

Motherhood and Apple Pie: The Effectiveness of Medical Care for Children

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SHIFTS IN POLICY CONCERNING HEALTH SERVICES, particularly those involving reductions in public financing and provision of services, engender widespread concern about their potential adverse effect on health. Reductions in eligibility for the major source of funding for health care of poor children, Medicaid, have been occurring at the state level since the mid-1970s (Davis and Schoen 1978). Between 1980 and 1984, 10 percent of the dollars previously spent by the national government on preventive and family support programs for children, including a variety of types of health programs, were lost (Children's Defense Fund 1984). Current doubts about the lack of benefits from health services (see, for example, Illich 1976; McKeown 1979; McKinlay and McKinlay 1977) appear to be, at least in part, responsible for the absence of a mechanism to assess systematically the impact of the withdrawal of federal support from many of the programs that facilitate access to health services, particularly for the poor. As a result, it may be many years before the effects of these cutbacks are known. If they are largely adverse (as some suspect), many individuals will have been deprived of care with detriment to their health. The situation is especially serious in the case of children; various analyses suggest that poor health early in life may be difficult to reverse (Starfield and Pless 1980).

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The extent to which the effects of health care can be measured is, at best, debatable. Health is primarily a reflection of genetic endowment, the sociocultural environment, and the result of certain personal behavior. Health services may, of course, operate "at the margin," and the benefits of "Samaritanism," which lends reassurance or at least gives support to individuals troubled by illness, are largely undocumentable given the current state of the art of measurement (McDermott 1978). This does not mean, however, that the adverse effect of relative deprivation of health services, or even some of the salutary effects, cannot be measured.

A task force of the Ambulatory Pediatric Association, a national organization of health professionals involved in teaching, research, and providing services to children in the outpatient setting, was charged with the responsibility to design a project to assess the extent to which changes in financing and organization of services have an effect on use of health services and on health status in children. The first task was to choose indicators thought to be particularly responsive to health care. The remainder of this paper reports the results of a subsequent review of the literature for evidence that health care does, indeed, make a difference, at least for these conditions. It is possible only to summarize these findings. A more complete analysis—including information on incidence and prevalence, the theoretical justification for believing that medical care would be beneficial, details about the evidence regarding benefits, and specific references to additional literature—appears elsewhere (Starfield 1985a).

It is important to recognize that the effort was to document effectiveness rather than efficacy. That is, the concern was whether health services as they exist in the community have a beneficial effect on health rather than whether particular modes of therapy are efficacious when used under optimum conditions. The evidence was of three types: changes in health coincident with or following changes in important aspects of health care delivery, such as improved access to services or alterations in the organization of services; greater illness of population groups thought to be less well-covered by optimum medical services; and evidence from the clinical literature that delay in receipt of services is associated with a greater likelihood of complications or sequelae.

Benefits were also of three types: prevention of the occurrence of mortality or morbidity (as is the case for neonatal mortality, postneonatal

mortality, low birth weight, teenage childbearing, communicable diseases, and, to a large extent, acute rheumatic fever and child battering); detection of problems in their early and presymptomatic stages (as is the case for congenital hypothyroidism and phenylketonuria, iron-deficiency anemia and, to a large extent, lead poisoning); and treatment to prevent the occurrence of untoward morbidity, complications, or sequelae of illness (as is the case for diabetes, epilepsy, bacterial meningitis, appendicitis, asthma, and gastroenteritis). At least one example of each type is presented in this paper; the conditions chosen for discussion are those that most graphically illustrate the basis for certain key conclusions.

Prevention of Low Birth Weight

Low birth weight (2,500 grams or less) is an important risk factor for other problems: the lighter the infant at birth, the more the infant is at risk for death in the neonatal period and postneonatal period, for morbidity in the first year of life, for congenital anomalies, and for subsequent disability (both physical and mental).

As figure 1 records, the percentage of infants who are of low birth weight increased in relative frequency during the 15-year period from 1950 to 1964, but only among nonwhites. This increase occurred in the absence of any change in length of pregnancy; if the increase in low birth weight had been due only to migrations of at-risk populations or better registration of births, there should also have been a shift toward shorter average length of gestation. Moreover, the increase was not due primarily to changes in age distribution of mothers, rates of twinning, or sex distribution. Why it occurred is not really clear, and, unfortunately, it is not possible to determine whether it was due to changing socioeconomic characteristics, because national vital statistics data for that period contain little that would be helpful in this regard.

Since 1965, low birth weight ratios have declined somewhat; the data from New York City (Pakter and Nelson 1974) showed how striking this was in some areas and in some population groups.

A variety of studies have shown that receipt of any prenatal care is correlated with increased birth weight even when other variables are controlled. There is agreement on this point. Disagreement arises

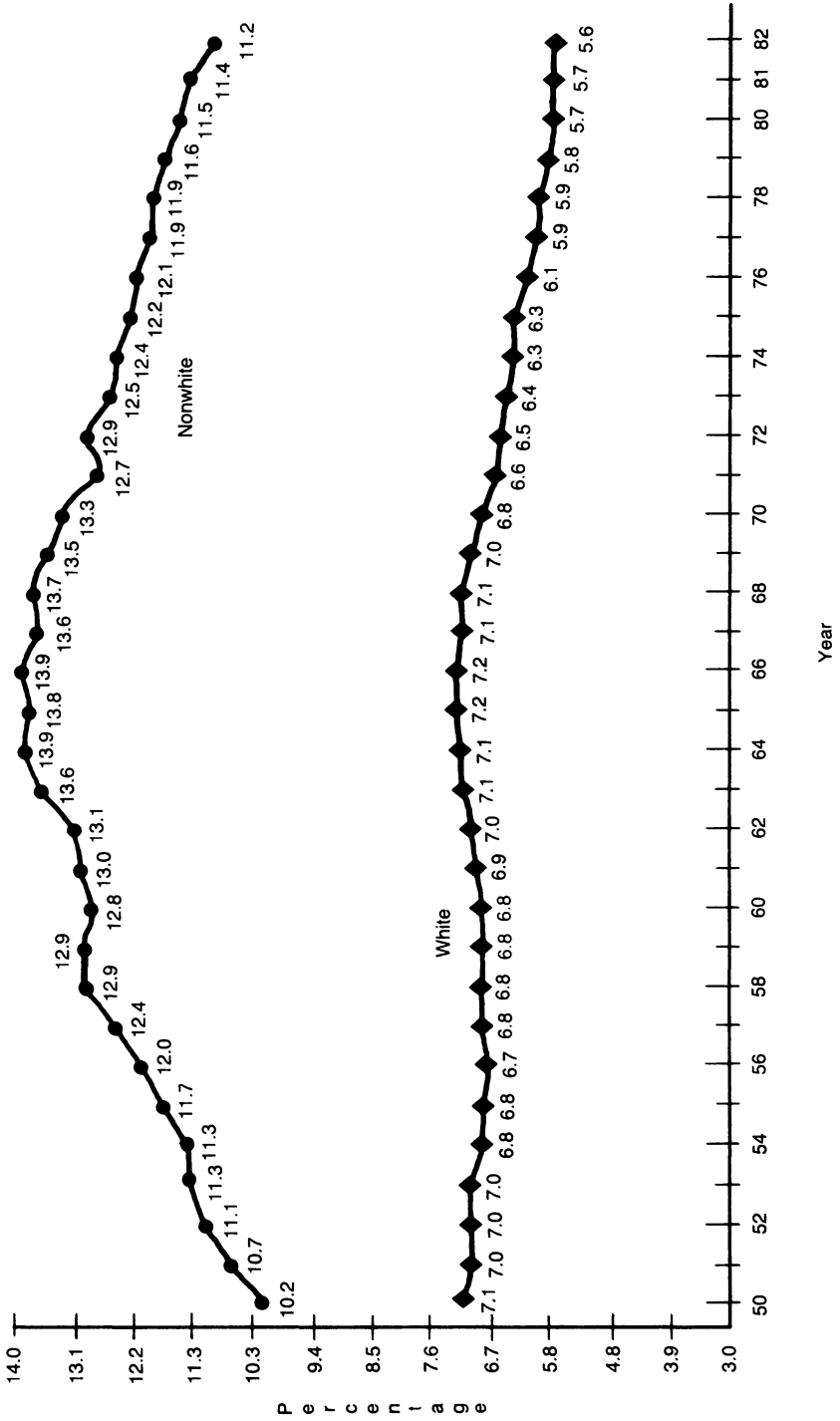


FIG. 1. Percentage of low birth rate in the United States from 1958 to 1982. Source: Vital Statistics of the United States (Natality).

when assessing the impact of the amount of that care or the impact of programs such as those instituted in the mid-1960s. On the national level, the maternity and infant care program did increase the proportion of pregnancies in which care was sought in the first trimester, but did not significantly influence low birth weight rates, even in areas where these programs were located. Evaluations of the effectiveness of the Special Supplemental Food Programs for Women, Infants, and Children (WIC) have been hampered by studies that have not been very well designed; in general they have shown insignificant or very small increases in mean birth weight among covered populations. Legalization of abortion, however, was associated with a decrease in the proportion of very low birth weight infants, at least in New York (Glass et al. 1974; Lanman, Kohl, and Bedell 1974).

An interesting but complex analysis of the effect of prenatal care was provided by the Harris (1982) study of black births in Massachusetts in the mid-1970s. His data suggest that part of the problem in studying the effect of prenatal care is that the effect is not linear. In particular, women at higher risk may seek care very early if they perceive the risk. Other women at high risk, who either do not perceive the risk or do not act on it, may seek care very late. The effect of this is that large amounts of early care may result in poorer outcome because the risks are much greater; conversely receipt of care very late in gestation may also result in poorer outcome. Harris's findings indicate that prenatal care is associated with a decrease in preterm births except for those who seek care very early. The effect of prenatal care on increasing gestational age is greater than its effect on increasing birth weight.

In the National Natality Survey of 1972, over 60 percent of the excess of those of low birth weight among the poor occurred at or near term rather than as a result of prematurity (see data in Placek 1977); that is, it was primarily a result of intrauterine growth retardation rather than premature labor. The most important correlates of low birth weight are those related to poor nutrition and poor physical condition, things that antedate the pregnancy and, hence, may be difficult to reverse during pregnancy. Therefore, it is not surprising that prenatal care, as generally provided, has little impact on low birth weight ratios among the poor. Prenatal care does serve, however, to identify women and infants at high risk of low birth weight, so that interventions that reduce the likelihood of adverse effects of low

birth weight can be instituted (McCormick, Shapiro, and Starfield 1985). Furthermore, even the relatively gloomy view of the effectiveness of prenatal care in preventing low birth weight is mitigated by evidence that some programs have had dramatic results. When nurse midwives assumed responsibility for organizing and delivering care in Madera County, California, low birth weight declined in frequency, but increased again when the program was discontinued (Levy, Wilkinson, and Marine 1971). Studies in the Health Insurance Plan of New York (Shapiro, Weiner, and Densen 1958) and more recently in the Portland, Oregon, Kaiser Permanente Plan (Quick, Greenlick, and Roghmann 1982) also indicate that health maintenance organization (HMO) patients, even those who are socioeconomically disadvantaged, have higher birth weights even though they may actually have fewer prenatal visits than apparently comparable non-HMO patients.

The conclusion reached from the literature review is the same as that reached by Shapiro, Schlesinger, and Nesbitt (1968), i.e., that "we will not fully understand the potential of prenatal care in reducing the risk of low birthweight unless we jointly consider the timing, frequency, and content of care. . . ."

Neonatal Mortality (deaths under four weeks of age)

In the 15 years between 1950 and 1965, neonatal mortality declined only slightly (figure 2). In some areas, such as New York City, it actually increased, primarily among black infants. The lack of improvement was present at all birth weights and hence was not due to changes in birth weight distributions. Shapiro, Schlesinger, and Nesbitt (1968), in an extensive review of the data, indicated that although an increase in teenage pregnancies and migrations from rural to urban areas with consequent increased birth registrations accounted for part of the increase in mortality, a very important correlate was the lag with which community facilities were developed to provide for these social changes. Another important correlate was thought to be increased overcrowding and low income that were associated with these migrations. The relatively stable rate was quite a contrast from the declines in neonatal deaths in the 1940s that had been associated with the Federal Emergency Maternity and Infant Care Program and other related programs developed to meet the urgent needs during World War II. In the mid-1960s, however, the declines reappeared.

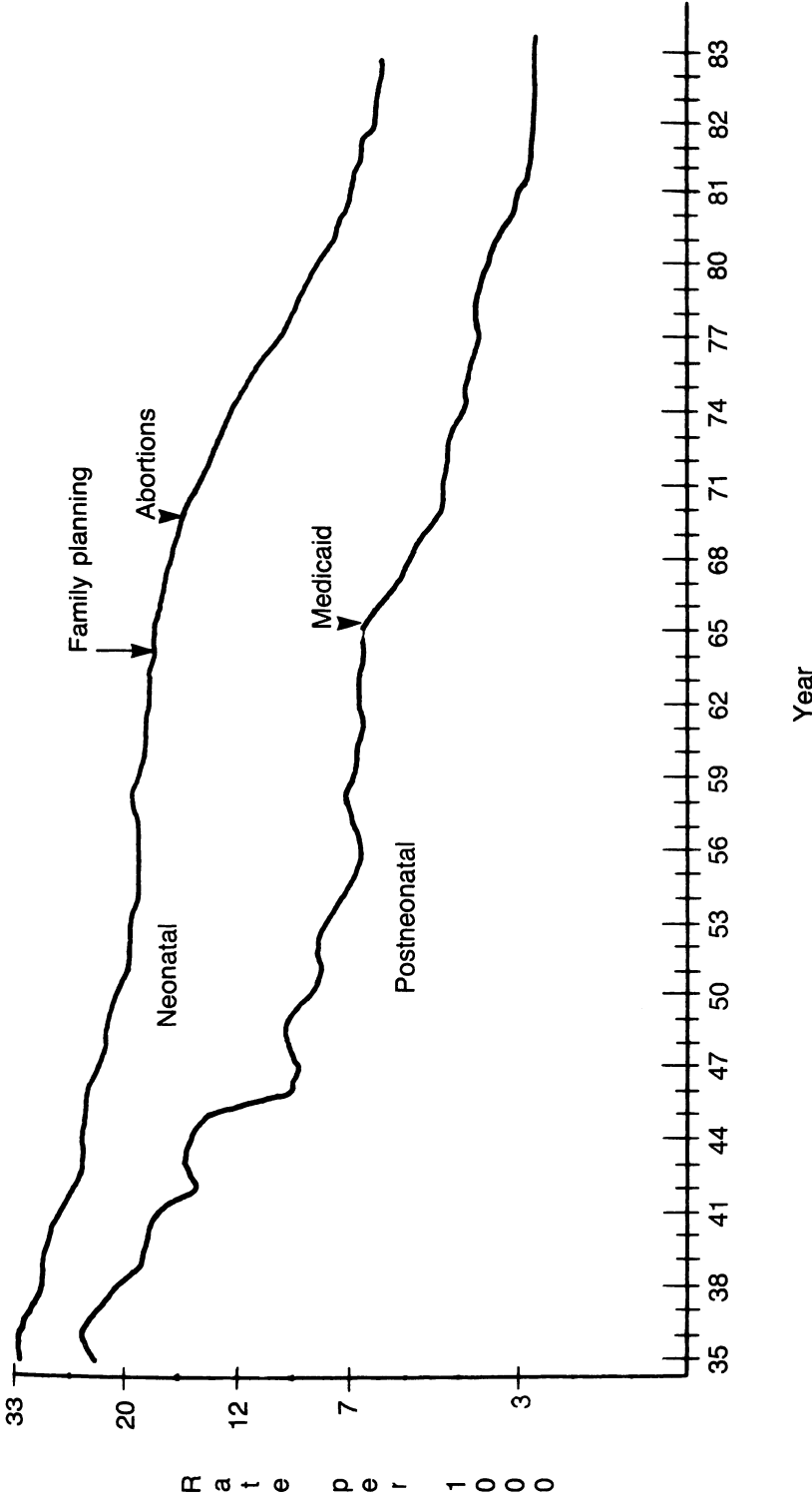


FIG. 2. Infant mortality in the United States from 1935 to 1983. (Figures for 1982 and 1983 are estimates.)
Source: Vital Statistics of the United States (Mortality).

They were found in all birth weight groups and were not, therefore, a result of better birth weight distributions. Although several innovations were associated with these declines, the three that had major effects on a national level were neonatal intensive care, family planning services, and the availability of legal abortions.

Evidence for the benefit of neonatal intensive care derives primarily from a large number of studies in individual institutions. Taken separately, each of the studies is flawed by the potentially large selectivity and hence unrepresentativeness of patients in particular institutions. Taken as a whole they provide impressive evidence that has been recently reviewed by Budetti and McManus (1982). The only adequately controlled study, that of Kitchen, Ryan, and Rickards (1978), attributed the benefits of neonatal intensive care units to staff experience rather than specific technology employed in the units.

Curiously, and despite the benefits derived from neonatal intensive care, the gap in neonatal mortality rates between the poor and nonpoor did not narrow (Davis and Schoen 1978). Does this mean that it is not possible to reduce the large disparity in neonatal death rates of the disadvantaged relative to the rest of the population—a disparity in which the likelihood of death is one and one-half to three times higher among the disadvantaged? Fortunately, there is evidence that this disparity can be lessened, and that it has occurred in some places. Some local maternity and infant care programs succeeded in reducing neonatal mortality rates among the poor to approximately those of the population as a whole (Davis and Schoen 1978). Grossman and Jacobowitz's (1981) multivariate analysis of data from the mid-1960s and the early 1970s demonstrated the marked effect of legalization of abortions on neonatal mortality between those two periods. This finding derived from a national study in which analyses were done by county, using data on Medicaid coverage for pregnancies, family planning facilities, maternity and infant care facilities, and the important sociodemographic correlates of mortality. The availability of legalized abortion was the most important factor, although family planning services were most important before abortion was legalized and the second most important one afterward. Medicaid coverage of pregnancy was the third most important correlate. The researchers calculated that a ban on abortion would lead to an estimated increase in the neonatal mortality rate of 2.8 deaths per 1,000 nonwhite births and 1.8 deaths per 1,000 white births if use of other birth control methods did not increase to compensate for it. Hadley (1982), using a similar

type of analysis based upon county characteristics, confirmed the importance of the availability of abortions, Medicaid coverage of pregnancies, and medical care expenditures (as measured by a proxy variable, Medicare expenditure per Medicare enrollee). The absolute reduction in neonatal mortality due to abortions was greater for blacks than for whites although the rate of decline was greater for whites. Medicaid coverage of prenatal care also was associated with lower neonatal mortality, especially among blacks.

The conclusion from this large and complex literature is that medical care does have an impact on reducing neonatal mortality. To the extent that its components are targeted at disadvantaged populations, it reduces the disparity between disadvantaged and nondisadvantaged populations. The provision of neonatal care by itself has not and probably will not reduce these disparities. Facilitation of access to neonatal intensive care for the disadvantaged, many of whom are at high risk, undoubtedly reduces the disparity because of the evident effectiveness of the neonatal intensive care units. Prenatal care and community clinics apparently have their beneficial effect at least partly by facilitating this access. Virtually all studies suggest that reductions in the availability of abortions, in family planning facilities, and in community programs facilitating access to prenatal care and to neonatal intensive care can be expected not only to increase neonatal mortality rates but to widen the gap between the poor and the nonpoor.

Postneonatal Mortality (deaths from 28 days to one year of age)

In contrast to the situation with neonatal mortality, where the impact of technological advances is evident, marked changes in postneonatal mortality have coincided with changing social conditions. From 1915 to 1930, the decline in postneonatal mortality was relatively greater than the decline in neonatal mortality; in the 1930s, the implementation of legislation to increase access to medical care was associated with an accelerated decline in neonatal mortality and a continued decline in postneonatal mortality (figure 2). These declines continued into the 1940s coinciding with the Federal Emergency Maternity and Infant Care Program during World War II. This program ended after the war and the rate of decline in postneonatal mortality slowed in the 1950s; from 1955 to 1960, the postneonatal mortality rate did not decline at all. An abrupt and large decline occurred in 1965, coinciding

with legislation associated with the "War on Poverty," and in the late 1960s the decline was greater than at any time since the 1940s. Since 1970, the rate of decline has slowed markedly and in 1977 to 1979—and again in the most recent years (1982–1984)—there was no decrease at all in the country as a whole, in marked contrast to the situation with neonatal mortality. The postneonatal mortality rate in the United States exceeds that of many other industrialized nations; this excess is due to deaths from infectious diseases and accidents, not congenital causes (Starfield 1985b).

Since 1965, the gap between the poor and the nonpoor has decreased although the evidence is indirect. When states are arrayed in groups of ten according to the proportion of families living in poverty, the poorer the group of states, the more the rate of postneonatal mortality declined (Davis and Schoen 1978). Goldman and Grossman's (1978) multivariate regression showed that counties with community health centers experienced greater relative declines in postneonatal mortality between 1970 and 1978 than was the case for neonatal mortality; these counties also showed reductions in the white/nonwhite disparity. Hadley's (1982) county-level analysis showed an association of medical expenditures and pediatrician/population ratios with lower postneonatal mortality rates; the effect of these medical care variables was much larger for postneonatal mortality than for neonatal mortality in blacks.

What is striking about the literature on postneonatal mortality is that the subject has been so infrequently studied. These few studies, however, suggest that postneonatal mortality is quite responsive both to general social change and to specific medical programs that have been instituted at various times, including those resulting from the legislation of the mid-1960s.

Congenital Hypothyroidism and Phenylketonuria

Screening of the newborn for congenital hypothyroidism and phenylketonuria, with subsequent diagnosis and management of affected infants, is important in the prevention of mental retardation. Procedures to confirm diagnoses when infants have a positive screening test are accurate and relatively straightforward. A wide network of referral centers supervises the prescription and management of interventions which are quite efficacious. The general excellence of follow-up and supervision and financial support for families who cannot themselves

afford the costly treatment are responsible for excellent outcomes when the diagnosis is made very early in life. The earlier the diagnosis and institution of therapy, the better the outcome. Effectiveness of medical care for these and similar conditions, therefore, depends on the adequacy of procedures for screening and follow-up (Egbuonu and Starfield 1985).

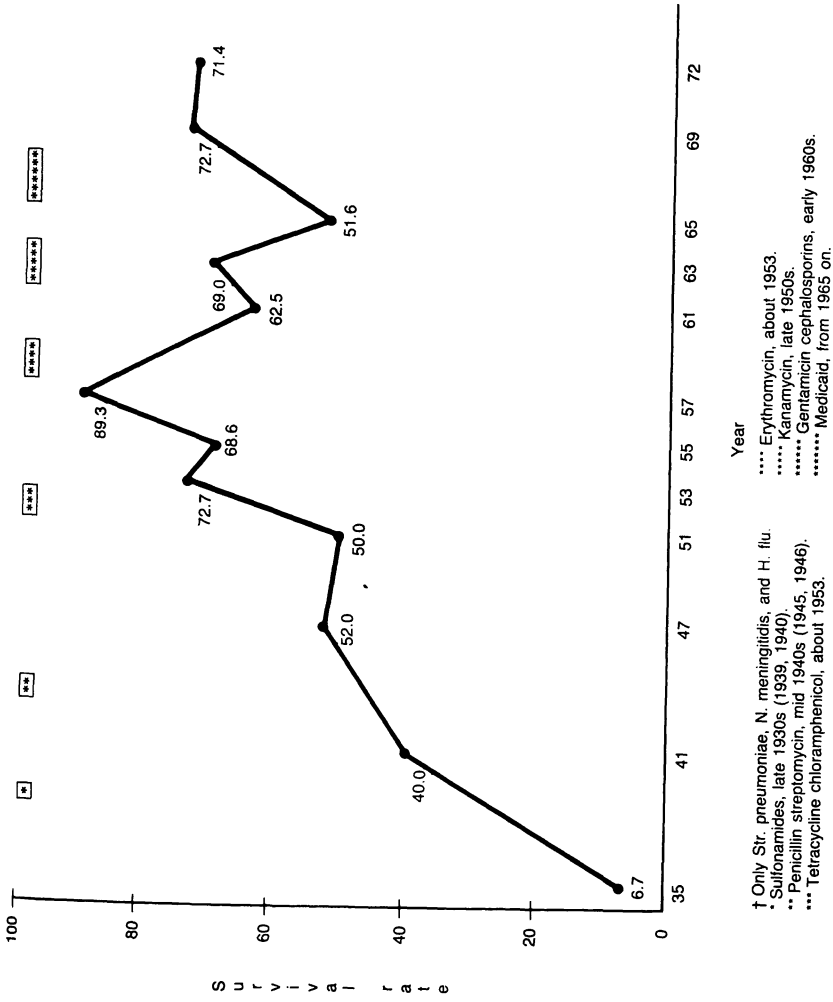
The relatively fragmented system of medical care in the United States is responsible for considerable delay in instituting therapy in affected infants, at least when compared with the United Kingdom or Ireland. Differences in organization of the health services in the three countries result in differing lengths of time between the procurement of the specimen and follow-up of abnormal results; in the United Kingdom and Ireland, this duration is 7 and 5 days respectively whereas it is 12 days in the United States (Starfield and Holtzman 1975). In England and Wales the roles of the procurer of the specimen, local public health personnel, the practitioners, and the consultants are very well-defined. The specimens to be tested are sent to a specific designated laboratory in each region, and that laboratory sends the reports to the local authority which has the responsibility to arrange for needed follow-up. In Ireland there is only one laboratory; lines of communication between the laboratory, local public health personnel, and consultative personnel are well established. In some states in the United States, in contrast, several laboratories may be involved, and there is no institutionalized quality control. Although each area has its own routine for arranging follow-up, the procedure varies from place to place with marked variation in results. States that provide the test free of charge are more likely to have the state laboratory as the sole site of testing; if a charge for the test is implemented, it is likely that more private and commercial laboratories will become involved. Evidence shows that centralization of the testing function leads to more accurate results and more effective follow-up, particularly if the centralized facility has the resources to coordinate the process.

Bacterial Meningitis: Sequelae and Complications

One type of evidence of effectiveness of medical care for a condition such as bacterial meningitis is a decrease in the case/fatality ratio. In the case of meningococcal infections the case/fatality ratio fell from 50 to 26 between 1930 and 1950, rose slightly to 29 in the 1950s

and early 1960s, then fell after 1964 reaching 16 in 1978 (Blendon and Rogers 1983). This type of evidence is useful in demonstrating the effectiveness of medical care only if the extent of diagnosis (or reported incidence) of the disease does not change over the same time period. For example, suppose that the seeking of care for a condition depends upon the severity of the symptoms (a not unlikely assumption) and that the greater the barriers to care (such as the unavailability of services) the more severe a condition is likely to be before care is sought. If, over time, access to care is made easier, and/or diagnostic acumen improves, it is possible that individuals with less severe disease will increasingly come for care and be diagnosed as having meningitis. Without any change in the likelihood of death from severe meningitis, an inflation in the denominator of the rate will decrease the apparent case/fatality ratio. Meningitis other than meningococcal meningitis is not a reportable disease; special efforts are required, therefore, to obtain data on the incidence of bacterial meningitis. A variety of studies indicate that there was a marked increase in the incidence of hemophilus influenza meningitis between 1935 and the mid-1960s, although probably not since then. If this increase in incidence was a result of better diagnosis of less severe cases, the declining case/fatality ratios between 1935 and the mid-1960s are not necessarily evidence of the benefit of medical care.

In several communities where meningitis has been studied by the *combined* examination of hospital records (for incidence) and death certificates (for fatalities), it is clear that case/fatality has decreased over time even after changing incidence rates are controlled. For example, in Olmsted County, Minnesota, the percentage of children of ages 1 to 4 who died from hemophilus influenza, pneumococcal, and meningococcal meningitis fell from 70 percent in 1935–1946 to 14 percent in 1947–1958 to 6 percent in 1959–1970 (Fraser, Henke, and Feldman 1973). At Boston City Hospital, survival ratios for pneumococcal, meningococcal, and hemophilus influenza meningitis showed marked increases from 1935 to 1972 (Finland and Barnes 1977) (figure 3). This happened in the absence of any change in admission rates for meningitis. The first increase (between 1935 and 1941) followed the introduction of sulfa drugs. Subsequent to the introduction of penicillin (between 1941 and 1947) there was another increase. A third increase in survival followed the introduction of erythromycin (1951 to 1953). Except for an apparent aberrance in



† Only *Str. pneumoniae*, *N. meningitidis*, and *H. flu.*
 * Sulfonamides, late 1930s (1939, 1940).
 ** Penicillin streptomycin, mid 1940s (1945, 1946).
 *** Tetracycline chloramphenicol, about 1953.
 **** Erythromycin, about 1953.
 ***** Kanamycin, late 1950s.
 * * * * * Gentamicin cephalosporins, early 1960s.
 * * * * * Medicaid, from 1965 on.

FIG. 3. Trends in survival from bacterial meningitis† at Boston City Hospital and periods of implementation and diffusion of various improvements in health care.
 Source: Adapted from Finland and Barnes 1977.

1957, there was a slight decline in survival ratios thereafter and into the early 1960s (1961, 1963, and 1965) but an increase in survival in the late 1960s and early 1970s. This last improvement occurred in the absence of an identifiable "technology," but it was associated in time with an increase in access to medical care (and probably earlier receipt of care) that occurred as a result of the legislation of 1965 and the implementation of programs such as Medicaid, Title V programs, and community health centers.

There are two other types of evidence of effectiveness of medical care for bacterial meningitis. First, there are those studies that document a relation between delay in seeking care and the likelihood of complications and sequelae. It is not self-evident that delay in care necessarily means more serious illness; in fact the opposite might be postulated as it is likely that a lesser severity of symptoms and hence milder disease would be associated with delay. A variety of studies from several countries as well as different areas of the United States since 1950 that show a direct relation between duration of symptoms and likelihood of complications, however, suggest that delay in receipt of adequate care has adverse consequences.

The other line of evidence derives from studies of deaths in poor as compared with nonpoor populations. Several studies involving entire communities show higher case/fatality ratios among the poor and uneducated; these have been interpreted as evidence of the existence of barriers to early receipt of health care. The most striking demonstration of the likely effect of medical care on bacterial meningitis derives from a study in Vermont by Fraser et al. (1975). In this study of the occurrence of bacterial meningitis and deaths from bacterial meningitis in children from 1967 to 1970, in towns where hospitalization rates were relatively low, the rates of recognized bacterial meningitis in children were also low, and rates of death from obscure causes in children under the age of 5 were significantly greater. After ruling out several competing explanations for these phenomena, the authors concluded that the observations were consistent with the hypothesis that inadequacies in medical care availability and utilization were associated with an underdiagnosis of meningitis. On the basis of coefficients from regression equations, they calculated the expected incidence of meningitis in the towns where it was underdiagnosed and, on the basis of the *actual* number of deaths from vague causes,

calculated a probable case/fatality ratio as high (80 percent) as those prior to the antibiotic era.

The variety of types of evidence, including increased deaths with unavailability of medical care and increased likelihood of sequelae with delay in receiving care, indicates the importance of access to and receipt of medical care in affecting the course of bacterial meningitis in children (Starfield and Joffe 1985).

Diabetic Ketoacidosis

The theoretical basis for expecting that adequate medical care would decrease the likelihood of diabetic ketoacidosis derives from its impact on managing infections and reducing the potential for fever and dehydration. Actual documentation of the beneficial impact of increased access to care is sparse but a few investigations provide strong suggestive evidence.

Studies on adult diabetics cared for in facilities in at least three separate cities showed marked reductions in the proportion of patients hospitalized after access to care was improved by special telephone lines, 24-hour access, or neighborhood satellite clinics. The same has been the case for children in that part of Florida served by a regional network for diabetic care (Giordano et al. 1977) and at the Childrens Hospital in Michigan (Hoffman et al. 1978). For example, after provision of access by telephone to 160 diabetic children and adolescents, the average number of admissions per year per 100 individuals dropped from 60 and 69 in 1972–1973 and 1973–1974 (before the program) to 56 the next year, 9 the following year, and 5 the third year. Although the lack of a control group in all of these studies makes it uncertain that the effect was a result only of the organizational change, the similarity of findings from a variety of studies in different locales and at different times provides some confidence in the conclusion that access to medical care does prevent hospitalization for diabetic ketoacidosis.

In addition to these clinical studies concerning the impact of changes in the availability of care at specific facilities, there is indirect evidence from community studies of the beneficial impact of medical care. In the period from 1949 to 1961, case/fatality ratios from diabetes among

poor children were more than double those of other children (Sultz et al. 1972). The incidence of diabetes among poor children increased between 1946 and 1979, suggesting that greater access to care may have improved the extent of diagnosis of diabetes, possibly even preventing deaths, although follow-up studies of case/fatality ratios by social class have not been conducted. Even at present, however, the likelihood of readmission to the hospital among poor children with known diabetes is much higher than that of other children (Fishbein and Faich 1982), suggesting a likely beneficial effect of access to appropriate and timely medical care among those who can afford it.

Thus, diabetes and bacterial meningitis present a somewhat different situation from that of universally reported events such as births and deaths, where epidemiological approaches provide good population-based data. For diabetes and meningitis, there are at least some studies that are community-based with complete counting of events and little chance of misinterpretation due to the selectivity of patients in individual institutions. For most other conditions, however, the only information concerning the impact of medical care derives from studies in specific institutions rather than from community-wide studies that provide estimates that can be generalized to the population.

Other Conditions

Asthma is a condition that usually does not require hospitalization. Hospitalization may be necessary, however, if ongoing control of the symptoms is poor and severe attacks occur. In at least two studies in Great Britain, children who received their care from a designated general practitioner were more likely to have an effective medication for asthma and less likely to be admitted to the hospital than children who reported no contact with their practitioner or who sought care directly from an emergency room, even when duration of symptoms and severity of disease were taken into account. The same was the case in Baltimore (German et al. 1976), where the likelihood of admission for asthma was less in children reporting health maintenance organizations or private physicians as their source of care than for those using the emergency room as their primary source. Several British studies that retrospectively reviewed the reasons for death

indicated that about one half of all deaths due to asthma occurred outside the hospital or upon arrival, and most had been wheezing for at least a half hour, and in some cases over a week, before seeking care. The studies suggest that both hospitalization and death from asthma appear to be preventable, at least some of the time, with good ongoing care (Wissow and Starfield 1985a).

Evidence of the benefits of ready access to medical care also exists for appendicitis (Hutton and Starfield 1985a). Data from the National Hospital Discharge Survey indicate that the rate of appendicitis in children has generally fallen in the last 15 years, as has the percentage of hospitalizations due to appendicitis. Mortality rates associated with appendicitis have fallen progressively from 2 per 100,000 in 1950 to 1 in 1960, 0.9 in 1965, 0.7 in 1970, and 0.4 in 1975. Rates of perforation, however, have not changed over the last 45 years. The duration of time between the onset of symptoms and hospital admission is directly associated with the likelihood of perforation and with length of stay, which, in turn, is highly related to the likelihood of death. These studies have been carried out using medical records at hospitals. Further evidence of the likely influence of access to medical care was provided by an analysis of rates of perforation by family income; in 1976–1978 the percentage of children with perforation increased progressively from 0 percent at family incomes over \$20,000 to 13 percent at incomes of \$15,000 to \$20,000, 22 percent at incomes of \$10,000 to \$20,000, and 35 percent at family income of less than \$10,000 (Scher and Coil 1980). These findings are consistent with those from Great Britain where there is no relation between frequency of appendicitis and social class but a constantly higher likelihood of complications and death among socioeconomically disadvantaged populations.

For births to teenagers, which have been falling in frequency for two decades (figure 4), there is evidence for the benefits of availability of abortions in particular and for family planning in general.

Data from the Centers for Disease Control show that immunization rates and communicable disease rates follow closely the input of resources to support immunization programs (Blendon and Rogers 1983).

For epilepsy, there is some evidence that good ongoing care improves the well-being of affected children; appropriate medication with good monitoring does improve seizure control.

There is evidence of benefit from the application of oral rehydration solutions for prevention of hospitalization in gastroenteritis, although

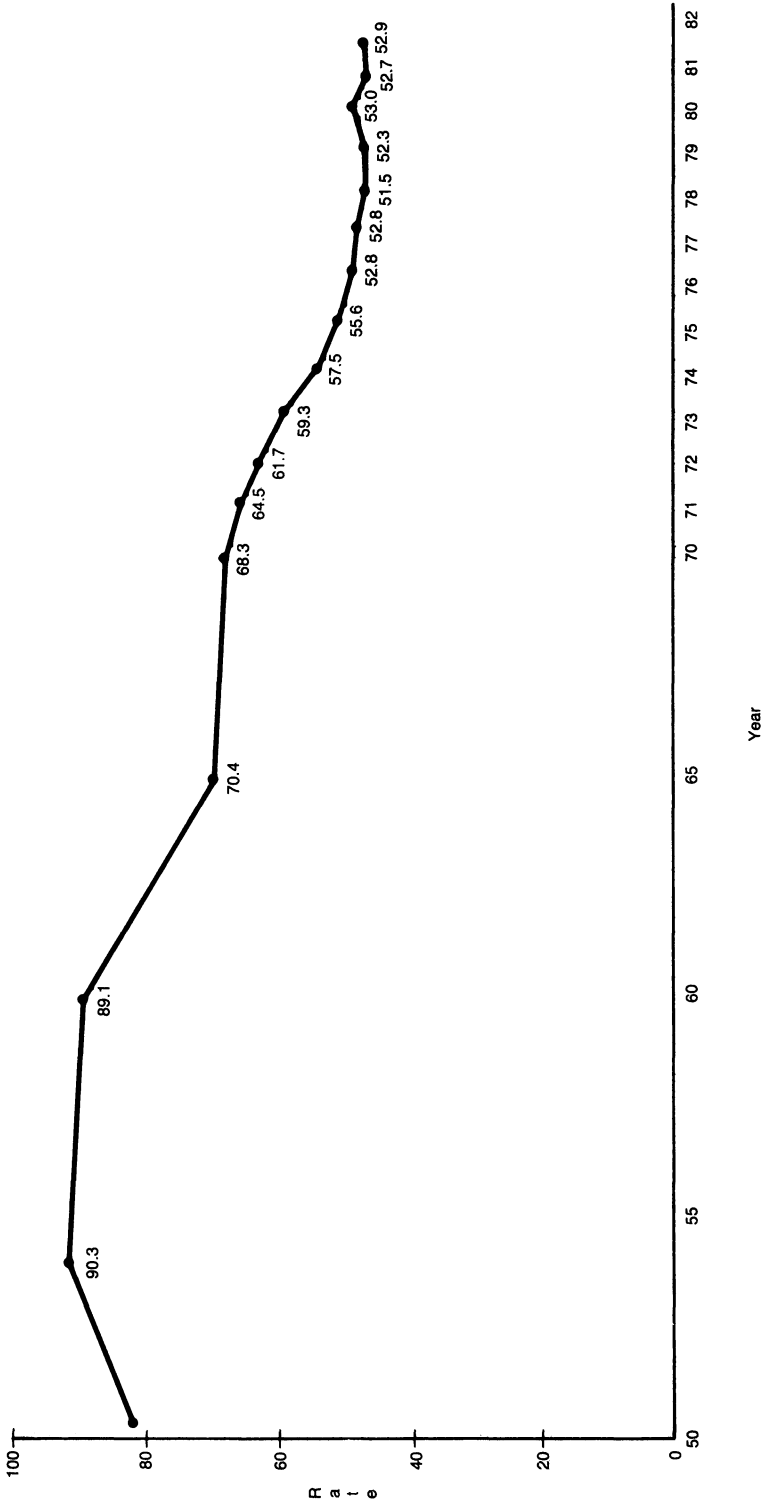


FIG. 4. Birthrate per 1,000 women age 15-19 in the United States from 1950 to 1980. Source: Vital Statistics of the United States (Natality).

the evidence comes primarily from developing countries (Wissow and Starfield 1985b).

For iron deficiency anemia, the evidence is fragmentary and based primarily on isolated demonstration programs. Part of the difficulty in demonstrating effectiveness of care for iron deficiency anemia may be the lack of consensus on the significance of milder degrees of anemia, and the general lack of recognition of the condition except where there is routine screening for it (Hutton and Starfield, 1985b).

Deaths from lead poisoning now occur very rarely and the acute symptomatic state, which was common in some cities as recently as twenty years ago, is no longer frequently seen. This progress was undoubtedly a result of many changes during the decades of the 1960s and 1970s, not the least of which was the development of an efficacious method of reducing body burdens of lead. However, it is clear that there has been a variety of factors responsible for the large decline in occurrence of acute toxicity from lead, including reduction in lead in gasoline, imposition of standards for industrial emissions, and possibly the lead paint prevention program. But the impact of these changes has been primarily on *acute* toxicity. There is evidence that levels of lead just under the acute toxicity threshold are a continuing problem in many communities, with consequences for impairment of cognition and behavior in children with the elevations (Farfel, Hutton, and Starfield 1985).

For rheumatic fever it has been shown that comprehensive care programs (Gordis 1973) and the use of appropriate diagnostic techniques and therapy are associated with reduction in frequency of both initial and recurrent attacks, although it is not clear that all of the decline in incidence rates is attributable to medical care as it began before the era of antibiotics.

Discussion

This review indicates that the frequency of occurrences of conditions, their severity, and fatality do change over time, usually but not always in the direction of marked improvement. Whereas it is tempting to attribute improvements to technological advances, in some instances they are almost certainly due to social advances or a result of changes in access to medical care. The impact of social change was noted in

the case of postneonatal mortality where there was marked variability in average annual rates of decline in the most recent three decades alone, ranging from 0 percent in 1955–1960 to 6 percent in 1965–1970 following important alterations in social policies. Greater access to care probably accounted for increased incidence rates both of hemophilus influenza meningitis and diabetes, which came to attention in time for accurate diagnosis to be made and for death attributed to an unknown cause to be averted; in these cases, an apparent deterioration in health was an artifact.

Evidence of benefit from medical care is of three major types. First, there are the multivariate analyses of the relation between differences in medical care resources at the community level (counties or cities) and rates of the health conditions in those communities. Such studies are possible only where there are data on the community-wide prevalence of the health events: that is, vital statistics and community-wide surveys such as were carried out for bacterial meningitis. Data on the existence and nature of resources must also be available. These data probably provide the most valid evidence of benefit although their limitations must be recognized: that is, they produce ecological correlations. It takes a leap of faith to infer relations noted at the population level to those at the individual level. For example, the fact that the availability of abortions at the community level is associated with lower community infant mortality does not necessarily prove that the individual deaths that were averted were a result of the seeking of an abortion, although the presumption is compelling.

The second type of evidence is based upon an analysis of differences in incidence and severity of problems across population groups. Where there is no reason to suspect a biological cause for differences in severity of disease, the differences must be due to medical factors or to medical factors that have not adequately overcome the social factors associated with greater illness. These studies also depend upon the availability of population-based data, as were obtained in the community-based studies of bacterial meningitis and diabetes.

The third type of evidence derives from clinical data obtained in specific health facilities rather than population-based data from communities. No conclusive inferences about the effect of the medical care system can be made from such data because it is always possible that the populations served by these facilities are not representative of the community at large, either locally or more broadly. It is clear,

however, that delay in the receipt of care or barriers to access to care is associated with a greater likelihood of more severe illness. This was the case for appendicitis and for most of the studies concerning asthma.

Conclusions and Implications

The impact on health status of changes in public policy regarding health services is rarely studied. Although there are many attempts to relate changes in health status to particular technological interventions (for example, in the case of immunizations against communicable diseases and antibiotics in the case of tuberculosis, scarlet fever, rheumatic fever, typhoid, and pneumonia as reported, for example, by McKinlay and McKinlay [1977]), there are few studies designed specifically to assess the impact of changes in medical care organization and financing that result from legislative and administrative actions. This paper has provided evidence of the importance of access to medical care, particularly for those most vulnerable to adverse effects of illness. The strength of the conclusion rests largely on the consistency of findings from a variety of types of approaches in various places and at different times.

Clinical investigations conducted in individual institutions, for the most part, are unable to provide definitive information because of the selectivity of their populations. They can, however, provide information about the mechanisms for the relations documented by health services research using epidemiologic approaches. The most useful information is obtained when there are data from both community-based and clinical investigations of the relations between medical care and health status. Collaborative efforts, therefore, between clinical and public health professionals in the design and conduct of both prospective and retrospective studies are essential if we are to effect a greater influence by medical care on the health of the populace.

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