

Medical technology in developing countries: useful, useless, or harmful?¹

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In 1972 McDermott et al. (1) and others reviewed their experience with a 5-year intensive effort to improve health through provision of health services in a small Navajo Indian community. They found a drop in the incidence of tuberculosis and otitis media, some benefit from use of hospital facilities, but no change in mortality rates, and particularly no change in the infant mortality rate that contributed 50% of total deaths. Most of the infant mortality was due to diarrhea and pneumonia and the incidence of these conditions did not change over a 5-year period. The reason for this, they felt, was that the available therapy (antibiotics) was ineffective against most of the organisms causing diarrhea and pneumonia and preventive measures could not be effectively implemented in the prevailing socioeconomic conditions. Their conclusion was that there was "a technological misfit of health care and the disease pattern" in the community served and that there was no reason to expect significant improvement in health without a change in the social and economic situation with resultant improved housing and sanitation. The authors recognized that there were some problems with this study that was conducted 20 years ago on a very small population that differed in several important respects from the populations found in most developing countries today. Nevertheless, their basic conclusion about a "technological misfit" has been echoed by many others and a large body of opinion holds that medical technology (whether preventive or curative) has little to offer at any level of development, and that improvement in health will follow inevitably upon improvement in social status.

Much of the basis for this opinion is derived by inference from historical evidence. It is frequently pointed out that the fall in the tuberculosis death rate in Western countries has been relatively constant since the early

19th century and that the discovery of the tubercle bacillus, the introduction of rest treatment, and even the development of effective antituberculosis drug had relatively little effect on this gradual fall (2). Whooping cough, scarlet fever, and many other diseases had exhibited declines of even greater magnitude long before the introduction of effective preventive or therapeutic measures (3). Better housing and improved nutrition are felt to be the main reasons for the drop in mortality from these causes, although there appears to have been a remarkable reduction in the virulence of some organisms (e.g., streptococci). The elimination of susceptible individuals from the population is also generally thought to have been a factor in the reduction of mortality from tuberculosis. The sharp drop in infant mortality in the United States and Britain after 1900 has been ascribed to the same socioeconomic causes plus a reduction in diarrhea mortality that is thought to have resulted from improved water supplies, indoor toilets, and the introduction of refrigeration (4). The strong influence of "life style" on differences in mortality rates between groups in affluent countries has been pointed out (5, 6) and there is general agreement that this is a more likely explanation for variation in mortality between different areas in the developed world than any medical efforts in these countries. The inefficiency and ineffectiveness of most of the curative and much of the preventive technology in use is well documented (7).

With regard to the developing countries, several authors have reviewed the available evidence and have been unable to find reason to believe that either preventive or curative

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medical efforts contributed significantly to the rapid decline in death rates since about 1930 (8–10). Improvement is generally ascribed to political and social stability, economic growth, and some improvement in equity, all of which has resulted in improved nutrition. The drop in mortality in Europe in the 18th century has also been ascribed to improved agricultural practices, particularly the widespread introduction of the potato (11).

Illich (12), Carlson (13), and McKeown (14) have put all this evidence together to present convincing arguments that medical technology is usually useless, frequently harmful, and a tremendous waste of public and private funds. Illich's arguments are particularly forceful, and there is no concession to the possibility of improvement in the delivery of the technology—including delivery systems in socialist countries, as, for example, the barefoot doctor in China. *Any* technology is considered harmful because it is externally imposed and therefore undermines the self-reliance that is necessary for development of individual and community health.

These views have had considerable influence. Most western donors of development aid have given a very low priority to health since the early 1960's, in large part because of a growing belief that preventive and curative medical efforts are irrelevant to improving the health and well-being of poor people in developing countries. The developing countries themselves (whether socialist or nonsocialist) have paid relatively little attention to all this debate.

The question of the ability of a technology either to develop or to undermine individual and community self-reliance to deal with health problems is critical. Health will not improve unless individual and communities make rational choices to improve sanitation and nutrition, to prevent diseases that can be prevented, and to seek early and adequate treatment for condition that can be effectively treated. Illich is quite correct in his view that the medical profession has not done much to guide these rational choices. We have distorted priorities, monopolized resources in the wrong place for the wrong reasons, promoted useless and sometimes harmful remedies, and, most important, we have under-

mined self-confidence by fostering the impression that only a professional (or a "paraprofessional") could know the answer to simple questions. Public health professionals have a somewhat cleaner record on this score than do most others, but it is far from perfect. Like all experts, the public health practitioner has his "thing" and he tends to recommend it to the exclusion of other possible choices. In this case the "thing" is usually mass immunization (e.g., smallpox), mass treatment campaigns (e.g., malaria), or mass programs to change personal habits ("space your children", "wash your hands", and "don't spit on the floor"). There is a place for such programs, but they are only effective in special circumstances and they can lead to serious distortions of priorities. Smallpox has probably been eradicated, but it may be the only important disease of man that can be eradicated by today's technology. It has already disappeared from most of the world without need for eradication campaigns, and, in any event, diseases preventable by immunization (all such diseases) are responsible for only about 10% of mortality of small children in most developing countries. Of course, mass campaigns are not the only activity of the public health physician, and the best of them have taken a broad view of the contributions to health of social and economic development, education, sanitation, and even curative medicine (16–18).

The point of this discussion, however, is to consider the role of a medical technology in the context of the socioeconomic factors thought to be important. Included in the "technology" are all those factors affecting health that could be altered by medically trained personnel or by individuals in communities who understand the potential for change and have the will to do something about it. This will include personal and community preventive measures, including immunization and nutritional improvement (that part of nutritional improvement that can be induced in the absence of major socioeconomic change); treatment of disease; and control of the environment through sanitation or other measures. In view of the serious doubts raised by Illich and others it is first necessary to decide whether the available technology really has anything to offer pop-

ulations, as opposed to individuals. If we can find any reason to think that it does, it will then be necessary to consider what the obstacles have been to successful application of this technology in developing countries since McKeown, Mosley, and Black are probably correct in their basic conclusion that the decline in mortality in these countries up to now has been due primarily to social, economic, and political causes.

Is there an effective technology?

In fact, the technology is not as bad as McDermott, Illich, or others have suggested. Tremendous distortions of priorities in the industrialized as well as developing countries have obscured abundant evidence that there are important identifiable areas in which medical efforts have made significant contributions to reduction of mortality and morbidity. The case of tuberculosis provides an illustrative example in Figure 1.

Figure 1 compares tuberculosis mortality rates between 1940 and 1960, in the United States, for the total population, the nonwhite population (both age-adjusted), and for non-white females ages 15 to 24. Tuberculosis deaths had been declining for both whites and blacks up to 1945 at an essentially constant rate of about 2.5% per year since 1920, and probably for some time before this. The annual percentage decline for blacks was almost the same as for white (in fact, very slightly higher) but the amount of disease among nonwhites was much greater. Before 1945 nonwhite females ages 15 to 24 had the highest tuberculosis death rate of any group in the population. The introduction of effective antituberculous chemotherapy in the late 1940's produced a significant increase in the rate of decline: between 1945 and 1955 death rates for the total population declined at a rate of 7.8% per year, and for the most severely affected group, nonwhite females ages 15 to 24, the rate of decline was 9.3% per

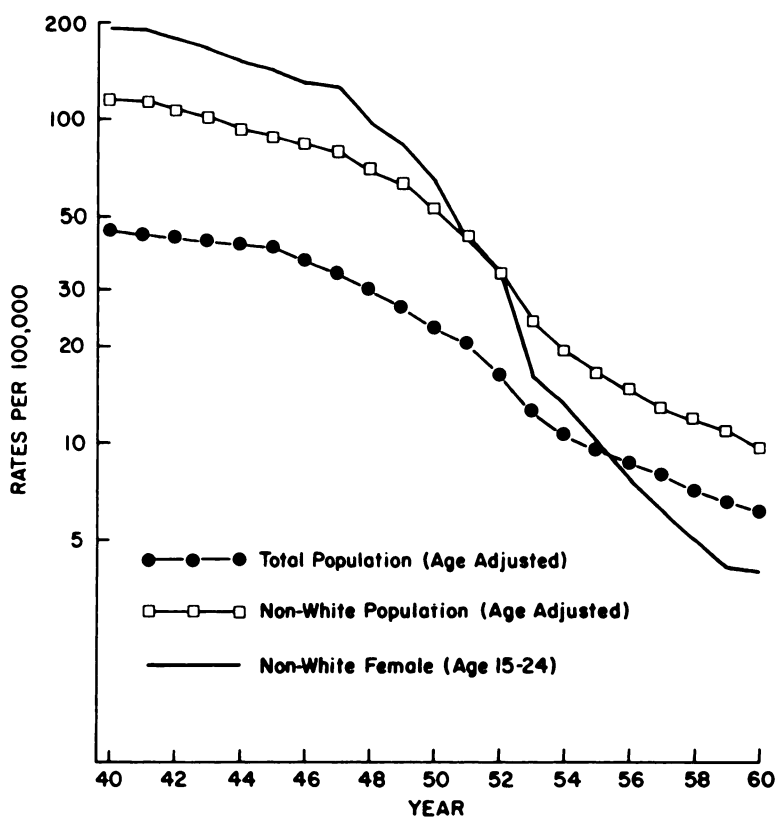


FIG. 1. Death rates from tuberculosis (all forms) in the United States. From Reference 19.

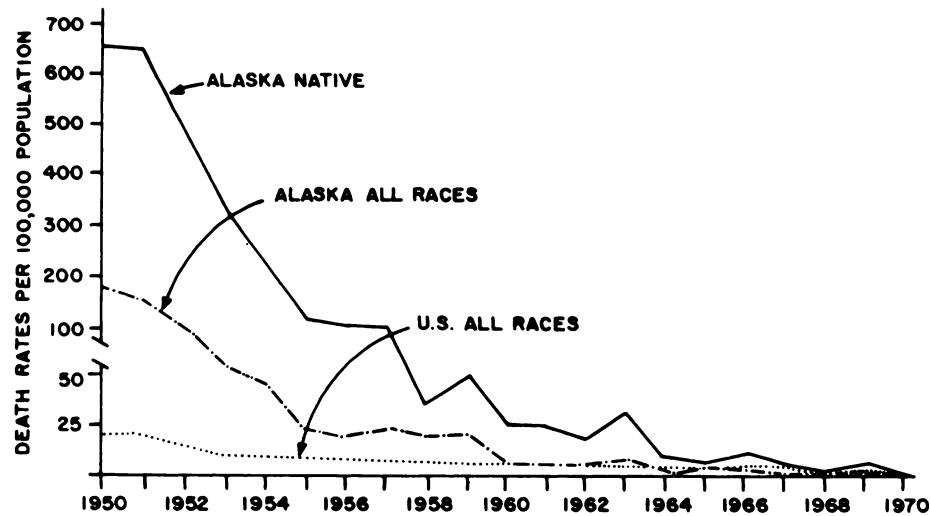


FIG. 2. Comparison of death rates from tuberculosis for Alaskan natives, Alaska, all races; United States, all races, from 1950 to 1970. From Reference 20.

TABLE 1
Causes of infant mortality in the United States, 1900 and 1954^a

Infant mortality (0-1 yr)	1900	1954
Total deaths per 1000 live births	150	26.6
Causes of death	%	
Infective and parasitic diseases	7.9	1.15
Diarrhea and enteritis	24.7	2.97
Pneumonia and influenza	14.7	6.93
Congenital malformations	6.4	12.54
Certain diseases of early infancy (including prematurity)	34.5	51.14
All other causes	11.8	11.55

^a From Reference 15.

year. The effect of antituberculous drugs on the tuberculosis problem is minor if one looks at the total population in which mortality had already been reduced to relatively low levels, but when one looks at the most severely affected population groups the effect can be seen to have been dramatic. In fact, elimination of tuberculosis as a major cause of death among nonwhites has been an important part of the reduction in total mortality for this group between 1930 and 1960.

The change in tuberculosis mortality among Alaskan Eskimoes and Indians provides an even more dramatic example of what can happen when an appropriate technology is effectively applied (Fig. 2). In this population the mortality from tuberculosis in 1960 was 4% of the mortality in 1950—a direct

result of an effective program using antituberculous drugs for treatment and prophylaxis. Improvement in socioeconomic conditions combined with a weeding out of susceptible individuals could have produced the same result eventually, but it might have taken a century or two.

The decline of infant mortality rate in the United States and Britain since 1900 provides an example of a more complex interaction between a technology and a set of disease problems. The causes of infant mortality in the United States and Britain in 1900 were essentially the same as the causes seen now in developing countries (Table 1). About half of the deaths were due to infectious diseases of multiple etiologies, often aggravated by malnutrition. Most of the rest were due to prematurity or other obstetrical problems. Woodbury's (21) classic study of infant mortality in eight eastern cities of the United States in the early 1920's demonstrated the strong influence of certain social and economic factors on infant mortality. Table 2 shows the mortality rates for various racial and national groups within these cities and Table 3 shows the influence of per capita family income on mortality rate. The complexity of socioeconomic analysis applied to this problem is illustrated by the very strong effect of father's income on mortality rate and the remarkably low mortality rate among

TABLE 2
 Infant mortality rates, by cause of death and color and nationality of mother.
 Live births in eight cities.^a

Color and nationality of mother	Infant mortality rates from specified causes					
	All causes	Gastric and intestinal diseases	Respiratory diseases	Early infancy	Epidemic diseases	Other causes
Total	111.2	32.4	19.6	36.1	7.1	16.1
White	108.3	32.6	17.9	35.1	6.4	16.4
Native	93.8	25.2	13.0	36.1	5.4	14.1
Foreign born	127.0	42.2	24.2	33.7	7.7	19.2
Italian	103.8	21.7	27.3	33.7	7.7	13.3
Jewish	53.5	10.5	8.9	22.7	4.9	6.5
French-Canadian	171.3	64.2	25.1	44.7	6.5	30.7
German	103.1	27.1	18.0	30.9	11.6	15.5
Polish	157.2	64.0	33.2	38.7	3.9	17.4
Portuguese	200.3	101.6	50.8	20.9	14.9	12.0
Other	129.6	38.5	20.6	35.8	8.1	26.7
Black	154.4	28.1	44.6	52.2	17.2	12.4

^a From Reference 21.

TABLE 3
 Infant mortality rates, by per capita income from father's earnings.
 Live births in seven cities^a

Per capita income from father's earnings	Infant mortality rates
Total	113.9
Less than \$50	215.9
\$50, less than \$100	141.8
\$100, less than \$200	123.2
\$200, less than \$400	96.1
\$400 and over	60.5

^a From Reference 21.

TABLE 4
 Effect of organized maternal and child health services, United Kingdom, 1840-1968^{a, b}

United Kingdom	Birth rate	Death rate	Infant mortality rate	1-4 Mortality rate (calculated)
1840-1845 (average)	32.3	21.4	148	35
1851-1855 (average)	33.9	22.7	156	37.5
1861-1865 (average)	35.1	22.6	151	38.8
1871-1875 (average)	35.5	22	153	32.4
1881-1885 (average)	33.5	19.4	139	28
1891-1895 (average)	30.5	18.7	151	25.5
1901-1905 (average)	28.2	16	138	20.3
1910-1915 (average)	23.9	14.3	110	15.3
1921-1925 (average)	19.9	12.1	76	8.5
1931-1935 (average)	15	12	62	6.56
1941-1945 (average)	17.6	12.8	50	3.50
1946	20.2	12	43	2.08
1948	18	11	34	1.75
1951-1955	15.2	11.7	27	1.14
1960	17.2	11.5	22	0.87
1964	18.4	11.3	20	0.91
1968	17.1	11.8	18	0.77

^a By courtesy of Professor D. D. Reid, personal communication. ^b From Reference 21.

children of Jewish mothers as compared to native-born white Americans, who at that time were much better off economically. Woodbury also showed that the risk of mortality was greater among the children of high parity mothers or mothers under 20 and if breast-feeding was discontinued too soon or food supplements were introduced before the 7th months of life.

Infant mortality in the United States, England, Wales, and most of Western Europe had been fixed at a high level throughout the 19th century (Table 4), and the causes of this high mortality were identified with considerable accuracy at about the end of that time. The major factors were felt to be early discontinuance of breast-feeding, malnutrition in general, too sudden exposure of the infant to disease present in the environment, early pregnancy, and inadequate spacing between pregnancies. Widespread recognition of these factors led to the introduction of the infant welfare movement in Britain, France, and the United States almost simultaneously at the turn of the century, and an impressive drop in infant mortality ensued. It should be noted that socioeconomic improvement, in Britain for example, had begun in the early 19th century and that the drop in mortality from many other diseases (such as tuberculosis) began much earlier than the drop in the infant mortality rate. The infant welfare centers focused on education of mothers to feed their children properly and to avoid the factors identified as risks—that is, to adopt the

practices that presumably were already instituted by most Jewish mothers in the early 1920's in the United States.

The educational process was carried out by a mixed group of public health nurses, social workers, and ultimately (once they were convinced it was important) physicians. It might be thought that this sort of common sense instruction is not much of a technology, but in fact it is precisely what a technology should be all about—identification of the causes of a problem, proposal of a solution, testing the solution, and finally attempting to apply the solution to those to whom it best applies—in this case the mother of the child. Many other examples could be cited of disease significantly influenced by application of an effective technology: deaths from neonatal tetanus in the area of the Albert Schweitzer Hospital in Haiti accounted for 50% of infant mortality in 1967. A mass campaign to inoculate mothers against tetanus, thereby protecting the newborn infants, has succeeded in wiping out this disease, halving the infant mortality, and eliminating a very expensive hospital program (22). Deaths from pneumonia and influenza in the United States were declining before 1935, but the use of sulfonamides and later of penicillin is certainly responsible for the virtual elimination of these conditions as major causes of death (Fig. 3). Reductions in maternal mortality (Fig. 4) and in deaths from appendicitis (Fig. 5) resulted from the introduction of a relatively more sophisticated obstetrical and surgical technology in the 1930's. It would be relatively inexpensive to extend this set of services to developing countries. But maternal mortality and deaths from common surgically curable conditions are relatively small parts of total mortality in any part of the world. A look at the common causes of death in a region usually leads to selection of other points of attack with higher priority. Furthermore, hospitals have an unfortunate tendency to expand their activities without regard to what is effective, leading to cost-benefit ratios that are difficult to justify.

Obviously, the key to successful intervention is the identification of specific conditions that are serious enough and prevalent enough to constitute a major component of total mortality and that are also susceptible to prevention or cure by simple and effective measures.

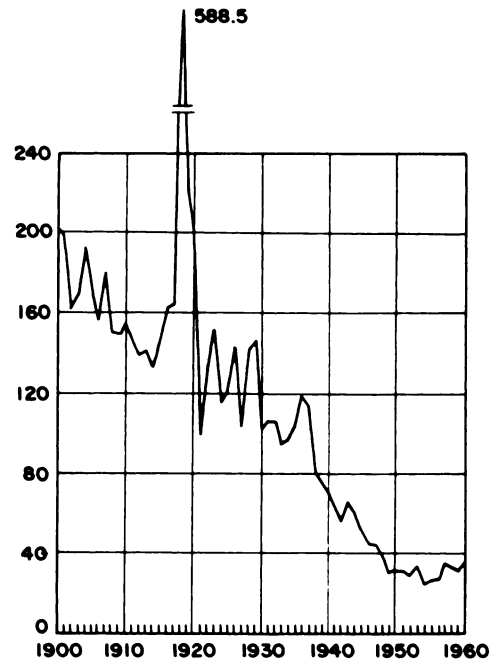


FIG. 3. Death rates for influenza and pneumonia: death-registration states, 1900 to 1932, and United States, 1933 to 1960 (rates per 100,000 population). From Reference 19.

A look at the common causes of death among children in developing countries (Table 5) shows that certain conditions are so common as to constitute a situation comparable to the epidemic of tuberculosis among Alaskan natives. Fifty percent of all deaths are in children under age 5 and death rates after this age are relatively low. In the "under-fives", diarrheal disease, pneumonia, and malnutrition (taken together) account for about one-half of the deaths and diseases preventable by immunization for 5 to 10%, or 20% if measles and tuberculosis are included, even though field use of measles vaccine in tropical countries may be limited by its heat lability and BCG is far from 100% protective.

McDermott's fear that diarrhea and pneumonia would not respond to treatment has not been borne out in practice. Antibiotics are not effective for most diarrhea, but deaths can be reduced 50% by oral fluid treatment given at home (24). Pneumonia (detected and treated at home without x-rays on the basis of cough combined with respiratory distress) does respond to penicillin in the vast majority



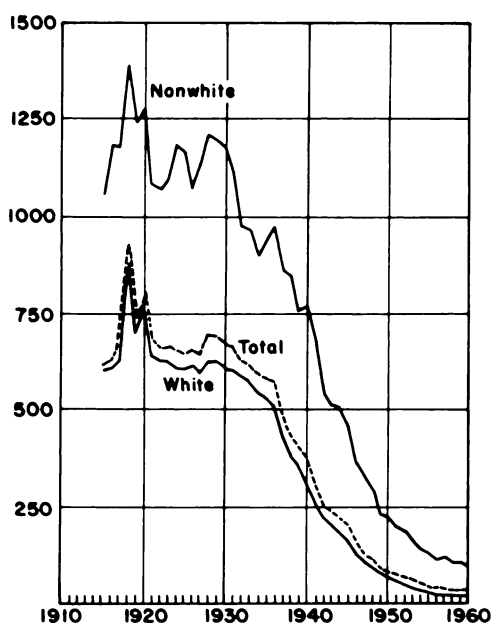


FIG. 4. Maternal mortality rates by color: birth-registration states, 1915 to 1932, and United States, 1933 to 1960 (rates per 100,000 live births). From Reference 19.

of cases (25) and mortality from this condition can also be reduced by 50%. Malnutrition in infants and small children is a complicated problem because of its interactions with infection, breast-feeding, maternal care, and the socioeconomic situation of the family, but several successful programs have shown that intervention at the village level is possible and practical (23, 26-29). It is interesting that the reduction in mortality produced by these program efforts is usually greater than the reduction in the prevalence of malnutrition. Prolongation of breast-feeding and nutritional rehabilitation after illness may be the most critical points of intervention (28, 30).

Home treatment of tuberculosis in India has been remarkably successful (31). A few other conditions easily treated or prevented at village level complete a list that constitutes easily two-thirds of the serious and potentially fatal illness found in children in developing countries—malaria, anemia, diphtheria-whooping cough-tetanus, scabies and skin infections, and intestinal worms. Most of the deaths that occur in young adults are due to diarrhea or enteric disease, pneumonia, tuberculosis, or complications of pregnancy. Treatment or prevention of these conditions

can easily be combined with a child care program.

Several programs around the world have integrated these medical interventions to provide care to small population groups through paraprofessionals of various sorts trained particularly in maternal and child care, nutrition, and the treatment of a short list of common infectious diseases. Reductions of the infant and age 1 to 4 mortality rates by 50% or more were produced in Africa, Guatemala, and in two separate locations in India (Table 6) (23, 26, 33, 34, 42). One of the programs, the Jamkhed Project, included some limited efforts at agricultural development and sanitation but there was no significant change in economic or sanitary conditions in any program during the time in which the drop in mortality was observed.

The list of causes of death in Table 5 could suggest alternative strategies to these integrated village-based programs. Three other approaches are commonly found competing for the scarce resources available: mass campaigns, sanitation, and family planning.

Mass campaigns have, in fact, produced some impressive results and the tuberculosis and neonatal tetanus programs cited earlier are examples of success. If it were impossible to establish a network of locally resident individuals capable of providing personal health services, there would be a case for a mass approach to nutrition education, immunization, and the treatment of a few dis-

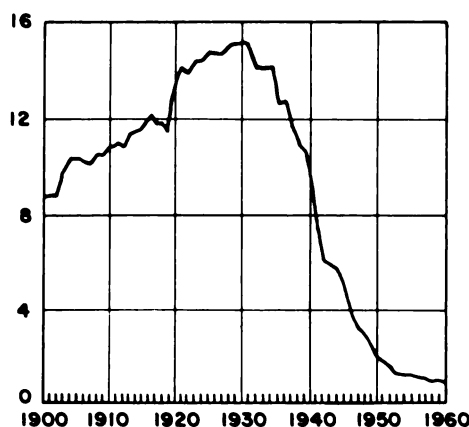


FIG. 5. Death rates for appendicitis: death-registration states, 1900 to 1932, and United States, 1933 to 1960 (rates per 100,000 population). From Reference 19.

TABLE 5
Causes of death in children under 5—percent of total

Cause of death	Imesi, Nigeria 1957 (23) ^c	Narangwal, India 1971–1973 ^a (26)	Companiganj, Bangladesh 1975 ^a (35)	Guatemala 1956–1957 (32)
Diarrheal disease	12	39	27	18
Pneumonia	12	19	7	19
Malnutrition	12	5	31	20
Malaria	8	0	0	0
Diphtheria, whooping cough, and tetanus	8	2	4	7
Smallpox	5	0	0	0
Measles	8	1	2	?
Tuberculosis	5	0	1	?
Anemia	0	0	0	?
Other, including neonatal deaths	30	34	29	37

^a Children age 8 days to 3 years. ^b 1975 was a famine year. ^c Numbers in parentheses are references.

TABLE 6
Mortality rates in four integrated mother and child health-nutrition programs

	Population receiving services		Population in same area without services	
	Infant mortality rate	1–4 Mortality rate	Infant mortality rate	1–4 mortality rate
Imesi, Nigeria (42) ^a	57.3	18.0	91.4	51.2
Guatemala (33)	55.4	5.9	84.7 ^b	22.0 ^b
Narangwal, India (26)	95.9	10.1 ^c	126.5	16.3 ^c
Jamkhed, India (34)	39		97	

^a Numbers in parentheses are references. ^b From official statistics, which are probably low estimates. ^c Age 1 to 3 mortality rate.

eases such as tuberculosis, but it would function with some important handicaps. Mass nutrition education has not had much effectiveness where it has not been combined with provision of other personal health services, and the diseases for which the mass approach is most effective (tuberculosis and those conditions preventable by immunization) are not the main causes of death in most developing countries. Deaths of children from malnutrition, diarrhea, and pneumonia will not be affected unless the mother of the child acquires the knowledge, the ability, and the desire to undertake a few simple, but critical, activities (25, 26, 28). The availability of such remarkably effective therapy as oral fluid treatment for diarrhea and penicillin for pneumonia should make it possible to reproduce the infant welfare center experience at a much more rapid rate than in the early 20th

century and with better final results. However, the use of these modalities depends upon the availability of health personnel resident at the village level, not only to provide treatment but also to provide continuing health education in a situation in which it is likely to be accepted. It is not reasonable to expect a retrained malaria worker visiting once a month to develop the level of understanding and confidence of mothers and families necessary for such acceptance. This is probably the most important reason for the poor results observed around the world with “multipurpose workers” trained to combine several health-promoting activities in a round of house visits (35, 36).

As for sanitation and family planning, they ought not to be considered in competition with other health efforts. Both are usually desirable, if practiced with moderation, and both have social value beyond the significant health benefits they can produce. In the case of sanitation, it should be remembered that cost limitations make it impossible to provide more than very simple facilities in villages, that these facilities are necessarily less effective than those available in the industrialized countries but that given an adequate quantity and a reasonable quality of water, personal habits are probably more important than the available facilities (37, 38). We really need to know more about the practical value for health of specific sanitation activities if we are to make intelligent recommendations, but it is clear that significant results can be produced with very simple measures if there is a community will to do something about sani-



tation (39). Pressure by Western countries, particularly the United States, to extend family planning services without supporting health services and without regard for the feelings and the rights of those whose families are planned, has led to a situation in which population control programs are considered racist and imperialistic in many parts of the world. Nevertheless, the health benefit to mother and child of widely-spaced children is established (40), and women have a right to access to methods for fertility control. The family planning technology is extremely simple and can be combined with almost any health system, but a village-based system works better. One of the important findings during the Narangwal study in India was the demonstration that a wide range of maternal child health activities can be added to a family planning worker's duties without reduction of the quality or quantity of the family planning services provided (41).

In several developing countries rapid expansion of integrated appropriate health services on a national scale has been associated with dramatic reduction of death rates, particularly among the 1 to 4 age group. It is not so easy to separate the medical effort from the general socioeconomic improvement in these instances as in the isolated projects described earlier, but it seems likely that the medical efforts played an important role. China is the example most commonly cited, but three other countries are particularly interesting because of the very great differences in the ways they have approached a common goal.

Sri Lanka and the State of Kerala in India are not communist states, but they have had governments that introduced a considerable degree of equity through land reform, rationing, which made low cost food widely available, and other measures. At the same time, there was a major expansion of health services provided through a system of health centers and subcenters which was quite similar to that available throughout India as a whole, but more extensive and better supported. Most services were provided by government employed and trained paraprofessionals supported by physicians (43, 44). Cuba, on the other hand, faced with the loss of 50% of its physicians after the revolution in 1959, chose to expand services by training

new physicians in the traditional way (45). For 10 years, 30% of university students were medical students. Most health services today are provided by physicians in rural or urban health posts attached to a network of district hospitals. Results have been quite good in all three countries. Comparison of infant mortality rates and per capita income in the nations of South and Southeast Asia (Table 7) shows that Sri Lanka is unique, in that infant mortality is quite low even though per capita income is not high. Kerala has an infant mortality rate of 50, with an even lower per capita income. In Cuba, the infant mortality rate was 29 in 1976. There are a few other small Latin American countries with comparable rates, but all have a much higher gross national product per capita.

None of these three countries chose to use "barefoot doctors," and although the three health systems relate closely to the community served, the service personnel do not necessarily come from the community. Village-based systems are probably cheaper and have other important advantages, but in the end they are not as important as the social system in which they function. Even doctors can provide effective services if they go where the problem is and do the right thing when they get there.

Another important observation can be made on this experience: none of these countries wasted any time on questions about the

TABLE 7
Infant mortality and per capita gross national product, South and Southeast Asia^a

	Infant mortality rate	Per capita gross national product (U.S.\$)
Afghanistan	182	130
Bangladesh	132	110
India	122	150
Iran	139	1440
Nepal	169	110
Pakistan	121	140
Sri Lanka	45	150
Burma	126	110
Indonesia	137	180
Malaysia	75	720
Philippines	74	370
Timor	184	150
Singapore	16	2510
Thailand	89	350

^a Data from the Population Reference Bureau Data Sheet, Washington, D.C., 1977.

role of health services in development. In each instance expansion of health services was accepted without question as an important aspect of an increase in equity in the society. In fact, this has been true of every developing country, socialist or nonsocialist, which has made a serious attempt to increase equity. This must be accepted as evidence for real demand for health services throughout the developing world.

Obstacles to the application of technology

If we accept that there is a technology available to developing countries with the capability to reduce infant and age 1 to 4 mortality by 50% in a matter of 1 or 2 years, then we must ask why this technology has not been adopted more widely. To some extent, this is a misleading question, since a sizeable part of the developing world has already expanded its health services efficiently, with good effect and with minimal assistance from external sources. China, Taiwan, South Korea, Vietnam, Sri Lanka, parts of India, Cuba, Hong Kong, Singapore, and Jamaica taken together, are not a small part of the world's population, and infant mortality in these countries is approaching that of the United States even though per capita gross national product is still much lower. Nevertheless, there are large parts of the world in which the decline in mortality has been much less, and some places where the decline seems to have stopped (5). There must be obstacles of some sort to the application of an effective technology in these areas.

It is not hard to find causes for the problem. Inadequate funds, public apathy, "inappropriate technology", and the indifference of governments and societies to human need are obvious features of health service systems in large parts of the developing world and in sections of the United States, as well. There is reason to believe that the first three are false problems that result from distortions in society that disappear when there is a will to do something about the last—the indifference of society to human need. If this is true, it is of some importance, since development efforts usually focus on financial support, education, or motivation of the public to change its ways, and changes in the technology. Grant (46) has pointed out that major im-

provements in health in developing countries have invariably been associated with the political will to increase equity in a society. In the absence of this will, development efforts focused on the first three problems have had very little success. A quick look at each of these problems will provide some insight into the reasons.

Adequate funds are in fact already available for quite satisfactory health programs. The four demonstration programs in Table 6 cost between less than \$0.50 (Jamkhed) and \$2.00 (Narangwal) per capita per year. Sri Lanka spent \$3.76 per capita per year on all government health services in 1971, and this country has an excellent health system. Most developing countries spend less than this on health, but several studies have shown that private expenditures for medical care in rural areas of those nations with minimal health services far exceed the government health expenditures. In India, private expenditure in a rural area was \$3.86 per capita per year (41). In Nepal it was estimated to be a minimum of \$2.00 per year (47). Comparison of health expenditures in Sri Lanka, India and elsewhere have shown that private expenditures tend to fall as government expenditure rises (48). This is not an exact trade-off, of course. The poorest and the youngest in the community have the most illness and would benefit most from medical care, but market forces concentrate the expenditure on the richer and the older part of the population. For this and other reasons the free market system for medical care in developing countries is extremely inefficient and government intervention to shift the balance is necessary.

Public apathy toward government health services is a very real problem. It is only in small part due to ignorance, superstition, and traditional custom. All the projects mentioned have demonstrated that there is considerable intelligently directed demand for health services and we have seen that many countries have been able to mobilize this demand on a national scale. In much of developing world, however, there is very little utilization of government services and poor acceptability of health education, sanitation, and other government programs. The main reason for this is *distrust*, which results from experience with low quality and unresponsive services provided without regard for any re-




relationship to felt health needs and without evaluation of the effectiveness of the services rendered. Even when appropriate services are meted out it would be naive to expect an immediate response to the measures that are introduced. Demand for medical care is not necessarily demand for supplemental feeding of infants, oral fluid treatment of diarrhea, or prolonged treatment of a disease like tuberculosis. Development of confidence requires demonstration of success through a long-term interaction between the community and the providers of services. This in turn means that the providers must be accessible, must communicate and must conduct an ongoing critical examination of the outcomes of their interventions. If services are offered through paraprofessionals it is unreasonable to expect people to accept the girl next door as the family doctor right away. Acceptance can be achieved, however, and it has been demonstrated repeatedly that it can be achieved in a remarkably short time.

"Inappropriate technology" is also an unfortunate reality, but it would be a mistake to think that it can be altered by recommending an appropriate one. The technology has been distorted by market forces, by misplaced professional pride, and by the "dual society" (urban rich and rural poor) of these countries, as Navarro has pointed out (48). This is not likely to change drastically unless the society as a whole rearranges its priorities.

There is more to the question than socioeconomic forces within developing countries, however. An appropriate technology cannot be developed outside of the country for which it is intended. Techniques can be transferred and improvement of the technology is certainly possible. If, for example, a heat-stable, lyophilized measles vaccine can be produced, this will be a useful and important advance. Technology is more than the introduction of techniques, however. It requires a considerable group of professionals within a society who understand both the capacity of the technology and the needs of the society, so that they can select appropriate measures for introduction, evaluate them after introduction and modify them as needed. For the most important health needs the "profession" will have to think in terms of transferring the technology to the people—that is, they must create in the people an understanding that

they have the ability to solve most of their problems themselves, that assistance is available when it is needed and that occasionally public action is necessary. Illich does not believe that professionals can do this. The evidence cited above suggests that it is possible. Whether it can be institutionalized in developing countries without creating the technological nightmare existing in the west, remains to be seen.

Most developing countries today have fairly large professional groups, particularly in medicine. Unfortunately, in many of these countries, the professional groups relate more to the needs of an industrialized society than to those of their own nation. It is important for professionals in the industrialized countries to recognize how large a role they have played in molding this inappropriate technology and to understand the critical need for a self-reliant and responsible professional group within each developing country. It is not at all an exaggeration to say that the real need is for appropriate people, not an appropriate technology. If we think in these terms we can look objectively at our own activities in these countries and, at the least, stop doing some of the things that have been harmful.

The fact that societies need to develop a political will to deliver medical services before they can be effective on a large scale ought not to be seen as a reason to abandon hope for half the developing world. The opposite argument can be made—perception of the very great improvement in health levels that results when decent services are provided could be one of the important incentives for social change in these countries. Every nation today has individuals within it who want to improve health and who understand how to go about it. A realistic appraisal of both the potential of the medical technology and the obstacles to its use is important for them and for any of us who want to support them. 

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