriminant Function Score: high = probability of poor outcome is 50%	14		86													2.4	30	87	13	70	2
Hobel et al., 1973	Screening to Predict High-Risk Neonates: high = 10+ low = 0-9 4 groups with prenatal and intrapartum scores	16 HH	20 LH	18 HL	46 LL	16 high/high	36 low/high	51 high/low	12 low/low	19	6					4	59	48	14	4	0.3	

TABLE 2 Continued

Reference	Titles and Scores for Risk	Prevalence of Risk			Ability of High- and Low-Risk Scores to Predict a Given Outcome[a]																	
					Neonatal Complications						Low Birth Weight (LBW)						Perinatal Death					
		high (%)	medium (%)	low (%)	inci (%)	sens (%)	spec (%)	fal+ (%)	fal- (%)	% low-risk with problem	inci (%)	sens (%)	spec (%)	fal+ (%)	fal- (%)	% low-risk with problem	inci (%)	sens (%)	spec (%)	fal+ (%)	fal- (%)	% low-risk with problem
Hobel, 1976	Hobel's updated Same	16 HH (Groups defined by being at high or low risk)	23 LH	16 HL	45 LL	16	37	51	12	18 High	6 Low						3	54	47	14	2	0.2	
							Poor weight gain			48	7											
Hobel, 1979	Hobel's: high = 10+ low = 0-9	18		82		54	72	28	46	12												
						(Prenatal factors only)																
						94	28	72	6	6												
						(Prenatal and intrapartum)																
Sokol et al., 1977	Hobel's: high = 10+ low = 0-9 4 groups with prenatal and intrapartum risks	26	20	23	31												3	82	31	24	0	0
Sokol et al., 1979	Hobel's modified: (not known)	Case-comparison																				
																	High-risk group = 46% death rate Low-risk group = 12% death rate					
Chik et al., 1979	Hobel's, modified: discriminant function scores used	Not known		33	93 (One minute Apgar as outcome; risk and monitoring data)	87	13	7	4													
Winters et al., 1979	Hobel's: high = 40+ low = 0-39	41		59	48	52	70	30	48	39												
Kessner et al., 1973	Social-Medical Risk Score: high = 2+ handicaps, 1 social & 1 medical	55		45							12	72	48	52	28	7	2.2	75 (Infant deaths only)	46	54	25	1

Kaminski et al., 1973	No title: multivariate score: high score = high risk; amount varies with outcome	16 8.5+	22 (Score for low birth weight as outcome)	62 0-5 0.5							4	39	63	15	36	2			
Donahue and Wan, 1973	Total Risk Score; multivariate score quartiles used for risk: high = upper 25% low = lower 25%	25	50	25													33 (Neonatal deaths only)	43	29	16	16	22
Haeri et al., 1974	No title: 3 systems, used here: high = 4+ low = 0.3	12		88													3	28	89	11	72	2
Halliday et al., 1980	Haeri's Scoring System: high = 7-16 med = 4-6 low = 0-3	26	36	38	7 (Neonatal transfer to large hospital)	64	40	23	13	2.5							1.4 (Neonatal deaths only)	67	38	25	6	0.2
Stembera et al., 1975	HPLN[c] Score: high = HP 30+ HPLN 40+ multivariate scoring	Not known					Population (%)		Morbidity (%)									Population %		Perinatal + infant deaths %		
					H+P		16		31								H+P	16		40		
					H+P+L+N		14		51								H+P+L+N	14		73		
Coradello et al., 1975	No Title: high = 51+ low = 0-50	Not known?									19 (Risk assessed at delivery)	58	86	14	42	10						
											6 (Risk assessed prenatally)	77	78	22	23	2						
Als and Brazelton, 1975	Brazelton Method: high = not stated	40		60	28 (Neurologically abnormal at 7 years of age)	80	76	24	20	9												
James et al., 1976	FHR-UP[d] Monitoring Score; multivariate scoring: high = 51+ low = 0-50	44		56	54	60	76	24	40	38												
Fedrick, 1976	No title: high = 5+ med = 1-4 low = 0	0.6 (Primiparae)	39	60	1.8 (Primiparae, early gestation only)	9	60	0.4	30	0.9												

TABLE 2 Continued

Reference	Titles and Scores for Risk	Prevalence of Risk			Ability of High- and Low-Risk Scores to Predict a Given Outcome[a]																	
					Neonatal Complications						Low Birth Weight (LBW)						Perinatal Death					
		high (%)	medium (%)	low (%)	inci (%)	sens (%)	spec (%)	fal+ (%)	fal- (%)	% low-risk with problem	inci (%)	sens (%)	spec (%)	fal+ (%)	fal- (%)	% low-risk with problem	inci (%)	sens (%)	spec (%)	fal+ (%)	fal- (%)	% low-risk with problem
Edwards et al., 1979	No title: high = 7+ low = 0-6	Not known)			26	75	63	37	25	12												

[a]inci = incidence of the occurrence of the outcome in the population studied.
sens = sensitivity of the screening tool; percent of those with the outcome who were correctly labeled "high risk" for it.
spec = specificity of the screening tool; percent of those without the outcome who were correctly labeled "low risk" for it.
fal+ = false positive rate of the screening tool; percent of those without the outcome who were erroneously labeled "high risk" for it.
fal- = false negative rate of the screening tool; percent of those with the outcome who were erroneously labeled "low risk".
% low risk with problem = percent of those labeled "low risk" who actually experienced the outcome (problem).
[b]R^2 = multiple correlation.
[c]HPLN = History, prenatal, labor, neonatal.
[d]FHR-UP = Fetal heart rate, uterine pressure.

the screening parameters of the risk assessment methods reviewed, 1953-1980, and outlined in Table 2.

The scoring for risk is described in detail because it often varies--even when one researcher is using the method of another. For example, Wilson and Sill (1973) used a high score of 0-40, whereas the originators, Nesbitt and Aubry (1969), used a high score of 0-70. Likewise, Hebb et al. (1980) used a high score of 4+ when applying the system designed by Goodwin et al. (1969), who used a high score of 7+. The chosen cut-off points, i.e., 0-40 or 0-70, 4+ or 7+, affect the proportion of the population declared to be at high risk. Thus, the variation between studies in which the same methods were allegedly used diminishes comparability but enhances the possibility of ascertaining which cut-off points are most effective (assuming other aspects of study methodology are comparable). The presentation of high-, medium-, and low-risk information in Table 2 facilitates such comparisons.

Scores are provided for middle-level risk, but details of sensitivity and false positive rates are given for the highest risk group only. Specificity, false negative rates, and percentage of low-risk women experiencing the outcome refer to the lowest risk group examined by the author. The issue of nonconventional birth settings would usually apply to the lowest risk women. For the sake of simplicity, the middle-risk group is excluded because the values for this group lie between the two extremes.

Screening parameters cannot be properly evaluated without information on the proportion of the group at each level of risk and on the outcome factor (disease). Frequencies in each category affect the accuracy of prediction. The incidence rate is provided for the outcome measures displayed in Table 2, i.e., neonatal complications, low birth weight, and perinatal death. A measure of incidence rather than prevalence was used because these conditions do not endure as long as conditions such as cancer or diabetes. (Incidence rates refer to the number of new cases of a disease in a specific time period for a population at risk; prevalence rates refer to the number of existing cases of a disease at a specific time for the total population.) The incidence rate is given for the entire population studied irrespective of the level of risk.

Predictive value is especially sensitive to the incidence (or prevalence) of the outcome. Because the predictive value is actually the incidence rate of the outcome for a certain risk group, it often mirrors the incidence rate in the general population. Where it does not mimic the population rate, there are probably significant differences between that risk group and the expected rate. In Table 2 the predictive value of the low-risk assignment is presented in reverse, that is, the percentage of the low risk group that experiences the undesirable outcome is given because pregnant women assessed as low risk are slated for less exhaustive diagnostic monitoring.

Authors varied as to which outcomes they considered important. Specific outcomes and the number of publications in which they were reported are as follows:

Neonatal or perinatal mortality	20
Neonatal morbidity	14
Early gestational age at birth	7
Low Apgar score	7
Low birth weight	6
Intrapartum complications	2
Maternal complications	1

In the studies reviewed, perinatal mortality received the greatest amount of attention. Most of the authors included at least one of the following three outcomes: neonatal complications, low birth weight, and perinatal death (see Table 2).

FINDINGS

The interplay between incidence of conditions, sensitivity, and predictive value is illustrated in Table 2. Richards and Roberts (1967) point out that if 5 percent of a population is at high risk, the incidence of an outcome must be 16 times higher in the high-risk group than in the low-risk group before the sensitivity of the risk assessment can reach 80 percent, the acceptable minimum. The Apgar (1953) score fits this criteria: 6 percent of the group was declared high risk, the incidence of perinatal death is 1.2/100, the sensitivity of the score is 92 percent, and 22 percent of the high-risk group died versus 0.1 percent of the low-risk group. The death rate is 22 times higher in the high risk group. Data from Nesbitt and Aubry (1969) indicate that sensitivity is not necessarily influenced by the incidence of the outcome while predictive value clearly is affected. The incidence rate of low birth weight is 13 percent and the incidence of perinatal death is 3 percent, but the sensitivity of the high-risk label is the same, 43 percent. Predictive value, on the other hand, varies with incidence; the predictive value of the high-risk assignment with low birth weight as the outcome is 20 percent, and with perinatal death it is 4 percent.

The role of sensitivity is to permit correct assignment of women with undesirable outcomes to a high-risk group prior to actual fulfillment of the outcome. Thus, the more sensitive a measure, the more often a woman will be correctly identified as high risk. Frequently a trade-off must be made between sensitivity and specificity; an increase in one may yield a decrease in the other. Hobel's method had a sensitivity of 37 percent with specificity of 51 percent using 126 factors and a dichotomized scoring system. In order to increase sensitivity, a multivariate scoring technique was applied to the data using 39 factors; the yield was a sensitivity of 94 percent but specificity decreased to 28 percent. The rate of false negatives also decreased from 18 percent to 6 percent, but this represents an improvement for obstetric risk assessment because fewer women are incorrectly assigned to a low-risk group.

Among the methods which used neonatal complications as an outcome,

the highest sensitivity (94 percent) was achieved by Hobel's method in 1979 with multivariate scoring, followed by Edwards et al. (75 percent) in 1979 and by Nesbitt and Aubry (47 percent) in 1969. The latter two methods employed arbitrary weights for the risk factors. There is only a slight indication of correlation between the number of risk factors assessed and the level of sensitivity. Any real association is masked by the differences in the populations studied.

Specificity is increased when fetal monitoring is included. Chik et al. (1979) used Hobel's method, plus fetal monitoring, to achieve sensitivity and false negative rates similar to those Hobel's method achieved with multivariate scoring. However, the specificity is much higher with the method of Chik et al.: 87 percent versus 28 percent. Indeed, monitoring seems to carry a high specificity with it; yet, when used alone, it appears to have a high false negative rate. For example, the method of James et al. (1976) yields a 40 percent false negative rate while Chik et al. (1979), using monitoring and Hobel's risk assessment scheme, have only a 7 percent false negative rate.

Low birth weight was an outcome variable for very few (six) of the reviewed articles. Only two of them contain enough information to permit comparisons. Nesbitt and Aubry (1969) attained a sensitivity of 43 percent with their index, which was applied only at the initial prenatal visit. Later, Aubry and Pennington (1973) added a labor index that increased sensitivity (63 percent) and specificity (82 percent) but also increased the rate of false negatives (37 percent). The method of Kaminski et al. (1973), using multivariate scoring, did not improve on that of Aubry and Pennington (1973). The proportion of women labeled low risk who deliver a low birth weight infant is small when information about labor is included.

Risk assessment activities have tended to concentrate on prediction of perinatal or neonatal mortality. Apgar's (1953, 1966) scoring system has the highest level of sensitivity (92 percent) and one of the highest levels of specificity (77 percent) of all the systems reviewed for predicting neonatal mortality. This accuracy is due to the direct observation of the neonate at birth, which is necessary to obtain the Apgar score. The other systems use information available during the prenatal period and attempt to predict perinatal outcome long before the infant appears in the delivery room. They are subject to less accuracy than the Apgar score.

The methods of Nesbitt and Aubry (1969) and Goodwin et al. (1969) achieved similar sensitivity (43 percent and 46 percent) using prenatal information only. Hobel's (1976) system, which includes the prenatal-through-delivery period, improved the sensitivity to 54 percent; it also improved the specificity (47 percent). Three studies (Goodwin et al., 1969; Hebb et al., 1980; Morrison and Olsen, 1979), using somewhat comparable methodology, employed the Goodwin et al. instrument but used varying cut-off points to assign high risk. The originators of the scheme achieved the lowest levels of accuracy (sensitivity, 46 percent; specificity, 28 percent). Their cut-off point of 7+ eliminates false negatives because it was assigned with knowledge of the level of risk at which no more deaths occurred. Morrison and Olsen's (1979) method has a very high false negative rate (30 percent) as well as a high

level of specificity (70 percent). Examination of the study methods of each investigation suggests the strength of the approach of Hebb et al. (1980) and indicates that its screening parameters are probably the best representation of the method's power.

The multivariable instrument of Hobel et al. (1973) has been used by several investigators other than the orginator: Chik et al. (1979), Sokol et al. (1979, 1980), and Winters et al. (1979). All of these groups have similar study designs. Winters et al. (1979) did not ascertain mortality. Comparing the findings of Sokol et al. (1979) with those of Hobel et al. (1976), it is interesting to note that the screening parameters produced by Sokol and associates are better than Hobel's: the sensitivity is 82 percent versus 54 percent; the false negative rate is 0 percent versus 2 percent. However, as sensitivity increased to 82 percent, the specificity decreased to 31 percent for Sokol's study, compared to 47 percent in Hobel's study. The incidence rates for mortality were equal. Sokol et al. (1979) had 26 percent of their group at high/high risk while the similar figure in the Hobel et al. (1976) study was 16 percent. Both investigative teams used the same cut-off points for high risk. Probably the two populations studied varied in other ways to account for some of the differences in the parameters. Several authors (Hobel, 1978; Stembera et al., 1975; Winters et al., 1979) have suggested that cut points will have to be determined for each population to which a risk assessment is applied.

None of the methods reviewed place many women with perinatal deaths at low risk incorrectly. The predictive value of a low-risk label for subsequent perinatal death is high, i.e., 98 percent of women in the low-risk group have live infants at the end of the perinatal period. Only the method of Donahue and Wan (1973) carries an unacceptable level of risk. Possibly, this is due to the assignment of weights based on prematurity, not mortality, as the outcome variable. Sokol et al. (1977) have noted that inclusion of the intrapartum risk assessment greatly enhances the prediction of perinatal death. Stembera et al. (1975) show similar improvement, rather dramatically. Using only historical and prenatal factors the predictability is 40 percent; it rises to 73 percent when factors for the entire pregnancy, labor, and neonatal period are included.

SCREENING CRITERIA IN UNCONVENTIONAL SETTINGS

Risk assessment is used as a screening tool in developing countries to decide where limited resources will be allocated (World Health Organization, 1978). In Great Britain, women were booked for delivery at home, in general practioners' clinics, or in hospitals. The bookings were based on characteristics predisposing to problems in the delivery (Butler and Alberman, 1969). Risk factors are assessed in the United States when families desire delivery in unconventional birth settings that do not have major life-supporting equipment immediately available. Use of risk criteria by lay midwives is not well documented in the literature, although personal communication with several midwives suggests that, when criteria are used, they are applied vigorously.

Bennetts (1982) studied 11 nonhospital childbearing centers administered by certified nurse midwives throughout the United States in 1981 (see Appendix C). Every center has admission criteria based partly on risk assessment. Only one center had no written criteria at the time of the study; a risk assessment was carried out by the certified midwife for admission to the center.

The factors assessed by the nonhospital childbearing centers are analogous to those in Table 1, but the centers tended to vary in the degree to which the factors were applied. Five of the centers used absolute criteria for admission, that is, the mere presence of certain factors obviates delivery in the center. The remaining centers employed a risk scoring system similar to those in Tables 1 and 2.

A woman labelled low risk and acceptable for delivery at a center may develop complications during pregnancy, labor, or delivery, or the neonate may have a problem. Therefore, intrapartum and postpartum transfer criteria exist. These criteria are based partly on the resources a center has for handling an emergency and partly on the risk a complication implies for further, more serious outcomes.

Bennetts (1982) sampled records from each center and obtained information about the proportion of women who began labor in a childbearing center and were transferred. This transfer rate can serve as an indicator of the predictive value rate of low-risk women to become high risk. Thus, it is similar to the rate in Table 2: the percentage of low-risk women who experienced an unfavorable outcome.

According to Bennetts' data, 10 percent of women had complications before labor and withdrew from the centers. Another 15 percent of those who began labor in the centers developed complications during or after labor and were transferred. Only one percent of infants required transfer. The predictive value of low-risk labelling by the time labor begins is 85 percent because 15 percent of women required transfer. Note that commonly used risk assessment methods are aimed at predicting perinatal mortality and not maternal or intrapartum complications. In Table 3 the rates in the childbearing centers compare favorably with those of Nesbitt and Aubry (1969), especially for neonatal problems. Of interest is the fact that 14 percent of the transfers from the centers to hospitals experienced no actual complication during labor or delivery (Bennetts, 1982). The datum is testimony to the false positive rate of some of the risk assessment methods used.

DISCUSSION AND SUMMARY

Weakness in Current Methods

1. Only one of the 33 papers presented in Table 1 included information on the ethnic group of study participants. The major demographic factors of age and ethnic group have been virtually ignored in developing weights for risk factors. Inattention to epidemiological factors probably contributes to the inability to apply the same methods in different populations and obtain similar predictability. Separate weight-

Table 3 Risk of Complications in Pregnancy

Study	Percent of Low Birth Weight with Maternal Complications	Intrapartum Complications	Neonatal Complications
Bennetts, 1982	10	15	1
Nesbitt and Aubry, 1969	24	15	4
Wilson and Sill, 1973		7 (cesarean section only)	

ing and scoring systems should be developed for each age group, ethnic group, and social level at least.

2. Past pregnancy history is a large component of most risk assessment methods reviewed. These methods are better at screening multigravada women for risk than primigravida women; e.g., Fedrick's (1976) method for predicting early gestational age had a sensitivity rate 64 percent higher when applied to multiparae women than when it was applied to primiparae women. Separate risk assessments need to be developed for primigravida women.

3. Reliability or repeatability of obstetric risk factor assessment is rarely addressed in the literature, yet women can be incorrectly labelled through misuse of the instrument. Hobel et al. (1973) include a handbook of definitions and instructions in the way to use their forms. Other authors (Edwards et al., 1979; Haeri, 1974) prefer simpler approaches. However, reliability in application of screening criteria is especially important when assessment is made only once in the prenatal period.

4. Expectations for what a risk assessment can do are often misaligned with the technique's real capability. In using the risk assessment approach, it is important to recall that the risk factors and weights are derived from population or grouped data. Most of the accusations of harm associated with using the risk approach are due to lack of appreciation for the "ecological fallacy" (Parmelee and Haber, 1973; Richards and Roberts, 1967; Wilson and Schifrin, 1980).

The risk inherent in any group may not apply to an individual member of the group. The fallacy is that the probabilistic risk of an outcome is assigned to an individual; i.e., whatever is true for the group is supposed to be true for the individual group member. However, the individual may or may not suffer the undesirable outcome. It is fair to say, "This person may be at higher risk," but is incorrect to say, "This person will experience the outcome because of the presence of these risk factors." The predicted risk of a neonatal death in

Hobel's high/high risk group is 11 percent. The neonate's actual risk is either 0 percent or 100 percent. The neonate will either survive or die; the neonate will not partially die or be 11 percent dead. Thus, even though a woman belongs to a particular group, she may not suffer any undesirable outcome. The reverse is also possible; a woman possessing none of the known risk factors for neonatal death may lose her infant.

In obstetrics, death is a rare event and therein lies the need to examine realistically the probability of poor outcomes. The performance of screening to assign correctly women who will have no problems during pregnancy and child birth to a low-risk group should be seriously considered. From the point of view of alternative birth centers, high false negative rates vis-a-vis perinatal death are anathema to the concept of women delivering out of hospital. The main risk is two percent or less, and among all women labelled low risk, fewer than 3 per 1,000 will experience a perinatal death. This is much lower than the national perinatal mortality rate.

Very little can be gleaned from existing literature on risk assessment methods regarding successful prediction of maternal/intrapartum complications or neonatal morbidity. In general, false negatives are high--usually over 20 percent of women or their infants experiencing undesirable outcomes are incorrectly assigned to a low-risk group. More work must be done in this area. From Bennetts' (1981) study it is also evident that 14 percent of women transferred for predicted complications do not experience any complications. At this time, morbidity in pregnancy and neonates cannot be predicted as accurately as death.

Summary

Thirty-three risk assessment articles were reviewed in detail, comprising 19 methods of assigning levels of risk for undesirable outcomes in pregnancy. The predictive power of the methods as screening tools was examined. Most of the methods are based on the prediction of perinatal death, which hampers their utility for predicting less severe outcomes.

Three major systems emerge from the literature: (1) the Nesbitt and Aubry (1969) Maternal-Child Health Care Index plus the Aubry and Pennington (1973) Labor Index, (2) the Goodwin et al. (1969) Antepartum Fetal Risk Scoring system, and (3) Hobel's (1973) Problem-Oriented Risk Assessment system. Numerous other authors proffer their methods, but they are all similar to one of the three major ones. Factors used by each system are similar; it is the importance, or weight, given to each factor and how it is derived that varies. Generally, systems that include prenatal and intrapartum information appear most successful, i.e., strike a good balance between sensitivity and specificity.

The cut points for declaring risk level are important and probably should be derived for each population, as should the weights. However, weighting of factors is problematic because we have no "pure" measure of risk--i.e., associating a characteristic with a negative outcome

prompts intervention, which interrupts the causal chain and distorts the relation of the factor to the outcome. This is as it should be, but predictive power of risk assessment methods will be more inaccurate because of it.

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APPENDIX F Vital Statistics and Nonhospital Births: A Mortality Study of Infants Born Out of Hospitals in Oregon

Nancy Clarke in consultation with Anita B. Bennetts

Delivering infants in settings other than hospitals became increasingly common in Oregon during the late 1970s. In 1974, only 1.5 percent of all births took place in freestanding clinics, doctors' offices, homes, and other nonhospital addresses, compared with 3.9 percent by 1979 (Oregon Center for Health Statistics, 1981, and unpublished data, 1981). The number of births not attended by a physician also increased. In 1974, 1.2 percent of all Oregon births were attended by a lay midwife, certified nurse midwife, chiropractor, naturopath, relative, friend, or other person, compared with 2.4 percent in 1979 (Oregon Center for Health Statistics, 1981, and unpublished data, 1981). There has been a similar though less pronounced trend for the United States as a whole. The proportion of births attended by midwives increased from 1.2 percent to 1.6 percent between 1977 and 1979 (National Center for Health Statistics, 1981). These changes in birth sites and delivery attendants have stimulated an interest in the safety of nonhospital births.

It is extremely difficult to assess the relative safety of births occurring in various settings with different providers. Definitive assessments cannot be made until results have been obtained from prospective studies that can control for maternal risks, demographic and social characteristics, and intended delivery sites, and that can assess outcomes in terms of morbidity for both mothers and infants. An important preliminary step in designing these studies is to review existing data on births and subsequent deaths for infants born elsewhere than in a hospital. Mortality rates provide only crude indicators for measuring birth outcomes, and retrospective studies using data collected for entirely different purposes introduce many measurement problems. Concluding that a causal relationship exists when mortality rates vary between subgroups is inappropriate. Nevertheless, vital statistics provide a relatively inexpensive means for generating hypotheses about providers, sites, and populations for further study. Also, the comprehensive coverage of vital data plays a crucial role in emphasizing the diversity of the providers and sites that must be included in the description of nonhospital births. Finally, vital statistics can be used to identify populations with excessive mortality, thereby serving as an important tool for those interested in promoting public health.

Shy et al. (1980) used vital statistics to examine differences in infant mortality outcomes by site. They found that the infant mortality rates for freestanding birth center deliveries were lower than those for all Washington State residents and that home delivery mortality rates were higher than state resident figures. The authors cautioned that biases are built into such comparisons because low-risk pregnancies should have lower mortality rates. They recommended that prospective studies should be based on the mothers' intention to have a nonhospital delivery.

In this paper, vital records are used to examine the providers of maternity care. The following pages describe the variation in neonatal and infant mortality for births occurring in all nonhospital settings by the category of attendant indicated on birth certificates. There also follows a discussion of the context for interpreting this variation.

NONHOSPITAL BIRTHS IN OREGON

The nonhospital birth experiences vary by state. Regulations concerning the births and who may attend them are not the same, and the populations choosing a nonhospital setting may differ. A review of Dingley's published data concerning Oregon's nonhospital births (Dingley, 1977, 1979) is relevant for an understanding of the mortality rates presented in this paper.

Since 1977, approximately 4 percent of the live births in Oregon have occurred in a setting other than a hospital. Oregon law prohibits lay persons from performing episiotomies and administering medications, but no other limitations concerning birth attendants exist. Dingley's descriptions of Oregon nonhospital births for 1976 and 1977 indicated that the parents tended to be better educated than the parents selecting hospital births. There were relatively fewer teenage mothers, fewer first births, and fewer immature and low birth weight babies than for all births to Oregon residents. This suggested a demographic profile that could favor the delivery of healthy infants.

When nonhospital births were categorized by the type of attendant, however, some indicators of low-risk pregnancies did not apply to all categories. For births attended by fathers, mothers, other relatives, friends, helpers, Followers of Christ, and other attendants, excluding licensed professionals and midwives, a high percentage of mothers had achieved less than a twelfth-grade education and had received no prenatal care. Dingley expressed concern that approximately 15 percent of all the mothers who delivered out of hospital had a history of previous fetal deaths, a high-risk indicator. Her findings concerning mortality outcomes for 1976 were inconsistent with those of 1977.

These studies noted two subcultures with a large number of nonhospital deliveries: a community of Old Believers that had emigrated from Russia, and a religious community called Followers of Christ. These two groups constituted approximately one-fourth of the deliveries in the "Other and No Attendant" category.

METHOD

The 1975-1979 birth and death records for all infants born out of hospital in Oregon were examined. Those classified as "born en route" were excluded because they were assumed to have been intended hospital deliveries. Certainly other births were meant to have occurred in a hospital but have been included in this analysis because they cannot be identified. The delivery attendants for all infants weighing 1,500 grams or less were contacted to assure that death reporting was complete.

State and county staffs have done extensive field work in an attempt to ensure as close to 100 percent coverage of nonhospital births as possible. In this study, nonhospital births have been defined as all deliveries that occurred in locations other than a hospital.

The birth attendants indicated on the certificates were classified according to the following categories:

Licensed Attendant	Midwife	Other and No Attendant
Medical doctors	Certified nurse midwives	Relatives
Osteopaths	Lay midwives who identify themselves as such	Friends
Naturopaths		Helpers
Chiropractors		Followers of Christ
Registered nurses		Old Believers
Emergency medical personnel		Unknown attendants
		No attendant

These categories are certainly not ideal because there are significant differences in training and orientation, for example, between a naturopath and a physician or between a lay midwife and a certified nurse midwife (CNM). However, coding practices in 1975 and 1978 did not make finer distinctions.[1] The necessity of combining five years of data in order to provide large enough numbers for statistical reliability prohibits the use of more refined categories.

A birth was attributed to a lay midwife if the attendant simply identified herself as such or if her name appeared on a sufficient number of certificates for the birth certificate coders to recognize her name and classify her as a lay midwife. In recent years nearly all lay midwives have been identified. However, as Dingley pointed out, there are many midwives, particularly those in traditional and religious communities, who do not sign certificates, preferring to have the

[1]Data from 1976, 1977, and 1979 indicate that the midwife category consists of 57 percent lay midwives and 43 percent CNMs. The proportion of births attended by lay midwives has been increasing. In fact, 66 percent of the 1979 births in the midwife category were delivered by lay midwives. No differences in the death rates for infants delivered by the two types of midwives are apparent in the three years for which more detailed information is available.

TABLE 1 Selected Oregon and U.S. Nonhospital Births and Subsequent Death Rates (per thousand), 1970-1979

Category	Nonhospital Births Occurring in Oregon 1970-1974	Nonhospital Births Occurring in Oregon 1975-1979	All Births to Oregon Residents 1975-1979	All U.S. Births 1975-1979[a]
Births	2,224	6,398	186,187	16,444,897
Neonatal deaths	58	48	1,475	165,696
Infant deaths	81	89	2,351	236,710
Neonatal death rate	26.1	7.5	7.9	10.1
Infant death rate	36.4	13.9	12.6	14.4

[a]Includes provisional estimates for 1979.

father or another relative sign as attendant (Dingley, 1977, 1979). These cannot be identified and have been classified in the "Other and No Attendant" category.

This analysis consists of cross-tabulations of the rates, maternal characteristics, and causes of death by attendant. Caution is warranted when interpreting these results because of the small sample used, the low probability of neonatal and infant deaths, and the inaccuracies in recording and lack of refinement in categorizing data on type of attendant.

RESULTS

Infant and Neonatal Death Rates for All Nonhospital Births

Table 1 compares the figures for nonhospital births occurring in Oregon during the past decade (1970-1974 and 1975-1979) to the 1975-1979 rates for all Oregon residents and to the U.S. rates for the same period. Although the number of nonhospital births has nearly tripled, the number of neonatal deaths (deaths in the first 28 days) and infant deaths (deaths in the first year) has stayed approximately the same. As a result, the rates for both infant and neonatal deaths are considerably less than half of what they were earlier in the decade. This dramatic drop in the rates indicates that the year for which data was collected must be considered when evaluating and comparing research findings.

For the last five years, there have been only small differences between the death rates for nonhospital births and those for all residents of Oregon (see Figure 1). The infant death rate for nonhospital births is approximately one point higher (13.9 compared with 12.6). The neonatal death rate, which is a better indicator of problems associated with pregnancy and delivery, is slightly lower (7.5 compared with 7.9). Because of the small numbers involved, these differences are not statistically significant ($p < .05$). Both rates are lower than the U.S. figures for all births.

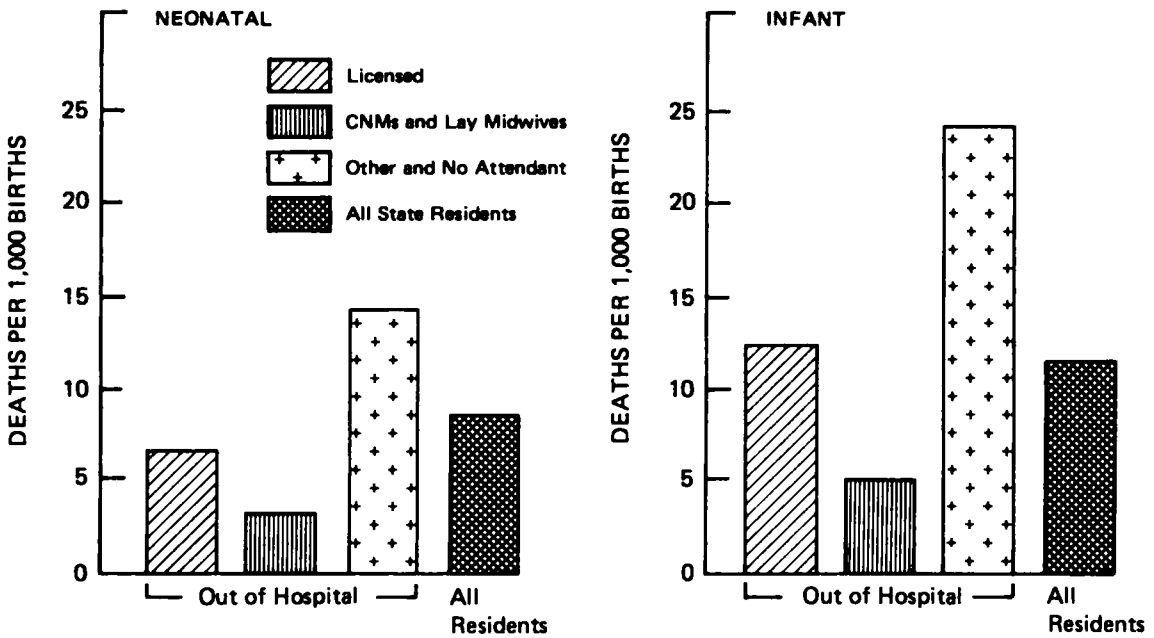

FIGURE 1 Neonatal and infant death rates for Oregon residents and for nonhospital births by attendant, 1975-1979.

Infant and Neonatal Death Rates, by Attendant

Marked differences in the reported figures by attendant are apparent in Table 2. Although the "Other and No Attendant" category accounted for only 28 percent of the nonhospital deliveries, this group contributed to more than one-half of the neonatal deaths and nearly the same fraction of the infant deaths. If the extremely small infants are eliminated and only the infants who weighed more than 2,500 grams at birth are considered, the differences become even more pronounced.

The neonatal death rate of 13.9 for the "Other and No Attendant" deliveries is more than four times higher than the rate for lay midwives and certified nurse midwives and twice the rate for the licensed medical professionals. These differences are statistically significant ($p < .05$). Although the midwife rate is one-half the licensed rate, this difference is not significant. Differences in the infant death rates show a pattern similar to that of the neonatal rates; the "Other and No Attendant" infant death rate is nearly twice the rate for the licensed attendants.

DISCUSSION

Extreme caution must be exercised when interpreting these rates. With vital records, a difference in mortality rates among settings may have little to do with the safety of a planned delivery in a nonhospital setting or with any particular attendant. The limitations associated

TABLE 2 Nonhospital Births in Oregon and Subsequent Deaths by Type of Attendant, Birth Weight, and Age at Death, 1975-1979

Category	Licensed Attendants		Midwives[a]		Other and No Attendants		Total Nonhospital	
Births	3,006	(47%)	1,597	(25%)	1,795	(28%)	6,398	(100%)
Neonatal deaths:	18	(37%)	5	(10%)	25	(52%)	48	(100%)
Unknown weight	0		0		2		2	
2,500 grams	8		1		7		16	
2,500 grams	10	(33%)	5	(13%)	16	(53%)	30	(100%)
Infant deaths[b]:	38	(43%)	8	(9%)	43	(48%)	89	(100%)
Unknown weight	0		0		2		2	
2,500 grams	12		1		7		20	
2,500 grams	26	(39%)	7	(10%)	34	(51%)	67	(100%)
Neonatal death rate[c]:								
All deaths	6.0		3.1		13.9		7.5	
Infant death rate[c]:								
All deaths	12.6		5.0		24.0		13.9	

[a]Includes CNMs and self-identified lay midwives.
[b]Nine infants delivered by nonprofessional attendants had an unknown birthweight. The seven who died during the postneonatal period have been added to the >2,500 category because all of them lived more than one month, none had any indication of being premature, and all died of causes not related to prematurity, pregnancy, delivery, or perinatal conditions.
[c]Per thousand.

with interpreting these rates are discussed in terms of measurement biases, risk factors, and causes of death--factors that may result in a misplaced emphasis on the attendants rather than on the populations served by those attendants.

Reporting Bias

The collection and coding of information from vital records introduces a number of biases in studies concerned with evaluating outcomes associated with nonhospital births. First, mortality is only a crude indicator of unsatisfactory pregnancy outcomes, and large populations are required to produce statistically significant rates. Five years of birth and death data for Oregon do not provide a sufficient population for adequately detailed comparisons. Second, the categories of attendants may be misleading. For example, although the neonatal death rate for all licensed attendants combined is 6.0 per 1,000 births, the rate for naturopaths and physicians may be vastly different. Furthermore, because the term lay midwife has no official definition in Oregon this category undoubtedly includes people with quite different skills and practices. A third factor to be considered is the possibility of incomplete registration. Although there are no means for assessing

underreporting of deaths, the severity of the consequences for failure to report a death suggests that this is probably a rare event. However, nonhospital births are known to be underreported because these births are sometimes registered after the children are more than one year old. This difference could result in exaggerated mortality rates for one group when compared with another.

A last set of important considerations concerns the differences between the reported and the intended site and provider. A midwife with appropriate physician and/or hospital backup may consult a physician as well as transfer a patient to a hospital in the event that complications arise during labor and delivery. But the birth record contains only information on the final site and provider. Therefore, the vital records identify many complicated deliveries as hospital-based or physician-attended when the birth was actually planned to be nonhospital with a midwife attendant. A bias in the opposite direction also exists because some of the nonhospital births may be deliveries for mothers who were unable to obtain medical assistance quickly when labor began. The possibility also exists that a father or other relative is asked to sign as attendant when a delivery by any attendant goes awry.

Bias Due to Variation in Risk Status

The reporting biases in the mortality rates presented in this paper are minor compared to the biases introduced in these rates by variations among the populations. The medical, social, and demographic risks presented to the different categories of attendants undoubtedly account for much of the variation in the rates. Birth certificates contain only limited information about maternal risks, and data are only available for 1976, 1977, and 1979. Nevertheless, the differences in the characteristics of mothers in the three attendant categories emphasize the necessity of considering these variables. Data concerning parental educational attainment and mothers' prenatal care show a pronounced disadvantage for mothers in the "Other and No Attendant" category.

An examination of prenatal-care history makes it apparent that the births in the third attendant category do not represent the ideal of well-screened mothers anticipating normal deliveries (Figure 2). In the three years for which information is available, more than one-fourth (28 percent) of the mothers without a licensed attendant or a midwife had received no prenatal care. For the same period, the figure is less than 1 percent for the mothers in the licensed attendant and midwife categories.

The mother's lack of education is another characteristic shown to be associated with higher infant and neonatal mortality. Of those who answered the education question on the certificates during the three-year period, slightly more than one-third of all mothers who delivered out of hospital reported exactly 12 years of education. However, 29 percent of the mothers who delivered without a licensed attendant or a midwife had less than a high-school education, compared with 13 percent

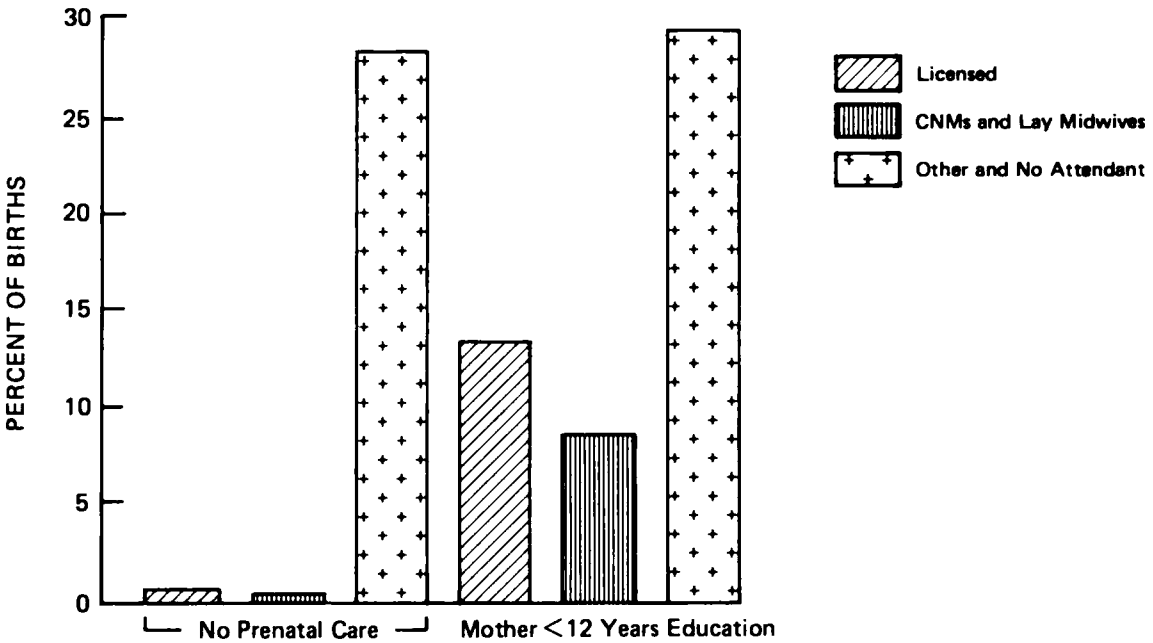

FIGURE 2 Percent of births in maternal risk category for births occurring out of hospital, by type of attendant, 1976, 1977, 1972.

of those with a licensed attendant and 9 percent of those with a midwife. Although more than one-half (53 percent) of the mothers attended by licensed professionals and midwives had some college education, only 36 percent of the "Other and No Attendant" category reported this level of education. Fathers showed patterns of educational attainment that were similar to those of the mothers.

Other data concerning varying numbers of high-risk mothers by the type of attendant are ambiguous. Although mothers with a reported complication of pregnancy accounted for 2 percent of each nonhospital attendant category (compared with 5 percent for all state resident births), it is doubtful that such problems as anemia and Rh incompatibility, which are common for medically attended births, would be diagnosed for the large number of mothers with no prenatal care and without a licensed attendant or a midwife. The risk factors concerning maternal age and pregnancy history did not vary by type of attendant.

The large differences in the educational attainment and prenatal care of the populations served by the three attendant categories used in this analysis are an indication that other medical, social, and demographic characteristics must vary as well.

Causes of Death

The above discussion of maternal risks demonstrates a need to consider not only the providers of care but also the populations served. An

TABLE 3 Nonhospital Births in Oregon and Subsequent Deaths of Infants with Birth Weights Higher than 2,500 Grams, by Type of Attendant, Age, and Cause of Death, 1975-1979

Category	Licensed Attendants	Midwives[a]	Other and No Attendants	Total Nonhospital
Births	3,006	1,597	1,795	6,398
Deaths by cause				
Pregnancy, delivery and perinatal conditions				
Neonatal	6	1	8	15
Infant	7	1	8	16
Congenital anomalies				
Neonatal	3	1	2	6
Infant	7	1	5	13
Other causes:[b]				
Neonatal	1	2	6	9
Infant	12	5	21	38
Sudden Infant Death Syndrome	9[c]	3[d]	10[d]	22
External causes (motor vehicle, drowning, accident, assault, undetermined)	1	-	5[e]	6
Pneumonia and upper respiratory tract infection	-	-	3	3
Meningitis	1	-	1	2
Malignant neoplasms	-	2	-	2
Septicemia	-	-	1	1
Skin infection	-	-	1[c]	1
Intestinal obstruction	1	-	-	1
Infant death rate (per thousand) for other causes	4.0	3.1	11.7	5.9

[a]Includes CNMs and lay midwives.
[b]From categories 000-739 and 780-999 in World Health Organization, 1977.
[c]Includes one neonatal death.
[d]Includes two neonatal deaths.
[e]Includes three neonatal deaths.

examination of the causes of death for infants born out of hospital provides further evidence that addressing the attendants rather than the population served can be misleading. Table 3 and Figure 3 present the causes of death for infants who were born out of hospital and who weighed at least 2,501 grams at birth.

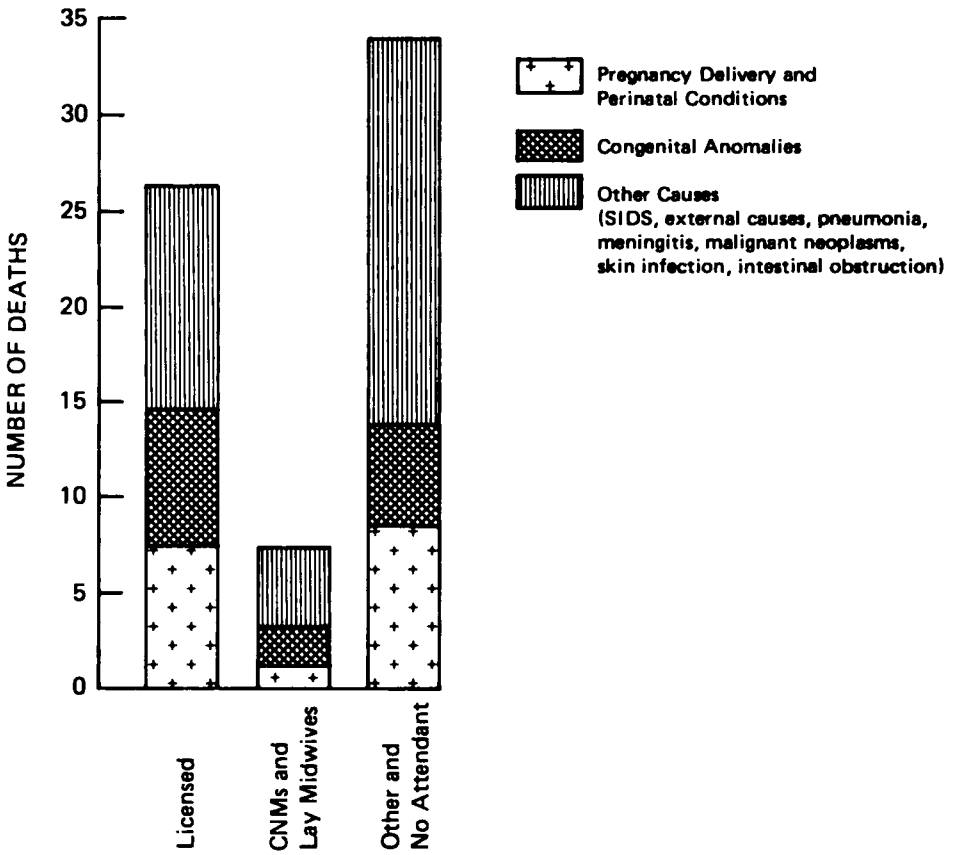

FIGURE 3 Infant deaths for births occurring out of hospital, by cause and type of attendant, 1975-1979.

More than one-half of all the deaths of infants born out of hospital were attributed to causes not directly related to pregnancy, delivery, perinatal conditions, or congenital anomalies. These other causes account for a large proportion of the differences in mortality rates between attendant categories. Nearly one-half of the neonatal deaths and almost two-thirds of all infant deaths in the "Other and No Attendant" category were attributed to causes such as Sudden Infant Death Syndrome (SIDS), external causes, and other diseases. This compares with one-sixth of the neonates and approximately one-half of the infants in the licensed attendant category. This is important because the number of infant deaths atributed to other causes was more than twice the number attributed to pregnancy, delivery, and perinatal conditions. The 21 infant deaths due to other causes in the "Other and No Attendant" category translates to a cause-specific rate of 11.7 per 1,000 births, which is significantly different from the 4.0 per 1,000 births rate for licensed attendants ($p < .05$). Differences in the rates due to perinatal conditions and congenital anomalies are not significant.

The list of other causes emphasizes the need to consider the entire social and health care environment of the population served by the "Other and No Attendant" providers. In nearly one-half (10) of the cases of other causes for other attendants, the state medical examiner could find no sign of disease and attributed death to SIDS. Another one-fourth (5) of the cases were due to external causes such as automobile accidents, drowning, and homicides. Three infants (not neonates) died of pneumonia and upper respiratory tract infections. Meningitis, septicemia, and skin infection each resulted in one death.

CONCLUSIONS

State vital statistics can be used as a basis for public health efforts to improve the outcome of nonhospital births. Such statistics can identify problem areas and suggest hypotheses for further study. Impediments to using the data include incomplete and missing information on such items as delivery site and personnel, reporting bias, and variation in risk factors associated with the population.

The data for Oregon indicate that more than one-half of the infant deaths associated with nonhospital births occurred in a population that delivered without the aid of a licensed attendant or a midwife. This same group had a poor prenatal-care history, a large proportion of parents with less than a twelfth-grade education, and, probably, a poor medical and demographic risk profile as well. In Oregon, attempts to influence the outcomes of nonhospital births will require much more investigation of those deliveries attended by relatives, friends, helpers, Followers of Christ, Old Believers, unknown attendants, and those with no attendant at all.

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