Cairo University-M.I.T. Technological Planning Program

THE INFLUENCE OF THE HEALTH SYSTEM ON THE RECORDED INCIDENCE OF INFANT MORTALITY AND BIRTH RATES IN RURAL EGYPT

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M.I.T.-Cairo University Health Care Delivery Systems Project
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PREFACE

This monograph is one in a series of studies being prepared by the M.I.T.-Cairo University Health Care Delivery Systems Project, a collaborative research venture featuring scholars at the two schools in association with senior officials in Egypt's Ministry of Health.[1]

Since its inception in May 1977, the project has examined health care delivery in relation to malnutrition, morbidity, infant and early childhood mortality, and fertility. The principal work of the project has involved design and analysis of a Health System Questionnaire which the Ministry of Health administered in a national sample of 132 rural health centers and units in the seventeen non-urban governorates of Lower and Upper Egypt in March-April 1978. Several studies based on this questionnaire have been completed, and more are planned.[2]

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1 The Health project is one of fourteen projects sponsored by the Cairo University - M.I.T. Technological Planning Program. This program was established in 1977 with funding from the United States Agency for International Development for the purpose of bringing Egyptian and American scholars together in policy-oriented research intended to assist the government of Egypt.

2 Mohamed el Lozy, John Osgood Field, George Ropes, and Robert Burkhardt, "Childhood Malnutrition in Rural Egypt: Results of the Ministry of Health's 'Weighing Exercise,' " M.I.T. - Cairo University Health Care Delivery Systems Project, Monograph #4 (June 1980); Robert Burkhardt, John Osgood Field, and George Ropes, "Supplementary Feeding in Rural Egypt: A Summary Profile of the Health System in Action," ibid.,

This monograph reflects a different line of inquiry. It examines data organized at the governorate level in an attempt to identify the extent to which and ways in which characteristics of the health system in rural Egypt affect the recording of births and infant deaths. Health experts are aware that a significant, if unknown, number of births and infant deaths are never registered. This study was intended to establish whether "reporting bias" is systematically related to such health system attributes as spatial dissemination, jurisdictional coverage of the population, and actual levels of system-society interaction as these vary across the governorates. An appendix explores the circumstances conditioning popular utilization of the government's health services in rural Egypt.[3]

The governorate level of analysis, although crude and statistically confining, is serviceable for purposes of initial examination of sub-national data. Differences among the governorates highlight critical

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2 (continued)
Monograph #5 (June 1980), and "Family Planning in Rural Egypt: A View from the Health System," ibid., Monograph #6 (June 1980); and John Osgood Field and George Ropes, "Monitoring Malnutrition in Rural Egypt: Opportunities and Constraints," ibid., Monograph #7 (forthcoming). In addition, the project has produced a Reference Manual containing distributions along with regional and governorate breakdowns of the data generated by the questionnaire: "Results of the Health System Questionnaire: A Reference Manual," Ibid., Monograph #3 (May 1980).

3 Two other studies based on governorate data are John Osgood Field and George Ropes, "Development in the Egyptian Governorates: A Modified Physical Quality of Life Index," L'Egypte Contemporaine, 372 (April 1978), 41-54, and "Infant Mortality, the Birth Rate, and Development in Egypt," M.I.T. - Cairo University Health Care Delivery Systems Project, Monograph #1 (May 1980).

relationships and causal patterns of general validity, and they are suggestive of at least some of the dynamics involved in relating the health system to health outcomes. Longitudinal analysis of more disaggregated data is a logical next step but one which we must leave for others to pursue.

It is a pleasure to acknowledge the many contributions of our counterparts at Cairo University and in the Ministry of Health in making this analysis possible. We hope that this product is worthy of their friendship and trust.

John Osgood Field
George Ropes

Cambridge, Massachusetts, U.S.A.
June 25, 1980

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THE INFLUENCE OF THE HEALTH SYSTEM ON THE RECORDED INCIDENCE OF INFANT MORTALITY AND BIRTH RATES IN RURAL EGYPT

In most low income countries, health care is skewed spatially and socially, with urban elites having access to the latest medical services while the rural poor lack even the most rudimentary attention to their very real, immediate, and often pervasive health needs. Some recent attempts at reform have been impressive, but the cruel fact of the matter is that even minimal health care is still not available to most people in most countries.[1]

Egypt is an exception to this generalization. Since the Revolution in 1952, the number of rural health facilities has increased almost ten-fold, as has the number of physicians, nursing staff, and paramedicals, while the unit-to-population ratio has declined by more than five times during the same period. The evidence reviewed in Table 1 attests to the extraordinary expansion of rural health services in Egypt since the 1950's.

Today, Egypt expends about eight percent of its national budget on health. This figure is not exceptional, but it does exceed the international norm. By two other standards -- the health budget as a percentage of gross national product and government health expenditures per capita -- Egypt does not rank especially high. What makes Egypt distinctive is

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[1]See, for example, Health: Sector Policy Paper, World Bank (March 1975).

Table 1: Development of Rural Health Services in Egypt (1952-1976)

Year	Rural Health Facilities	Ratio: Facilities to Population	Physicians	Nurses	Paramedicals
1952	289	1:48,038	289	855	400
1962	875	1:18,795	856	1,838	950
1970	1,835	1:10,700	1,902	4,932	3,505
1976	2,252	1: 9,364	2,270	6,203	4,282

Source: Almotaz B.O. Mobarak and Salah Shahbender, "Development of Rural Health Care in Egypt," background paper, M.I.T.-Cairo University Health Care Delivery Systems Project (Autumn 1977), p. 7. See also Arab Republic of Egypt, Ministry of Health, Egyptian Experience in Primary Health Care (undated), pp. 29-31.

the dissemination of its health services. According to Ministry of Health data, the catchment area of a typical rural health unit is only 15 square kilometers, a most respectable figure and one which is becoming even more enviable as the planned doubling of rural health facilities proceeds.[2] In Egypt rural health services are not only widely available, they also appear to be extensively utilized. Ministry data suggest that about half of the total population avail themselves of outpatient services

[2] A goal of 4,500 rural health centers and units has been set for the near future. As of 1978, the average distance to all villages served by rural health centers and units (including combined units) in Egypt was three kilometers, although the number of villages that this entails varied considerably. The typical center was responsible for a population of 15,000, the typical unit for a population of 7,000. Combined units covered 10,000 people, on average. These figures all exceed W.H.O.-specified targets. Source: Results of the Health System Questionnaire Administered by the Ministry of Health, Arab Republic of Egypt, at 132 Rural Health Centers and Units, March-April 1978: A Reference Manual, M.I.T.-Cairo University Health Care Delivery Systems Project, Monograph #3 (May 1980), pp. 146-154.

in a given year.[3] Thus, not only is the system in place, but an impressive amount of system-society interaction can be documented as well.

The diffusion of Egypt's rural health system and the relatively impressive levels of utilization being experienced lead to somewhat contradictory expectations concerning two problems in Egyptian society for which the Ministry of Health has been given principal responsibility. One of these is the high incidence of infant mortality, officially documented at 98 infant deaths per 1,000 live births in 1973. The other is Egypt's persistently high birth rate, which was measured at 36 births per 1,000 population in 1973.[4] In response to both problems the Ministry is experimenting with major new approaches to providing nutrition, health, and family planning services; and this effort is an appropriate backdrop against which to ask what happens to birth and infant death rates as the health infrastructure expands and contact with the public increases.

In the abstract, it is possible to imagine two seemingly opposite outcomes. On the one hand, the combination of expansion and increased interaction with the public suggests the capacity for greater impact on the multiple causes of high mortality and fertility. As the system penetrates

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[3] The data referred to are the governorate data used in this study. See Table 2, column 3. As measured here, utilization reflects the number of new outpatients as a percent of population. Other Ministry data report the total number of outpatient visits as a percent of population. When this is done, the level of contact increases markedly (to 78% for 1972), with even higher rates identified for mothers' clinics and child clinics. See Arab Republic of Egypt, Ministry of Health, Egyptian Experience in Primary Health Care (undated), p. 32. Other studies suggest a much lower rate of utilization.

[4] In each case 1973 is the most recent year for which a rate has been officially established. Estimates for subsequent years are at the same order of magnitude. For an analysis of how these demographic patterns relate to each other and to various socio-economic parameters in Egypt, see John Osgood Field and George Ropes, "Infant Mortality, the Birth Rate, and Development in Egypt," M.I.T.-Cairo University Health Care Delivery Systems Project, Monograph #1 (May 1980).

society, it is ever more able to disrupt the malnutrition-morbidity-mortality dynamic and to save vulnerable children. One might expect, therefore, that expansion of the system would be associated with a reduced incidence of early childhood mortality. Similarly, though to a lesser extent, one might expect expansion of the system to affect fertility by contributing to the establishment of lower norms for optimal family size, in part because of enhanced child survival and in part because the health infrastructure is the principal vehicle for disseminating family planning information and contraceptive devices in Egyptian society.[5]

On the other hand, development of the health system may also be expected to improve the recording of births and infant deaths. Distance deters detection; proximity facilitates it. As the system expands and becomes more interactive with the public in rural Egypt, the first observable effect may be better reporting, resulting in apparently higher -- not lower -- mortality and fertility rates. Again, mortality is likely to be more responsive than fertility. It is widely believed that many infant deaths are simply not recorded at all by the health authorities, whereas most births probably are registered, albeit incorrectly. With infant mortality the suspicion is one of serious underestimation based on imcomplete recording. With fertility the suspicion is more one of inaccurate attribution of the date of birth, as against the fact of birth.

These contrasting expectations present the analyst with a dilemma. As the health system expands its presence in the countryside, it should

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[5]The rural health service's experience with family planning, including perceptions of popular responsiveness by the doctors in charge of the program at the center/unit level, is examined in Robert Burkhardt, John Osgood Field, and George Ropes, "Family Planning in Rural Egypt: A View from the Health System," M.I.T.-Cairo University Health Care Delivery Systems Project, Monograph #6 (June 1980).

encounter more of the health problems that have been there all along, and it should begin to alleviate those problems. One prediction is better reporting; another is greater impact. The latter suggests that development of rural health services should result in lower infant death and birth rates. The former implies that expansion of the health system will appear to have quite the opposite effect. One question before us, therefore, is how these contrasting expectations balance out in fact. Another question to be addressed concerns which aspects of the health system's own development are most influential in determining this balance.

This paper examines data organized at the governorate level to answer these questions, employing simple Pearson correlation coefficients and step-wise regression equations to do so.

The Data

Figure 1 lists the health system variables available to us for purposes of this inquiry. There are nine in all, three of which pertain to dissemination, or the system's capacity to cope with the health needs of the rural population, and six of which entail actual system-society interaction. The latter set, in particular, includes several rather weak measures which, we discovered, do not add meaningfully to the analysis. The four most useful variables and their values are listed in Table 2.

Table 2 shows that there are pronounced differences in the development of the health system from governorate to governorate. To illustrate, the average population served by a health facility in Damietta, Assiut, and Souhag is virtually double the population served in Menufia and Aswan, although the latter are clearly atypical of rural Egypt as a whole.

Figure 1: Measures of Health System Development, Governorate Data for 1976, Arab Republic of Egypt (Rural)

A. DISSEMINATION (CAPACITY TO COPE)

1. Area served

: Refers to: spatial responsibility
: Measured as: average number of square kilometers covered by each facility

2. Population served

: Refers to: jurisdictional coverage
: Measured as: average population size per facility

3. Population per bed

: Refers to: curative capacity
: Measured as: average population per bed available

B. CONTACT (SYSTEM-SOCIETY INTERACTION)

4. Utilization

: Refers to: number of new outpatients relative to population
: Measured as: new outpatients as a percent of population

5. Amount of contact

: Refers to: average population seen at least once
: Measured as: new outpatients divided by number of facilities

6. Overall "busyness"

: Refers to: load on the system, activity
: Measured as: total outpatients divided by number of facilities

7. Tests

: Refers to: load, activity
: Measured as: average number of urine and stool tests per facility

8. Smallpox immunizations

: Refers to: service to children
: Measured as: percent of live births immunized against smallpox

9. Diptheria immunizations

: Refers to: service to children
: Measured as: percent of live births immunized against diptheria

Source: Ministry of Health

Table 2: Principal Measures of Health System Development and their Values for 1976, Governorate Data, Arab Republic of Egypt (Rural)

Governorates	....Dissemination... AREA	POPULATION	.....Contact..... UTILIZATION	"BUSYNESS"
Damietta	15	10,358	67%	12,221
Dakahlia	16	9,846	49%	6,116
Sharkia	22	9,816	43%	4,201
Kalyubia	9	9,609	a	a
Kafr-el-Sheik	29	9,187	a	a
Gharbia	13	9,550	53%	5,676
Menufia	11	4,820	a	a
Behera	24	9,862	48%	4,970
Ismailia	a	a	a	a
Giza	9	9,043	75%	7,063
Beni-Suef	12	7,728	34%	5,538
Fayoum	19	9,288	a	a
Minya	12	8,507	48%	4,296
Assiut	13	10,473	76%	7,927
Souhag	10	10,131	14%	2,664
Kena	13	9,594	17%	1,710
Aswan	11	5,069	78%	4,100
Rural Egypt[b]	15	8,930	50%	5,540

AREA = average number of square kilometers covered by each facility
POPULATION = average population size per facility
UTILIZATION = new outpatients as a percent of population
"BUSYNESS" = average total number of outpatients per facility

[a] Data were not available.

[b] Unweighted averages.

Note: This table pertains to rural Egypt only, minus the sparsely populated Frontier governorates.

Source: Ministry of Health

Moreover, the area served by the average rural facility may be 15 square kilometers, but it is almost double that is Kafr-el-Sheik (29 square kilometers). By contrast, it is only 9 square kilometers in Kalyubia and Giza.[6]

The amount of system-society interaction is subject to even greater diversity, as Table 2 also indicates. Popular utilization of the rural health system varies from two-thirds or more of the rural population in Damietta, Giza, Assiut, and Aswan, to barely a sixth of the population in Souhag and Kena. The average number of outpatients seen per unit in 1976 ranges from a high of more than 12,000 in Damietta to a low of less than 2,000 in Kena. And so on. The overall picture is one of remarkable diversity from one part of rural Egypt to another.

The way in which these several attributes of the health system relate to one another is of interest. Two patterns stand out, both of which are counter-intuitive.

First, the size of the area served by the average facility and the size of the population in that area are only weakly associated ($r = .29$, n.s.). Evidently, much of the spatial difference observed across the governorates has little to do with the jurisdictional coverage of people. Thus, the physical dispersion of health facilities may be most impressive in rural Giza and Kalyubia compared with elsewhere, but the average population to be served by each facility in Giza and Kalyubia is itself quite average. Similarly, the population per facility may be unusually high in Assiut and Souhag, but these two governorates possesss catchment areas that are actually below average. Whether by design (a preference for improving the geographical dispersion of the health system over reducing the load

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[6]The average population per bed in rural health centers and hospitals is also subject to considerable variation, from a high of 1,233 in Souhag to a low of 402 in Menufia.

on its most burdened facilities) or by chance, distance and responsibility are substantially independent in rural Egypt.[7]

Second, the dispersion of health facilities also says very little about interaction with the public. The conventional wisdom may regard accessibility as a major factor conditioning popular utilization,[8] but the governorate data in Egypt reveal no association. Areal coverage is unrelated to utilization and to overall health system "busyness" ($r = -.10$ and $r = .03$ respectively). At this level of analysis distance is simply not relevant to the amount of contact between system and society. Nor is population size. It would appear that the extent to which people cross the threshold of rural health centers and units for outpatient care is not related either to the size of the catchment area or to the size of the population being served.[9]

Moreover, closer inspection of the data reveals something else that may not be immediately apparent to health experts. Whereas health system development in most countries tends to follow and reflect economic development

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[7] By contrast, as the population to be served by the average facility declines with expansion, so does the population-per-bed ratio ($r = .79$, sig. at .001). This is because the number of beds per rural health center and combined unit tends to be relatively constant. The two variables are basically measures of the same thing, with population per facility being of greater interest in this study because it is not limited to in-patient services. Appendix B contains a correlation matrix of all the health system variables listed in Figure 1.

[8] See the evidence concerning accessibility in World Bank, op. cit., p. 35. See also Tara Gopaldas et al., Project Poshak (New Delhi: CARE India, 1975), Volume One.

[9] See Appendix B for the relevant coefficients. None are statistically significant, and some imply that dispersion may actually be associated with somewhat lower, not higher, levels of interaction, a pattern explainable by the socio-economic bias in health system expansion noted below and by the tendency for utilization to reflect attainment of modern attributes such as literacy.

generally, with health services being most available in more modern areas of a country, the reverse is true in Egypt outside of the several urban centers. For example, the rural health system's jurisdictional coverage of the population is not highly correlated with any standard measure of development. Governorates high in literacy, urbanization, rural electrification, water purification, agricultural productivity, and per capita income derived from agriculture are no more favored in terms of population coverage than are less advantaged governorates.[10] The pattern is actually inverse with regard to the average facility's spatial coverage. Evidently, Ministry policy has been to locate health facilities in the relatively poorer, less developed governorates in preference to the more affluent and productive governorates. It is clear that, when analyzed at the governorate level, dissemination of the health system in rural Egypt varies inversely with the development of society.

Ironically, this commendable policy of enhancing the availability of health services in the less developed parts of the country does not reap commensurate gains in impact. The reason has to do with popular responsiveness to what is provided. Health system development may tend to favor underdeveloped governorates, yet system-society interaction is clearly a function of socio-economic change. Popular utilization of health services improves markedly with increases in literacy, urbanization, and rural

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[10] To illustrate, after Fayoum, Assiut has the highest per capita income derived from agriculture in Upper Egypt (LE 82.00 per annum), but Assiut also has the largest number of people served by the average health facility in all of rural Egypt (10,473). Damietta has the next largest number of people served by the average health facility (10,358), but Damietta's literacy (51%) is highest in Egypt outside of the urban governorates and the sparsely populated Red Sea governorate. Overall, the correlations between development and population coverage hover near zero.

electrification.[11] The irony is that the health system has expanded most impressively in areas where people are least likely to take advantage of the services offered.

The Effects of Health System Expansion

Of principal importance to the present discussion is how expansion of the rural health system affects birth rates and infant mortality rates. In a related analysis we have shown that development, variously defined, has a complex, mixed, and -- on the whole -- rather mild influence on births and infant deaths.[12] It is apparent that development by itself will not cure these two demographic afflictions of Egyptian society in the short run. Direct interventions by the Ministry of Health seem required if the mortality-fertility spiral is to be broken at its source: the generally low health and nutritional status of small children in poor families. Given this need, we turn now to the effects of the Ministry's expanding presence in the countryside to date.[13]

Whatever else may result from expansion of the health system in rural Egypt, it has a profound effect on the recorded incidence of infant mortality. Statistically, the infant mortality rate increases as the area

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[11] The relevant Pearson coefficients are all in the .6 to .7 range (sig. at <.025). See Appendix A for a more complete analysis of utilization and its determinants.

[12] Field and Ropes, Monograph #1, op. cit.

[13] The reader may be disturbed by the fact that, of necessity, we are relating infant mortality rates in 1972 and 1973 to attributes of the health system in 1976 as if the latter influence the former. Although this is logically impossible, empirically it is justified if one assumes that features of the health system in the different governorates in 1976 resemble the patterns for 1972-73 and earlier.

served by the average health unit decreases. Also, the infant mortality rate increases as the average population served per health unit decreases. Table 3 reveals that the correlation coefficients are uniformly inverse, substantial, and highly significant. Moreover, the basic pattern holds whether mortality rates are considered for 1972 or 1973 and also when rural

Table 3: The Association between Infant Mortality Rates (1973 and 1972) and Expansion of the Rural Health System: Pearson Correlation Coefficients, Governorate Data, Arab Republic of Egypt

	HEALTH SYSTEM EXPANSION			
	AREA		POPULATION	
	r	(sig.)	r	(sig.)
Infant Mortality in 1973	-.76	(.001)	-.61	(.01)
Infant Mortality in 1972	-.72	(.001)	-.54	(.05)
Rural Infant Mortality in 1972	-.67	(.01)	-.54	(.05)

AREA = average catchment area (square kilometers) per rural health facility.

POPULATION = average population size per rural health facility.

Note: These statistics pertain to the 17 rural governorates of the Lower and Upper Egypt minus Ismailia, omitted because of missing values.

mortality (1972) is isolated.[14] Substantively, of course, these are absurd associations. They are statistical artifacts reflecting improvements in the recording of infant deaths.[15]

Regression analysis confirms the message of the correlation coefficients that health system expansion is associated with higher rates of officially recorded infant mortality, thereby implying reporting bias. Regression analysis also attributes causality to the relationships observed, meaning that the health system itself is responsible for at least some of the difference acknowledged in mortality rates across the governorates. Finally, regression analysis reveals that areal responsibility is the principal influence at work.[16] As Table 4 demonstrates, much the same patterns emerge regardless of the mortality data employed while the overall explanatory power of the equations is considerable. Not indicated in Table 4 is the interesting fact that these equations survive intact even when developmental influences on infant mortality are introduced as well. Not only is the recording of infant mortality in rural Egypt very much a function of health system expansion; the influence of the health system tends to

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[14] The last is probably the most telling coefficient because it relates rural mortality to the expansion of the rural health system, thereby removing the influence of urban mortality in the associations.

[15] We tested another explanation, namely that expansion of the rural health system has favored those parts of the country (governorates) in which health needs are greatest. Were this the case, the higher incidence of infant mortality in areas best covered by health facilities might be ascribed either to policy or to coincidence. Neither interpretation receives support from the data because, in fact, there is no relationship between health system expansion and the reported magnitude of disease.

[16] Area loads consistently and first in step-wise regression analysis. Jurisdictional coverage of the population loads in two of the three "best" equations examined, as does the birth rate.

Table 4: The Influence of Health System Expansion on the Recorded Incidence of Infant Mortality: Step-Wise Regression Analysis, Governorate Data, Arab Republic of Egypt (Rural)

Dependent Variable	Variables in Best Model: Beta and (Significance)	Statistical Significance of Model	% of Variation in Infant Mortality Explained (Adjusted R^2 x 100)	Variables Not Entering Model Significantly
Infant mortality in 1973	-.63 Area (.01) -.43 Population (.05)	.01 (F = 19.0)	71%	Birth rate Population/bed
Infant mortality in 1972	-.46 Area (.05) -.44 Population (.05) +.39 Birth rate (.05)	.01 (F = 13.7)	72%	Population/bed
Rural infant mortality in 1972	-.62 Area (.01) +.45 Rural birth rate (.05)	.01 (F = 11.8)	59%	Population Population/bed

Note: These equations pertain to the 17 rural governorates of Lower and Upper Egypt minus Ismailia, omitted because of missing values.

overwhelm the influence of socio-economic parameters.[17]

The burden of the evidence is three-fold. First, there is a gap between the actual incidence of infant mortality in rural Egypt and the incidence reported in government statistics. The former is greater than the latter by some unknown magnitude. Second, the bias contained in the official statistics is not random. Rather, it is directly related to the health system's own presence in the countryside as that presence varies from governorate to governorate (and, we may presume, within governorates). Third, the principal factor affecting the magnitude of the discrepancy is spatial. Improved dissemination of rural health centers and units both reduces the catchment area of the average facility and results in better (if higher) mortality statistics.

In short, expansion of the rural health system in Egypt over the past two decades may have had a positive influence on the actual rate of infant mortality, but that influence is not observable in the governorate data. On the contrary, these data suggest strongly that much infant mortality remains hidden from official view. As the health system develops, it uncovers more and more of what is already there. The true rate at which infants die in rural Egypt remains unknown, but expansion of the health system would appear to be reducing the gap between statistics and reality.

A very different pattern emerges in the recording of births. It is appropriate to note that two difficulties with birth data are widely acknowledged in Egypt, as in other low income countries. One difficulty concerns an imputed gap between the actual and registered incidence of

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[17] When the key developmental influences on infant mortality (see Field and Ropes, op. cit.) are entered in the three equations shown in Table 4, they fail to load in two of the three and their significance is greatly reduced in the third.

births, particularly when neonatal mortality is involved. The second concerns an imputed gap between the actual and registered date of birth. If neither gap is easily documented, both -- to the extent that they exist -- are serious in their implications. Incomplete birth registration leads to an underestimation of birth rates and overall population growth. Inaccurate birth registration compromises the monitoring of child growth and nutritional status, with attendant consequences for identifying children at risk. The governorate data do not permit us to specify either suspected deficiency, but they do enable us to assess whether birth registration, like the recording of infant deaths, is a function of health system expansion.

The answer is negative. Birth rates are not influenced by spatial dissemination of the health system in rural Egypt. Nor are they influenced by variation in jurisdictional coverage of the population. The correlation coefficients are low and consistently insignificant.[18] Moreover, regression analysis fails to establish any meaningful linkage.[19].

In sum, governorate data reveal no relationship between the extension of health services and the registration of births in the aggregate. The reporting bias that so clearly exists in the case of infant mortality is not a factor with regard to births. This is not to say that all births are registered, much less that birth dates are correctly attributed. It is to say that birth registration is not influenced by the relative proximity of rural health facilities or by the population load which they

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[18] The strongest coefficient is -.33 (n.s.), but it collapses to 0 when the rural birth rate is isolated.

[19] That is to say, neither area nor population loads significantly when attempting to explain variation in the birth rate (1973) and the rural birth rate (1972).

bear. These characteristics of the system simply are not relevant to the recording of births, in contrast to the recording of infant deaths. By extension, expansion of the rural health system is not likely, in and of itself, to improve the accuracy of birth data, although it does promise considerable improvement in the accuracy of data concerning childhood mortality.

The (Negligible) Effects of Increased System-Society Interaction

Interesting as they are, these patterns reveal only one aspect of the potential dynamics involved. It is also of interest to learn what happens when the inquiry turns from attributes of the health system alone, such as spatial dissemination and population coverage, to measures of system-society interaction. The latter may have an influence of their own; that influence might run in either direction, toward reporting bias or demonstrable impact; and it might be equally relevant to birth statistics as to mortality data. Indeed, expansion of the health system may well exert its real influence on infant births and deaths through the greater contact with rural society facilitated by it. The possibility exists that expansion is less important than contact. It may even be that, with the effects of contact identified, expansion is not important at all.

These considerations led us to examine the second set of health system variables in our file. Our analysis covered all six variables measuring contact. Here we will discuss only the patterns revealed by the two strongest of these variables: rates of utilization by the public and the overall "busyness" of the average rural health facility in each governorate.[20]

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[20] These measures are variables #4 and #6 in Figure 1. They are discussed at length in Appendix A.

The former is the best indicator at our disposal of popular responsiveness to the health system; the latter most effectively conveys the actual amount of contact with the public that occurs in the typical facility of each governorate. That the governorates vary markedly on each measure is evident from the distributions shown in Table 2.

The results obtained come as something of a surprise. Contrary to expectation, the contact variables are anemic. Several correlations are initially promising, but the relationships fail to stand up in regression analysis. The dissemination variables consistently load first; and once there, they leave the contact variables devoid of independent significance. In fact, the contact variables are not even significantly influential on their own. Stated in more substantive language, interaction between the health system and the fellahin in rural Egypt -- as measured -- would seem to have little bearing on the recorded incidence of births and infant deaths. Evidence of positive impact is again invisible in the data, while suggestions of additional reporting bias evaporate when the matter is pursued.

To illustrate, when utilization rates are examined in relation to the reported incidence of infant mortality, evidence of an association is apparent that, at first glance, resembles what we have already seen in the case of health system expansion. The greater the proportion of rural inhabitants utilizing the health services provided to them, the higher the recorded levels of infant mortality. The observed correlations are in the .5 range, and the most sensitive of them are statistically significant.[21]

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[21] For example, the Pearson coefficient for utilization rates in relation to infant mortality in rural areas alone is .52 (sig. at .05).

The meaning of the correlations is unclear, however. Perhaps the circumstances which dispose toward higher infant mortality also dispose toward greater popular interaction with the health system, the relationship between need and contact being strong enough to show up even in governorate data. Perhaps causality runs in the opposite direction, with utilization facilitating the recording of childhood deaths much as expansion of the health system itself does in rural Egypt. The first interpretation regards utilization as a reflection of deprivation. The second posits utilization as yet another factor influencing the accuracy of mortality statistics in the countryside.

Neither interpretation is confirmed by regression analysis. Utilization rates do not predict variation in infant mortality. Nor does infant mortality predict variation in utilization across the governorates. The latter finding is consistent with the failure of other measures of health status in our file to predict differences in utilization.[22] The former finding implies that outpatient contact with the rural health system does not, in fact, facilitate the recording of infant deaths. The two forms of linkage between system and society would appear to be independent of each other for all intents and purposes. That this is probably so is further suggested by the fact that, once the effects of area are taken into account, utilization rates add no predictive value to variation in infant mortality

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[22] Our measures of health status are not especially strong, the principal ones being the percentage of the population infected with schistosomiasis based on urine analysis and the percentage infected with ascariasis. See Appendix A.

across the governorates.[23]

The same holds when other contact variables are considered in relation to infant mortality and also when birth rates are examined. We are unable to find any causal relationships of significance. System-society interaction, whether measured in terms of utilization, overall "busyness," or otherwise, says nothing about the incidence of infant births and deaths. If the contact data reveal no additional source of reporting bias, neither do they reveal signs of impact.

A Summary Perspective

These findings based on the individual measures of health system dispersion and system-society interaction are nicely summarized in an aggregate index combining area, population, and utilization. These three aspects capture much of what the process of health system development is all about, with improved health status in the population being the desired outcome. They also happen to be only weakly associated with each other, at least as revealed by governorate data.[24] However, rather than dilute the effects of each component, the index actually strengthens the principal patterns observed. It would seem to reflect both the essence of the process and what the process means in terms of recording infant births and deaths. This is shown in Table 5.

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[23] The implication of this finding is that the mildly impressive zero-order correlations between utilization and mortality are inflated by other factors associated with either or both variables. We might add that the importance of spatial dissemination does not lie in the greater interaction between system and society that results from it. Area is not a blind for contact, the statistical reason being that there is hardly any association between the two ($r = -.10$, n.s.).

[24] The strongest coefficient is .29 (n.s.). The index, therefore, is not loaded in favor of any particular set of attributes.

Table 5: Health System Development Index (HSDI) in Relation to Recorded Infant Mortality and Birth Rates: Regression Equations, Governorate Data, Arab Republic of Egypt (Rural)

Dependent Variable	Beta*	Statistical Significance of Model	% of Variation Explained (Adjusted R^2 x 100)
Infant mortality in 1973	.87 HSDI	.001 (F = 45.6)	75%
Infant mortality in 1972	.76 HSDI	.001 (F = 19.2)	55%
Rural infant mortality in 1972	.77 HSDI	.001 (F = 20.9)	57%
Birth rate in 1973	.11 HSDI	n.s. (F = 0.2)	--
Rural birth rate in 1972	.37 HSDI	n.s. (F = 2.2)	7%

*The betas in these equations are identical to the Pearson correlation coefficients obtained in the same relationships.

The health system development index underscores our previous findings in that the health system does indeed have a bearing on infant mortality rates in rural Egypt, while the only observable effect of the system's expansion is simply to uncover, through improved detection and recording, more of what is already a social reality so far as infant deaths are concerned. By contrast, the index reveals yet again that the registered incidence of births is not significantly influenced by the attributes of the health system examined here.

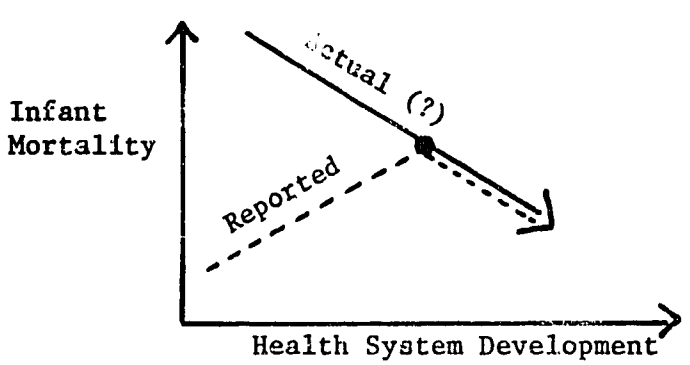
Conclusion

The following four observations summarize the patterns discerned in the government data.

1. The Ministry of Health's statistics on the incidence of infant mortality in rural Egypt are incomplete. Extensive under-recording occurs, the magnitude of which is not random. On the contrary, the degree of under-recording is inversely related to the development of the system itself. As the system expands, it uncovers ever more of the reality known to the fellahin in their homes and villages.

2. The rural health system may, in fact, be having an impact on infant mortality rates through its preventive and curative programs; but if so, the effects are not yet observable in the data. At best, the situation would appear to reflect the diagram in Figure 2, with the intersection of the actual and reported incidence of infant mortality being unknown.

Figure 2: Health System Development in Rural Egypt in Terms of Actual and Reported Incidence of Infant Mortality: A Hypothetical Diagram



Note: The two lines are drawn straight for clarity. In truth, there is no reason to believe that either line is linear.

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3. The dispersion components of health system development are more important to the accuracy of mortality data than are measures of system-society interaction. The spatial dissemination of health facilities is the strongest influence on officially tabulated rates of infant mortality. As the catchment area of the average facility declines, more of the actual incidence of infant mortality will be documented by the system. The same holds as the size of the population to be served also declines. Utilization rates and general "busyness," by contrast, are not significant factors.

4. Birth data would appear to be more accurate, in overall magnitudes, than mortality data. The registration of births in rural Egypt is subject to distortion, given the separation of the fact of registration from the fact of birth, and this may well entail a modest amount of under-reporting in addition to pervasively inaccurate attributions of birth dates. On the other hand, neither problem is systematically linked to health system development. Neither expansion of the system nor contact with the public seems to have a significant effect on official birth statistics.

If there is solace to be sought in these findings, it lies principally in the independence of birth rate assessments from attributes of the health system in rural Egypt as these vary from governorate to governorate. Also reassuring is our evidence that development of the health system is largely independent of socio-economic development, indeed that the prevailing pattern is of an inverse relationship between the physical expansion of health services and the overall wealth and well-being of the different governorates. Were the two more closely linked, the strong suggestion of reporting bias concerning infant mortality in one would obviously spill over to the other and contaminate it as well. Assuming that health system development and general development are, in fact, as separable as they appear to be at the governorate level of analysis, it is possible to conclude -- pending evidence to the contrary -- that the attempt to identify demographic and developmental influences on infant mortality in Egyptian society is valid notwithstanding deficiencies in the official mortality

statistics.

Be that as it may, the sad truth is that we (and everyone else) have been using faulty data on infant mortality, the values of which are simply and consistently incorrect. This is especially regrettable because the errors are systematically skewed as well. Mortality data reflect the dispersion of health facilities as much as the reality they purport to describe. When such a key indicator of health status is unreliable, any use of the indicator becomes suspect.

Fortunately, continued expansion of the health system will lessen the margin of error and eventually reduce it to insignificance. Given the impressive infrastructure that already exists, this is -- conceivably -- an imminent prospect. Indeed, in the longer terms our findings have more serious implications for other low income countries than for Egypt, if only because most of them have much further to go in penetrating the countryside.

Appendix A

WHY POPULAR UTILIZATION AND THE OVERALL "BUSYNESS" OF RURAL HEALTH FACILITIES VARY: AN EXPLORATION

What explains popular utilization of rural health facilities? By asking this question, we are able to test the validity of three plausible hypotheses in the Egyptian context.

Hypothesis #1: Use of the health system reflects health status in the population. People seek care when they are sick.

Hypothesis #2: Use of the health system varies with socio-economic development. People with more modern attributes and living in more developed environments are more likely to take advantage of the modern health system than are their more traditional counterparts.

Hypothesis #3: Use of the health system is a function of the system itself. The more disseminated and competent the system, the more people will utilize it.

In short, to what extent is popular utilization of rural health facilities in Egypt based on need as against being based on general socio-economic development as against being based on more specific health system development? We have sought to answer this question and to test each hypothesis, alone and against each other hypothesis, by regression analysis of the many variables at our disposal, with the number of new outpatients as a percentage of the rural population of each governorate serving as the dependent variable whose variation is to be explained.[1] Figure A-1

[1] So conceived, utilization refers to the proportion of society that seeks health care, not the level of "busyness" experienced by a health facility (which is also examined in this appendix). The emphasis is on coverage of the population in the form of contact typically initiated by the citizen. As Table 2 in the main text indicates, half of the rural population in Egypt utilized outpatient services in 1976 but with marked differences from governorate to governorate.

lists the variables employed in the analysis.

Figure A-1: Variables Used to Explain Variation in Popular Utilization of Rural Health Facilities: Governorate Data, Arab Republic of Egypt

Popular Utilization:	- new outpatients as a % of rural population (COVERPOP)
Health Status:	- % infected with schistosomiasis -- urine analysis (SHISTO) - % infected with ascariasis (ASCARIS) - rural infant mortality rate (RURIMR72) - rural crude birth rate (RURCBR72)
Socio-Economic Development:	- % illiterate (TOTILLIT) - % urban (URBAN) - % woman in the paid labor force (PDLABOR) - rural per capita income from agriculture (AGINCOME) - per capita "food" availability (FOODPOP) - % rural homes with electricity (RURELEC) - % rural homes with purified water in building or dwelling (RURWATER) - population density (DENSITY)
Health System Development:	- rural population per rural health center-unit (POPUNIT) - area (sq. km's) per rural health center-unit (AREAUNIT) - rural population per health system beds (POPBED) - number of urine and stool tests per center-unit (TESTLOAD) - % live births immunized against smallpox (SMALLPOX) - % live births immunized against diphtheria (DIPTHER) - total outpatient visits per center-unit (TOTLOAD)*

*TOTLOAD was both included and excluded in all appropriate runs because of its partial overlap with the dependent variable COVERPOP (r = .64, sig. at .01).

The first hypothesis, relating utilization to need, fares poorly. Even when considered in isolation of other influences, none of the health status measures "loads" reliably. This pattern is repeated when all three explanations are tested in the same equation. Health status, it seems, says very little about use of the rural health system.

Perhaps this is because all four measures of health status reflect detection -- reporting by the system -- rather than need as such. Nor do the four variables available to us adequately encompass the concepts of health status and need. On the other hand, neither health status nor need may -- in fact -- be very influential in disposing people to use the rural health system in Egypt at the present time. One senses, on the strength of infant mortality alone, that much "need" is not translated into "demand." A similar impression is conveyed by the relative weakness of the rural health service vis-a-vis village dais in presiding over births.[2] The data sustain the inference that in Egypt, as in most low income countries, rural health facilities may be overburdened and under-utilized, relative to need, at the same time.

The second hypothesis, predicting that utilization is at least in part a function of socio-economic development, is verified in two intriguing ways. First, it is the only hypothesis to receive support from the data; and second, among the eight indicators of socio-economic development

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[2]Data from a national sample of rural health centers and units suggest that in 1977 only 36% of the births in rural Egypt were supervised by an auxiliary nurse-midwife, with another 22% being attended postpartum and 43% not being attended, officially, at all. Source: "Results of the Health System Questionnaire Administered by the Ministry of Health, Arab Republic of Egypt, at 132 Rural Health Centers and Units, March-April 1978: A Reference Manual," M.I.T.-Cairo University Health Care Delivery Systems Project, Monograph #3 (May 1980), Part II, Question 1, p. 217.

entered into the equation, only one loads. This is the literacy variable. Increases in literacy are conducive to greater use of the services provided by the rural health system.[3]

This finding is consistent with patterns observed elsewhere, notably in Kerala and Sri Lanka.[4] It also suggests that utilization reflects personal orientation and competence more than affluence or environmental factors, although the influence of any single variable is itself conditioned by the broader context in which it functions. Be that as it may, education to the level of literacy would seem to produce two positive results so far as modern health care in rural areas is concerned. Conceivably, it weakens the hold of superstition in explaining illness while at the same time eroding faith in traditional practitioners (e.g., literacy "secularizes"). Second, it might well dispose to a more positive perception of the formal health system or perhaps simply to a greater sense of personal efficacy in negotiating one's way through a health facility and in interacting with the personnel there.

The third hypothesis, attributing utilization to the dissemination and development of the health system itself, is not supported by the data.[5]

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[3] One reason why literacy alone loads is multi-collinearity. Literacy is significantly correlated with urbanization and with electrification (.6 in each case, sig. at .025). With literacy already in the regression equation, these two variables become redundant, although individually they do load successfully.

[4] John W. Ratcliffe, "Poverty, Politics and Fertility: The Anomaly of Kerala," Hastings Center Report (February 1977), 34-42; Davidson R. Gwatkin, "Nutrition Planning and Physical Well-Being in Kerala and Sri Lanka," Overseas Development Council (January 1978), 28 pp.

[5] When included, system "busyness" (TOTLOAD) did load and with it two other measures as well. The problem with these results is that popular utilization and system "busyness" contain an important common ingredient, the number of new outpatients. The equation had to be dismissed on grounds of redundancy.

Surprisingly, people are not more likely to seek care at rural health centers and units as these become more accessible in terms of area covered and population served. Nor are people more likely to come with improvement in certain services. Utilization, it would appear, is simply not affected meaningfully by health system characteristics denoting either capacity or activity.

To summarize, while it is plausible to assume that people -- including people in rural Egypt -- will utilize health services in response to need and the availability of services, the data suggest otherwise. Neither cluster of variables suitably explains variation in utilization. In fact, nor does a rather impressive battery of variables signifying socio-economic change. Not even development is a potent influence. Out of 18 variables referring to three discrete elements -- health status, general development, and system development -- only one variable, literacy, reliably accounts for differences in utilization of the health system across the governorates.[6]

Needless to say, the governorate level of analysis is too gross to permit a more sensitive accounting of the dynamics involved. Nevertheless, the evidence strongly suggests that popular use of the health system in rural Egypt has less to do with actual health needs or the system's capacity to respond, or even with much in the realm of economic development, than with characteristics of the population. Indeed, it is quite possible that, when all is said and done, utilization is a function of a very small number of personal attributes indicating secularization and competence.

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[6] As noted above, literacy does correlate significantly with urbanization and electrification. These are also influences on utilization, although their principal effects are picked up in the literacy variable.

Just as we have asked what explains popular utilization of rural health facilities, so we can ask what explains variation in how busy rural health centers and units are. And again, three hypotheses can be tested, one attributing system "busyness" to the public's health needs as these vary from one part of the country to another, a second attributing "busyness" to general socio-economic development, and a third attributing "busyness" to characteristics of the rural health system itself.

The dependent variable in this exercise (TOTLOAD) records the number of outpatients, first timers and repeaters together, seen by the rural health centers and units in a governorate divided by the number of such facilities in each governorate. Like the utilization variable (COVERPOP) already examined, this one includes new outpatients and alludes to popular utilization of health facilities. Its thrust, however, is different. COVERPOP presents new outpatients as a percentage of the total rural population in a governorate. TOTLOAD relates all outpatients to the number of facilities. COVERPOP is a population attribute. TOTLOAD is more a system attribute. It measures load, activity, or general "busyness."[7] That the two refer to substantially different things is suggested by their rather modest correlation coefficient (.64, sig. at .01) given the overlap of ingredients.

Our findings are quite similar to those reported for popular utilization (COVERPOP) in the following respects.

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[7] See Table 2 in the main text for the values of this measure.

1. Health system "busyness" is NOT a function of health needs as these are, imperfectly, reflected by our variables (imperfectly reflected because all four health status variables in our file are based on diagnosis, not actual prevalence). The incidence of ascariasis does load when the health status variables are considered in isolation, possibly because it is correlated at .64 with the dependent variable; but it fails to load when all 18 variables used in the analysis are entered. It bears noting that "busyness" is not explained by the amount of infant mortality recorded. Nor is it explained by the number of births or even by the incidence of a major, debilitating disease like schistosomiasis. Within the health needs pantheon, the incidence of worms as parasites is the strongest predictor of how busy rural health centers and units are likely to be.

2. Health system "busyness" is NOT a function of the system's own dissemination, capacity, and services.[8] We entered the six independent variables employed in several different combinations. Not a single variable loaded. System development, in the conventional ways measured, is not a significant incentive to "busyness" any more than it is an incentive to popular utilization. This is sobering.

3. Health system "busyness" IS a function of socio-economic development. Again, this is the only cluster of variables that reliably predicts variation in the dependent variable.

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[8] None of the health system measures employed are significantly correlated with TOTLOAD.

The core difference in our findings for TOTLOAD as against COVERPOP is the indicators of socio-economic development that enter the regression equation. Popular utilization of rural health centers and units is influenced principally by personal secularization and competence as conveyed by literary acquisition. System "busyness," on the other hand, is stimulated by general development and increased affluence. As shown in Table A-1, the dissemination of purified water in rural communities,

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Table A-1: Explaining System "Busyness" -- The Best Model

$$\text{TOTLOAD} = \underset{(.001)}{.88\ \text{RURWATER}} + \underset{(.025)}{.46\ \text{AGINCOME}}$$

$F = 16.87$ (.005)
Adj. $R^2 = .78$

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along with rising rural income derived from agriculture, are the principal inducements to greater health system involvement with the public. These two variables explain three-fourths of the variation in system "busyness," with the availability of purified water alone accounting for 60% of the variation.[9] Other variables denoting socio-economic development failed to load because of their close association with one of these two.

The message would seem to be that the rural health system in Egypt is going to be more engaged with its intended beneficiaries as incomes rise and as the benefits of development -- better water, electricity, and so on -- are experienced by increasing numbers of people. What makes health facilities more involved with the public in some governorates

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[9] For what it is worth, the simple correlation between RURWATER and TOTLOAD is quite high: .80 (.001). This is methodologically bad but, perhaps, substantively meaningful.

(Assiut, Giza) than in others (Kena, Souhag) has little to do with health needs or with the system's own development. It has a great deal to do with the objective conditions in which people live.

In sum, since health care delivery in rural Egypt remains essentially clinical and reactive, its effectiveness is powerfully influenced by circumstances that lie outside the Ministry of Health's own jurisdictional competence. Contact with the public, system-society interaction, and the actual delivery of health services rest more on dynamics in the economy and society of Egypt than on health policies as such. And so it shall remain, for better or worse, unless and until the rural health system assumes a major share of the initiative for improving health status in the countryside.

Appendix B

Pearson Correlation Coefficients

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Key

Health System Variables

AREAUNIT	-	area per rural health facility in square kilometers
POPUNIT	-	rural population per rural health facility
POPBED	-	rural population per health system beds
COVERPOP	-	new outpatients as a % of rural population
NEWLOAD	-	new outpatient visits per facility
TOTLOAD	-	total outpatient visits per facility
TESTLOAD	-	number of urine and stool tests per facility
SMALLPOX	-	% live births immunized against smallpox
DIPTHER	-	% live births immunized against diptheria
HSDI	-	health system development index (average of standardized scores for AREAUNIT, POPUNIT, and COVERPOP)

Demographic Variables

MORT73	-	infant mortality rate, 1973
MORT72	-	infant mortality rate, 1972
RURIMR72	-	rural infant mortality rate, 1972
BIRTH	-	crude birth rate, 1973
RURCBR72	-	rural crude birth rate, 1972

Health Status Variables

SHISTO	-	% infected with schistosomiasis - urine analysis
ASCARIS	-	% infected with ascariasis - stool analysis

Key (Continued)

Socio-Economic Development Variables

TOTILLIT	- % illiterate
URBAN	- % urban
PDLABOR	- % women in the paid labor force
AGINCOME	- rural per capita income from agriculture
FOODPOP	- per capita "food" availability
RURELEC	- % rural homes with electricity
RURWATER	- % rural homes with purified water in building or dwelling
DENSITY	- population density, 1976

PEARSON CORRELATION COEFFICIENTS

	AREAUNIT	POPUNIT	POPBED	COVERPOP	NEWLOAD	TOTLOAD	TESTLOAD	SMALLPOX	DIPTHER	HSDI
AREAUNIT	1.0000 (0) S=0.001	0.2872 (16) S=0.140	0.2785 (16) S=0.148	-0.0999 (12) S=0.379	0.0847 (12) S=0.397	0.0256 (12) S=0.469	0.4667 (12) S=0.063	-0.2290 (13) S=0.226	-0.2300 (13) S=0.225	-0.7166 (16) S=0.001
POPUNIT	0.2872 (16) S=0.140	1.0000 (0) S=0.001	0.7856 (16) S=0.001	-0.2694 (12) S=0.199	0.2516 (12) S=0.215	0.2736 (12) S=0.195	0.2222 (12) S=0.244	-0.3485 (13) S=0.122	-0.1789 (13) S=0.279	-0.7383 (16) S=0.001
POPBED	0.2785 (16) S=0.148	0.7856 (16) S=0.001	1.0000 (0) S=0.001	-0.3593 (12) S=0.126	-0.0230 (12) S=0.472	-0.2552 (12) S=0.212	0.1151 (12) S=0.361	-0.5030 (13) S=0.040	0.0413 (13) S=0.447	-0.6658 (16) S=0.002
COVERPOP	-0.0999 (12) S=0.379	-0.2694 (12) S=0.199	-0.3593 (12) S=0.126	1.0000 (0) S=0.001	0.8563 (12) S=0.001	0.6415 (12) S=0.012	0.1231 (12) S=0.352	0.3806 (10) S=0.139	-0.2442 (10) S=0.248	0.7329 (12) S=0.003
NEWLOAD	0.0847 (12) S=0.397	0.2516 (12) S=0.215	-0.0230 (12) S=0.472	0.8563 (12) S=0.001	1.0000 (0) S=0.001	0.8148 (12) S=0.001	0.2822 (12) S=0.187	0.2650 (10) S=0.230	-0.3063 (10) S=0.195	0.3416 (12) S=0.139
TOTLOAD	0.0256 (12) S=0.469	0.2736 (12) S=0.195	-0.2552 (12) S=0.212	0.6415 (12) S=0.012	0.8148 (12) S=0.001	1.0000 (0) S=0.001	0.4111 (12) S=0.092	0.1521 (10) S=0.337	-0.3703 (10) S=0.146	0.2313 (12) S=0.235
TESTLOAD	0.4667 (12) S=0.063	0.2222 (12) S=0.244	0.1151 (12) S=0.361	0.1231 (12) S=0.352	0.2822 (12) S=0.187	0.4111 (12) S=0.092	1.0000 (0) S=0.001	-0.3669 (10) S=0.148	0.1479 (10) S=0.342	-0.2221 (12) S=0.244
SMALLPOX	-0.2290 (13) S=0.226	-0.3485 (13) S=0.122	-0.5030 (13) S=0.040	0.3806 (10) S=0.139	0.2650 (10) S=0.230	0.1521 (10) S=0.337	-0.3669 (10) S=0.148	1.0000 (0) S=0.001	0.1065 (13) S=0.365	0.4677 (13) S=0.054
DIPTHER	-0.2300 (13) S=0.225	-0.1789 (13) S=0.279	0.0413 (13) S=0.447	-0.2442 (10) S=0.248	-0.3063 (10) S=0.195	-0.3703 (10) S=0.146	0.1479 (10) S=0.342	0.1065 (13) S=0.365	1.0000 (0) S=0.001	0.0812 (13) S=0.396
HSDI	-0.7166 (16) S=0.001	-0.7383 (16) S=0.001	-0.6658 (16) S=0.002	0.7329 (12) S=0.003	0.3416 (12) S=0.139	0.2313 (12) S=0.235	-0.2221 (12) S=0.244	0.4677 (13) S=0.054	0.0812 (13) S=0.396	1.0000 (0) S=0.001

(COEFFICIENT / (CASES) / SIGNIFICANCE)

II. Demographic Variables by Health System Variables

HEALTH SYSTEM VARIABLES

	Dispersion Variables			Contact Variables						Aggregate Variable
	PEARSON CORRELATION COEFFICIENTS									
	AREAUNIT	POPUNIT	POPBED	COVERPOP	NEWLOAD	TOTLOAD	TESTLOAD	SMALLPOX	DIPTHER	HSDI
MORT73	-0.7582 (16) S=0.001	-0.6133 (16) S=0.008	-0.5816 (17) S=0.007	0.5363 (12) S=0.036	0.1240 (12) S=0.350	0.0161 (12) S=0.480	-0.1657 (12) S=0.303	0.4715 (13) S=0.052	0.0408 (13) S=0.447	0.8746 (16) S=0.001
MORT72	-0.7218 (16) S=0.001	-0.5354 (16) S=0.016	-0.5151 (17) S=0.017	0.3941 (12) S=0.102	0.0671 (12) S=0.418	-0.1333 (12) S=0.340	-0.2697 (12) S=0.198	0.5606 (13) S=0.025	0.0090 (13) S=0.488	0.7603 (16) S=0.001
RURIMR72	-0.6653 (16) S=0.002	-0.5369 (16) S=0.016	-0.5521 (17) S=0.011	0.5209 (12) S=0.041	0.2151 (12) S=0.251	0.0055 (12) S=0.493	-0.1131 (12) S=0.363	0.5757 (13) S=0.020	0.0323 (13) S=0.458	0.7742 (16) S=0.001
BIRTH	-0.3269 (16) S=0.108	0.0997 (16) S=0.357	-0.2205 (17) S=0.197	-0.0694 (12) S=0.415	0.1360 (12) S=0.337	0.2370 (12) S=0.229	0.2345 (12) S=0.232	0.2435 (13) S=0.211	-0.0987 (13) S=0.374	0.1104 (16) S=0.342
RURCBR72	-0.0990 (16) S=0.358	-0.2540 (16) S=0.171	-0.5550 (16) S=0.013	0.5282 (12) S=0.039	0.3653 (12) S=0.121	0.5432 (12) S=0.034	0.5081 (12) S=0.046	0.3593 (13) S=0.114	0.0348 (13) S=0.455	0.3690 (16) S=0.080

(COEFFICIENT / (CASES) / SIGNIFICANCE)

III. Utilization and "Busyness" by Health Status Variables

----PEARSON CORRELATION COEFFICIENTS----

	RURIMR72	RURCBR72	SHISTO	ASCARIS
COVERPOP	0.5209 (12) S=0.041	0.5282 (12) S=0.039	-0.5323 (12) S=0.037	0.2079 (12) S=0.258
TOTLOAD	0.0055 (12) S=0.493	0.5432 (12) S=0.034	-0.2158 (12) S=0.250	0.6359 (12) S=0.013

(COEFFICIENT / (CASES) / SIGNIFICANCE)

IV. Utilization and "Busyness" by Socio-Economic Development Variables

---PEARSON CORRELATION COEFFICIENTS---

	TOTILLIT	URBAN	PDLABOR	AGINCOME	FOODPOP	RURELEC	RURWATER	DENSITY
COVERPOP	-0.6589	0.6157	0.0841	0.2747	-0.1689	0.5936	0.3721	0.2343
	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)
	S=0.010	S=0.017	S=0.398	S=0.194	S=0.278	S=0.021	S=0.117	S=0.232
TOTLOAD	-0.6482	0.2338	0.1713	0.1185	-0.0612	0.7428	0.7976	0.1818
	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)
	S=0.011	S=0.232	S=0.297	S=0.357	S=0.425	S=0.003	S=0.001	S=0.286

(COEFFICIENT / (CASES) / SIGNIFICANCE)

V. Utilization and "Busyness" by Health System Development Variables

----PEARSON CORRELATION COEFFICIENTS----

	AREAUNIT	POPUNIT	POPBED	TESTLOAD	SMALLPOX	DIPTHER
COVERPOP	-0.0999	-0.2694	-0.3593	0.1231	0.3806	-0.2442
	(12)	(12)	(12)	(12)	(10)	(10)
	S=0.379	S=0.199	S=0.126	S=0.352	S=0.139	S=0.248
TOTLOAD	0.0256	0.2736	-0.2552	0.4111	0.1521	-0.3703
	(12)	(12)	(12)	(12)	(10)	(10)
	S=0.469	S=0.195	S=0.212	S=0.092	S=0.337	S=0.146

(COEFFICIENT / (CASES) / SIGNIFICANCE)