# Issues in the Allocation of Resources in the Health Sector of Developing Countries

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# ABSTRACT


## Issues in the Allocation of Resources in the Health Sector of Developing Countries

The pattern of resource allocation in the health sector of developing countries often suggests excessive distortions in the balance of expenditure, interregionally and between urban-rural areas. This reflects the reliance on a "medical referral system." This paper examines the theoretical rationale underlying such a system, and argues that policy analysis must examine the operating characteristics of such a system in order to appraise its efficiency and equity. As a case study, the Tunisian medical referral system is evaluated in terms of the distribution of resources, structure of referral capacity and the extent of actual referral.

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Le modèle d'allocation des ressources dans le secteur sanitaire des pays en voie de développement suggère souvent des distorsions excessives dans la balance des dépenses, à l'intérieur des régions et entre les zones rurales-urbaines. Ceci reflète une dépendance d'un "medical referral system." Ce document examine les bases rationnelles théoriques soulignant un tel système, et soutient que les analyses politiques doivent examiner les caractéristiques opératives de ce système afin d'en évaluer l'efficacité et l'équité. En tant qu'étude représentative, le "medical referral system" tunisien est évalué en terms de distribution des ressources, de structure de capacité de référence ainsi que de degré de référence réelle.

Studies of the health sector of developing countries (LDC's) commonly conclude that there is considerable inefficiency and inequity in the allocation of health resources.[1] Focusing primarily on aggregative measures, a significant imbalance invariably is determined in the level of expediture and medical resources available per capita, interregionally and between the urban and rural areas. It is argued that an "excessive" level of expenditure is devoted to specialized urban hospitals rather than to primary health care institutions for the mass of the population. Policy conclusions are immediately drawn that a more equitable and efficient program requires a more decentralized allocation of resources.

In this paper, we shall argue that at a theoretical level, there may exist a sound basis for many of these putative "imbalances". In fact, the "optimal" medical care system may, on the surface, display many of these characteristics, while being both efficient and equitable. Consequently, a policy analysis of an LDC health system requires both a description of the pattern of resource allocation and an analysis of how the system operates. Only in this way can one know whether the surface "imbalances" are offset by the operating efficiency of the overall system. This paper will illustrate these issues through an analysis of Tunisia's medical system.

In Section II, we shall briefly describe the basic structure of the health care system commonly observed in LDC's--a "medical referral system"--in terms of the pattern of resource allocation. In Section III, we shall examine the theoretical rationale underlying the choice of a medical referral system, and heuristically develop some of the basic requiremenets that an optimal system must satisfy. Section IV will evaluate whether Tunisia's medical referral system satisfies these criteria.

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[1]See Heller (1975a), Bryant (1969), Barlow (1973), Fendall (1972), and King (1966).

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## II

The basic medical or "technological" premise which implicitly underlies many LDC health systems[1] is that most of the disease problems that arise at a primary (or general medicine) outpatient clinic do not require, for diagnosis or treatment, highly sophisticated medical skills or equipment. At any point in time, only a small proportion of a country's population is afflicted with disease problems for which the diagnostic and treatment process requires expensive medical resources. A "medical referral" system is the institutional response to this coincidence of disease prevalence and medical technology. By limiting the capacity for sophisticated treatment to only those cases in need of it, the system maximizes the productivity of its scarce medical resources.

Organizationally, a "medical referral" system has a pyramid-like structure. Each level of the pyramid corresponds to a qualitatively different type of medical-health institution. As one moves up the pyramid, the number of institutions diminishes while the capacity for sophisticated treatment, as well as the attendant cost per case, increases. Institutions at different levels are linked through a referral mechanism. If patients cannot be diagnosed or treated at one level, they are referred to the institutional tier of the pyramid with such a capacity.

At the base of the "ideal" pyramid, one would expect a network of accessible low cost medical institutions. These would provide preventive health services, and have a capacity to diagnose and treat a large fraction of its client community's recurrent medical problems on an ambulatory basis. A small fraction of the patients would require further referral action, consisting of inpatient care or a more sophisticated diagnostic capability. In principle, an efficient referral system would not

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[1]It must be noted that for most LDC's, the core of the medical system's capacity was shaped more by historical factors, such as a colonial experience, than by any theoretical design. Also, government policy memoranda often do not explicitly relate the organization of the medical care system to the theoretical criteria discussed

refer a patient beyond the lowest tier possessing the skills and supplies necessary for adequate diagnosis and treatment. With egalitarian goals, the treatment would depend on the medical severity of a case rather than the socioeconomic status of the patient.

The medical system of Tunisia takes the appearance of this structure, institutionally. The country is divided into health regions, which are further subdivided into health districts. Each district contains a Regional or a District Hospital. In each district, there is a network of primary care outpatient clinics, located in the rural and urban dispensaries, and in the general medicine outpatient clinic of the hospital. In addition, the development of a network of maternal-child health centers is providing ante-natal and post-natal care at the district level. At the next pyramid level, inpatient capacity in the basic medical services of general medicine and obstetrics (and often pediatrics) is provided at almost all the District and Regional Hospitals. Patients in need of more sophisticated services will be referred to the Regional Hospital, where a wider range of medical specialty services are available (i.e. surgery, gynecology, opthalmology, etc.).

At the top of the pyramid are six General Hospitals and several specialty Institutes located in four of the regions. The General Hospitals provide the forementioned services as well as a range of specialty services (e.g., dermatology, opthalmology, orthopedics, otolaryngology, cardiology and neurosurgery). They also may serve as the point of primary inpatient and oupatient care for their urban populations. Each General Hospital receives patients referred from a designated set of other Regions. For example, the General Hospital in Sousse receives cases referred

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below. Yet whenever health officials are pressed concerning the rationale for a given pattern of resource allocation, these types of issues are inevitably raised. In some countries, this policy rationale is made explicit (e.g., some of the E. African countries, Malaysia, Tunisia).

from Kasserine and Kairouan. Finally, the specialty Institutes serve as national referral centers for complex cases in specific specialty services.[1] Both General Hospitals and Institutes are also used as teaching hospitals for the University of Tunis Medical School.

Table 1 provides an estimate of the distribution of capacity and expenditure across the different levels of the medical referral system.[2] The expenditure and capacity at the upper pyramid levels clearly dominate the pattern of resource allocation. Although institutions at the base of the pyramid are more numerous, the General Hospital and Institute levels alone have 60% of total bed capacity; the District Hospitals have only 18%. Inpatient services at the upper two tiers account for 42% of total Ministry expenditure, whereas expenditure on all outpatient services accounts for only 17.2%. Since the latter also includes expenditure on specialty outpatient services, primary outpatient and maternal-child health care services receive an even smaller fraction of the budget.

Another perspective is that that (i) approximately 6.6 million dinars was spent on approximately 88,000 specialty inpatients, (ii) approximately 2.0 million dinars was spent on 181,000 general medicine and gynecology-obstetrics inpatients, and (iii) 2.49 million dinars on 5,120,000 outpatients. Does this represent an appropriate allocation of resources? Should more emphasis be accorded to improving the quality of the primary outpatient and inpatient services available at the pyramid base, at the expense of lowering quality at the upper pyramid levels?

These equity issues are drawn into sharper perspective by their associated inter-regional and urban-rural differences. Since most of the General Hospitals

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[1]There are specific Institutes for pediatrics, psychiatry, tuberculosis, cancer, orthopedics and opthalmology.

[2]These estimates have been derived by econometric analysis and are discussed further in Heller (1975a).

Table 1

The Capacity of the Tunisian Referral System: 1971

| Number of Units | Percent of Population by Hospital[2] | | Specialty Beds (#)[7] | Primary[7] Beds (#) | Number of Inpatient Admissions | Specialty[4 6] Outpatient Visits (#) | Primary[4 5] Outpatient Visits (#) | Public Sector Expenditure[3] |
|---|---|---|---|---|---|---|---|---|
| 8 | 25% | Institutes | 2,567 | -- | 8,170 | 200.7 | | 2356.8 |
| 7 | | General Hospitals: Inpatient Service | 3,546 | 1,243 | 113,187 | | | 3738.2 |
| 12 | 15% | Regional Hospitals: Inpatient Service | 1,726 | 1,226 | 85,500 | | | 1807.5 |
| 54 | 60% | District Hospitals: Inpatient Service | 376 | 1,896 | 60,815 | | | 672.0 |
| 7 | | General Hospitals: Outpatient Service[1] | -- | -- | | 648.8 | 149.9 | 366.8 |
| 12 | | Regional Hospitals: Outpatient Service[1] | -- | -- | | 444.6 | 470.3 | 271.8 |
| 54 | | District Hospitals: Outpatient Service[1] | -- | -- | | 77.1 | 978.2 | 194.2 |
| 61 | | Dispensaries: Urban[5] | -- | -- | | | 996.3 | 626.0 |
| 327 | | Rural[5] | -- | -- | | | 1360.0 | 371.8 |
| 88 | | Maternal Child Health Centers | -- | -- | | | | 665.0 |
| | | Subtotal | | | | 1170.5 | 3954.7 | 11.1 |
| | | TOTAL Ministry of Health Expenditure (1971 est.) | | | | | | 14,531.0 |

[1] Includes both specialty and primary outpatient services

[2] This represents the percentage of the population living in the districts possessing a General Hospital, Regional Hospital and District Hospital.

[3] In 1,000 dinars.

[4] In thousands of outpatients.

[5] Includes outpatient visits and consultations in general medicine.

[6] Includes outpatient visits and consultations other than in general medicine.

[7] Primary inpatient services include general medicine, gynecology and obstetrics. Specialty inpatient services include all other specialties

Source: Heller (1975), République Tunisienne (1973, 1973a, 1973b).

and Institutes are located in Tunisia's four largest urban areas, there are large inter-regional differentials in the level of government expenditure on hospital beds, physicians and paramedical workers per capita.[1] For example, relative to a mean regional expediture per capita of 1.59 dinars, the mean expenditure level is 2.39, 2.21 and 4.56 dinars respectively, for Sousse, Bizerte and Tunis. Since virtually all major hospital units above the District Hospitals are located in the major metropolitan center of each region, this also implies potential urban-rural differentials in medical resources per capita. If effective access to the upper levels of the pyramid was limited to the residents of these urban centers, it would imply that the bulk of public sector resources were absorbed by only 20 to 30% of the population. In this case, the referral system's legitimacy becomes even more questionable on equity and efficiency grounds.

The problem with drawing such policy inferences is that a comparable pattern of resource allocation across pyramid levels, and probably on a spatial basis, is likely to be characteristics of an "optimal" referral system.[2] Consequently to evaluate the equity or efficiency of a system, one would have to go beyond these surface indicators and answer more fundamental questions. First, does the distribution of resources in the medical system maximize its responsiveness to the health problems of the country? Since the optimality conditions of such a problem are both hard to specify and to empirically validate, can we find other proxy measures of whether there are sufficient resources available at the different levels of the pyramid? Second, even if resources are optimally distributed does the system's

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[1]Heller (1975a).

[2]For example, from the little that is known concerning the much acclaimed Chinese health system, the distribution of capacity and resources suggests similar structural characteristics, with a significant proportion of health sector resources devoted to the higher pyramid levels. See Heller (1974), Hu (1974), Orleans (1974).

referral mechanism operate efficiently? If patients are not being referred or if there are severe inequalities in access to higher level units, then the rationale for concentration of high quality resources in a small set of units breaks down. What indicators measure the success or failure of a medical referral system to operate according to its own rationale?

III

## A Conceptual Framework for the Analysis of Medical Referral Systems

Ideally, an LDC's health system should reflect its solution to the basic problem of how to distribute limited resources to optimize the health of its population. The structure of this optimization problem and the policy issues that arise in its theoretical formulation can be reasonably well-defined. Practically, the specification and solution of the problem is extremely difficult due to our ignorance of many basic behavioral, epidemiological, medical and economic relationships. In what follows, we shall first outline the basic policy problem. Although we cannot solve for its solution, we can suggest why a medical referral system often emerges as the policy of many LDC's. Second, we shall examine some of the basic requirements of an "optimal" referral system and the significance of alternative disequilibria in such a system.

### An Optimal Policy Model

Assume that over a given time period, $P_o$ persons seek medical care, and that a "disease density" function, p(d), distributes them across specific categories of disease problems (d=1, ..., D). It is likely that this density function would have high values of p for the set of common disease problems, whereas the p value for most complex disease categories would be quite low.[1]

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[1] The p(d) function is specified such that $\sum_{d=1}^{D} p(d) = 1$, and $p(d) \geq 0$ for all d.

Second, assume that for any medical problem there exists some "optimal" diagnostic and treatment process. "Optimality" is defined as associated with a mean probability of the sick individual bearing the minimum cost of the illness. The cost of illness is assumed measurable by a vector of attributes (financial cost of treatment, pain and suffering, the increase in the probability of premature death, lost earnings, degree of permanent disability, etc.)[1] Let us also assume that the standard of medical care achieved, $s_d$, for particular disease d, is a function of the level of recurrent and capital inputs per patient, $v_d$ and $k_d$, respectively, or $s_d = s_d(v_d, k_d)$. We would expect a positive marginal product to the medical resources expended per case.[2] The optimal form of treatment for any disease is defined as associated with the maximum value of $s_d$.

Third, with limited resources, policy decision-makers are forced to choose among policy alternatives which include some $s_d$ less than their maximum value. This necessitates a judgement on the relative social worth of achieving different levels of $s_d$. Let us define a function $H(s_1, \ldots, s_d) = H(\bar{s}_d)$, to represent society's measure of the benefits associated with a set of achieved standards of care, $\bar{s}_d$. The binding budget constraint ensures that total resources spent on preventive and curative care in any period must be less than some total resource level, B, viz.,

$$B = \sum_{m=1}^{M} \ell_m I_m + \sum_{d=1}^{D} v_d p(d) P_o + y_o P_o + \sum_{d=1}^{D} t(d, p(d), \bar{\ell}_m) p(d) P_o \qquad (1)$$

where: $I_m$ is the capital investment, human and physical, associated with the treatment of the subset of diseases included within m,
$\bar{\ell}_m = (\ell_1, \ldots, \ell_M)$ is a set of integers, for m=1, ..., M,
$y_o$ is the average cost of an initial diagnosis, and

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[1]Assume that the weights associated with these attributes are variables for policy choice.

[2]$\frac{\partial s_d}{\partial v_d} > 0, \frac{\partial s_d}{\partial k_d} > 0.$

$t(d,p(d),\bar{\ell}_m)$ represents the average cost of transport of the patient with disease d to and from the treatment facility possessing the required capital m for treatment of d.

The value of total resources must exceed the value of capital investment, human and physical, the recurrent costs of treatment and of initial diagnosis, and the cost of transporting patients to and from the point of initial diagnosis to that of treatment.[1]

Embedded in this constraint are several constraints on the feasible technology set. We assume that the cost of the initial diagnosis of all patients who seek care is a fixed cost, $y_o$, to the system.[2] Patients are then referred to a higher level where they receive the level of treatment, $s_d$, associated with the dth disease, as diagnosed at the initial level.[3] We shall assume that the system is constrained to provide the same standard of care to all patients with the same disease d.[4] The cost of transportation is determined by a complex function relating the density of patients with associated diseases, to the location of referral points for treatment.

We also assume that each form of capital, m, corresponds to a subset of disease categories.[5] Each type of capital may be used interchangeably in the treatment of any of the diseases with which it is associated. For example, $K_2$, may be the capital, human and physical, required to provide an operating theatre to treat the

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[1] This model could clearly be specified in a dynamic framework, since current decisions both influence and are influenced by expectations concerning the future pattern of morbidity.

[2] Another policy issue ignored by the model is the choice of the number and location of the base level clinics. The demand for primary care is influenced by the cost of utilization, even if there is no fee for service, as in Tunisia.

[3] We ignore the spatially-related issue of the number of units that need exist at any level of the pyramid, and assume one institution at each level.

[4] As discussed below, one can obviously conceive of objective functions that would differentiate the quality of treatment for patients with the same disease, according to other criteria such as marginal productivity.

[5] For example, it may be that $m_1 = [d_1, d_2, d_3]$, $m_2 = [d_4, \ldots, d_8]$, etc.

specific set of disease problems included in m=2.[1] Finally, we have made the critical but hopefully realistic assumption, that capital can only be purchased in indivisible amounts, set by the constants in the $\bar{I}_m$ vector. The level of the m capital stock $K_m$ can only be raised by $\ell_m I_m$ units, where the integer $\ell_m$ is the relevant policy variable. It is this aspect of medical technology which leads to a tendency for a medical referral solution to this policy problem. Given a value for $\ell_m$,

$$k_m = \frac{(1-\partial_m)K_{m,t-1} + \ell_m I_m}{P_o \sum_{d \in m} p(d)} \qquad (2)$$

where $\partial_m$ is the depreciation rate on the mth capital stock and
$k_m$ equals the value of the mth capital per patient for which it is used in any period.

Due to capital's indivisibility, the s function may be insensitive to values of $k_m$ over a wide range, but the marginal loss if $k_m$ falls below a fixed level $\bar{k}_m$ is substantial. In other words, congestion in the use of a facility, or skilled manpower, will sharply drop its marginal productivity.[2] We can restate the form of the s and h functions as,

$$s_{d_o} = s_{d_o}(v_{d_o}, k_{m_1}, \ldots, k_{m_e}) \text{ and} \qquad (3)$$

$$H = H(s_1, \ldots, s_d) = H^*([\bar{v}_d],[\bar{k}_m];p(d)), \qquad (4)$$

where $d_o$ is included in subsets $m_1$, $m_2$, ..., $m_e$, and where $[\bar{v}_d]$ and $[\bar{k}_m]$ represent vectors of the values of $v_d$ and $k_m$.

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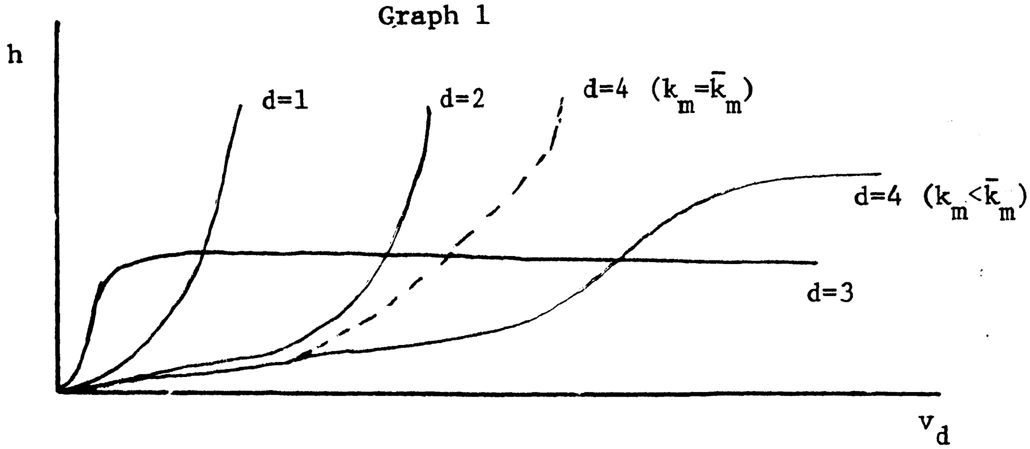
[1] This includes the human capital of the surgeon, surgical nurse and anaesthesiologist, etc.

[2] This may be incorporated either inwith the s function or by contraining $k_m > \bar{k}_m$, for each m.

A sense of the meaning of the H function can be gained by looking at the social value $h_d(s_d)$, associated with the treatment of specific disease problems, ignoring for a moment the interdependencies among diseases in the more complex objective function H*.[1] In graph 1, we note that for some diseases, a small level of resources is sufficient to yield sharp improvements in health status and associated social benefits (d=1). Others require a larger level of resources (d=2). For others, the social marginal productivity of additional resources quickly drops to zero (d=3).

Graph 1




For d=4, we have shown the impact of providing a discrete level of $k_m \geq \bar{k}_m$ on the health status improvement function.

The critical policy issue is the choice of the level of resources to allocate to the treatment of the different disease problems. The structure of the H function will differ across societies. A growth oriented society may impose significant weight to achieving relatively optimal treatment of diseases afflicting high productivity individuals in the society. Most LDC's claim to adhere to the egalitarian premise that income should not be the primary criterion of the degree of access or quality of care. The choice of objective function clearly influences the policy solution.

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[1] The $h_d$ functions are assumed as alternative objective functions.

The policy problem takes the form of maximizing,

$$Z = P_o H^*[\bar{v}_d, \bar{k}_m; p(d)] \qquad (5)$$

(6) $$\text{subject to:} \quad \sum_{m=1}^{M} \ell_m I_m + P_o[y_o + \sum_{d=1}^{D} \bar{v}_d p(d)] + \sum_{d=1}^{D} p(d)t[d, p(d), \bar{\ell}_m]P_o \leq B,$$

(7) $$\sum_{d}^{D} p(d) = 1, \text{ and}$$

(8) $$k_m = \frac{(1-\delta_m)K_m + \ell_m I_m}{\sum_{d \subset m} p(d)P_o}, \text{ and}$$

where $\ell_m$ takes on integer values for all m. The critical policy variables are the levels of $\bar{v}_d$ and $\bar{\ell}_m$ associated with the diagnostic and treatment process.

The qualitative implications of the model are determined by the solution values of $\bar{v}_d$ and $\bar{k}_m$, whereas the quantitative impact on capacity is determined in association with the disease density function, p(d). In effect, one can infer from these results the implications for resource allocation in the medical referral system. Those diseases associated with the highest level of $k_m$ and $v_d$ are effectively those referred to the highest pyramid levels. From p(d), we can then derive the level of recurrent and capital resources devoted to treating these disease problems, and thus that are associated with the different pyramid levels. The model solution will also yield the values of $s_d$ for all d.

In a developing country, one possible policy solution would be for $K_m*$, $\ell_{m*} = 0$ for the diseases $d \subset m^*$ that are relatively rare in the society, and which require fairly complex forms of treatment (high $\ell_{m*}$ and $v_d$). This would imply these cases are treated only minimally. Often, however, LDC's impose a political constraint that $s_d > s^*_d$ for all d. In effect, this guarantees that $k_m$ and possibly $\ell_m$ be nonzero. The constraint reflects the political undesirability of a significant number of medical problems which cannot be domestically treated at a medically acceptable level. This political premise over-rides the economic issue of the opportunity cost of such treatment.

The tendency to choose a medical "referral" system derives from three factors: (i) the political constraints on $s_d$ or $\ell_m$,[1] (ii) the indivisibility associated with capital resources in medical care, (iii) the aforementioned character of the disease density function. The overhead cost of the diagnostic and treatment process is high for many disease problems, while the percentage of the country's population in need of such treatment is small. Economies of scale dictate against the proliferation of complex treatment facilities for such diseases to many hospitals in order to minimize the extent to which scarce medical resources are in excess of that required. This suggests that the client population for any complex medical specialty service be drawn from a large population pool. Conversely, one may satisfy a large fraction of the demand for medical services through an abundant network of more limited, primary care hospitals and/or clinics.

The difficulties in solving such an optimization problem should be obvious. For any country, such a first best optimization would necessitate the specification of an objective function and the estimation of a production function for the "health status" of individuals and of social groups. It would require data on the cost of medical services, the incidence of disease, and the characteristics of the demand function for health services. Yet at a second-best level, there remains relevant policy issues that can be fruitfully examined. Is a given referral structure operating effectively? Are there obvious points of demand pressure or inefficiency which suggest directions in which the referral system could move with obvious gain? Can we identify factors which illuminate such disequilibria?

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[1]Another possible policy constraint would be that $s_d$ be the same value ($s_d^{**}$) for all d. This would virtually guarantee a referral structure, given the above technological assumption. It would imply that the more complex the medical problem, the higher the pyramid level at which it would be treated in order to receive the fixed standard of care $s_d^{**}$.

Characteristics of a Referral System

The principal characteristics of a referral structure are that: 1) any referral pyramid has a set of n discrete levels, $i=1, \ldots, n$, 2) At any level i, there are a set of $j_i$ institutions, all of which are comparable in quality (i.e. a patient with a given disease problem, d, could go to any institution at level i and receive the same standard of care, $s_d$; 3) Each institution has a defined capacity for treatment at a standard $[\hat{s}_d]$, where we assume that $[\hat{s}_d]$ represents the set of policy acceptable medical standards of diagnosis and treatment for each disease, as determined (perhaps implicitly) by the policymakers. This capacity will be a function of the disease mix of patients treated, and of the total level of its recurrent $(V_{ij})$ and capital resources $(K_{ij} = \sum_m K_{mij})$. 4) As one rises from level i to level i + q, the quality of care rises. Specifically, given a particular case mix, the standard of care at the i + qth level would be higher than at the ith level. 5) Each level must be able to screen out those medical problems that it cannot treat at a standard, $s_d$, and refer them to some higher level unit. Presumably, no patient should be treated at a level i + q if treatment at the required standard $s_d$ is possible at a lower level. Any referral structure may be described by the number n of levels, the magnitude of capital, $K_{ij}$, and recurrent resources $V_{ij}$ at each institution of the pyramid, and by the standard of care which the system provides $[\hat{\bar{s}}_d]$.

Evaluation Criteria

What are some of the criteria that we would expect an optimal referral structure to satisfy? Two requirements that an optimal referral system would satisfy are that the number of patients that should be referred to higher level institutions equals 1) the number that can be referred, and 2) the number actually referred. This may be specified more fully.

Let $\beta_{ij}^{i+q}$ equal the minimum percentage of patients seen at the jth institution of level i, that should be referred to some higher level i+q in order to obtain a

The parameter $\beta_{ij}^{i+q}$ is a function of $[\hat{s}_d]$,

standard of care $[\hat{s}_d]$. of the level of recurrent and capital resources, and the particular case mix $(P_{1ij}, \ldots, P_{Dij})$ confronting the institution, viz.,

$$\beta_{ij}^{i+q} = \beta\{[\hat{s}_d], [V_{ij}], [K_{ij}], [P_{dij}]\} \qquad (9)$$

For example, if the level i=1 related to an outpatient institution then $\beta_{ij}^{i+q}$ relates to the share of total outpatients that should be referred for further diagnosis or for hospitalization. Clearly, this could mean referral within the same institution (as within a General Hospital) or across institutions.[1]

Presumably, an increase in inputs would allow a lower referral percentage, either by increasing the qualitative capacity of the institution or by allowing a larger case load with quality unchanged. Similarly, the particular disease mix of its patients will determine the adequacy of inputs in relation to the standard $[\hat{s}_d]$.[2] Implicitly we assume institutions will not cram facilities with patients at the expense of a lower level of $[\hat{s}_d]$. Thus, an increase in patient demand $[\bar{P}_{ij}]$, will necessitate referring more patients to preclude dilution of $[\hat{s}_d]$. Clearly $\beta_{ij}^{i+q} > 0$ in a referral system implies either that there are discrete jumps in the quality of medical care provided at higher pyramid levels <u>or</u> that there is inadequate capacity at a given level i.

Let $\alpha_{ij}^{i+q}$ equal the <u>maximum</u> percentage of patients of institution j at the level i that <u>can</u> be referred to a higher level i+q in order to obtain standard of care $\hat{s}_d$,

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[1] One institution may embody several levels. A general hospital in an urban area services both the general urban population for common disease problems and a larger regional or national population for complex specialty problems. There may be a primary care outpatient clinic and separate secondary specialist clinics.

[2] Symbolically,

$$\frac{\partial \beta_{ij}^{i+q}}{\partial \hat{s}_d} > 0, \quad \frac{\partial \beta_{ij}^{i+q}}{\partial V_{ij}} \leq 0, \quad \frac{\partial \beta_{ij}^{i+q}}{\partial \bar{K}_{ij}} < 0, \text{ and } \frac{\partial \beta_{ij}^{i+q}}{\partial \bar{P}_{ij}} > 0.$$

$$\alpha_{ij}^{i+m} = A([\hat{s}_d], [V_{i+q}],[K_{i+q}], [D_{ij}^{i+q}][\bar{P}*_{d,i+q-1}] \qquad (10)$$

where $D_{ij}^{i+q}$ is the distance from institution j to a referral unit of level i+q, $[\bar{P}*_{d,i+q-1}]$ is the patient load at all institutions below the i+qth level.[1] In effect, $\alpha$ is determined by the absorptive capacity of the higher level referral institutions. The greater their inputs, the higher $\alpha_{ij}^{i+q}$.[2] *Cererus paribus*, the greater the competition for this capacity, proxied by the pool or potential referrents, $[\bar{P}_{d,i+q-1}]$, the lower the share of patients from any institution that can be referred. The greater the distance to the higher referral unit, the higher the cost of any referral. The higher the standard of care $[\hat{s}_d]$ that must be provided at any unit in the system, the lower its own absorptive capacity for referrals, so that $\alpha_{ij}^{i+q}$ would fall.

Finally, let $\gamma_{ij}^{i+q}$ be the percentage of patients that are *actually* referred from institution j at level i to a referral unit at a higher level i+q. Some examples of these levels institutionally may be useful. Given our previous example, if i=2 refers to a primary inpatient facility, $\beta_{1j}^{2}$ is the percentage of outpatients seen at the jth primary clinic that should be hospitalized in order to receive a standard of care $[\hat{s}_d]$. Similarly, $\alpha_{1j}^{2}$ represents the maximum percentage of outpatients that any clinic can refer for primary inpatient care.

If one solved the earlier first-best policy problem, the matrix of optimal $\beta_{i}^{i+q}$ could be implicitly derived from the results. If the actual $[\beta_{ij}^{i+q}]$ set differed, it would imply a lower level of $s_d$ and a greater burden of illness in a society than is possible for a given budgetary effort.

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[1] $\sum_{q=0}^{q-1} \bar{P}_{d,i+q} = \bar{P}.$

[2] The absorptive capacity is not completely fixed. Any inpatient unit has some flexibility to increase the flow of admissions by lowering the average duration of stay and substituting ambulatory treatment. However, there is a limit to this flexibility, in that the length of stay for any patient is largely medically determined.

In a first-best solution, two necessary, though not sufficient conditions of optimality, would be that $\beta_{ij}^{i+q} = \alpha_{ij}^{i+q}$ and that the actual standard of care, $s^*_d$, for a given disease $d_o$ not exceed the policy-prescribed standard $\hat{s}_{d_o}$. It would be inefficient to design a system to "medically" require hospitalization of $\beta_{ij}^{i+q}$ percent of patients, with only $\alpha_{ij}^{i+q} < \beta_{ij}^{i+q}$ per cent of them able to be absorbed at the i+qth level. Similarly, one would expect that even if this equality holds, the actual effectiveness of a system would require that $\gamma_{ij}^{i+q}$ equal $\beta_{ij}^{i+q}$ and $\alpha_{ij}^{i+q}$. The absence of these equalities at different levels of the system imply disequilibria which reduce the system's operating efficiency.[1] Similarly, if the standard of care is higher than is socially optimal, it suggests resources could be diverted to other levels of the pyramid with a net social gain. What is the significance of a disequilibrium in these measures?

If $\beta_{ij}^{i+q} > \alpha_{ij}^{i+q}$, it may reflect two possible disequilibria in the referral structure. Both nominally suggest insufficient capacity at level i+q, but in only one case would increased capacity at the i+qth level be needed.

(i) Qualitative inadequacy at level i. Specifically the i-level institutions are deficient in the medical skills or medical equipment required to treat a higher fraction of their cases, viz., $(1-\alpha_{ij}^{i+q}) > (1-\beta_{ij}^{i+q})$. Ironically, this may lead to an excess capacity phenomenon. For example, there is excess capacity in the Tunisian district auxiliary hospitals, arising from insufficient resources. Physicians are unwilling to hospitalize more patients than can be adequately treated (at an implicit standard $[\hat{s}_d]$), given available resources. This disequilibrium can be resolved only by referring all other patients to higher level units or treating them on an ambulatory basis at a lower $[\hat{s}_d]$.

(ii) Quantitative inadequacy at either level i or level i+q. The volume of patients requiring the standard of services $[\hat{s}_d]$ that are provided at an institution

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[1] It is a problem of the second-best to determine whether a disequilibrium in a sub-optimal referral system increases the welfare produced by the system.

j of level i may exceed its capacity. Referrals exceed the absorption capacity of the higher level. Even if they could be referred, and $\beta_{ij}^{i+q} = \alpha_{ij}^{i+q}$, it could still be inefficient, if the higher level and higher cost institutions were treating patients at a level $[\hat{s}*_d] > [\hat{s}_d]$. This is one reason why equality is not a sufficient condition. Alternatively, it may lead to patients not being treated, or having the treatment deferred. In many Tunisian outpatient clinics, the physician will arbitrarily limit the number of outpatients to be seen during a clinic.

The alternative disequilibrium, $\beta_{ij}^{i+q} < \alpha_{ij}^{i+q}$, is equally serious, implying excess capacity at the higher level units; the volume of patients that can be referred is larger than those in need of referral. As a result, capacity at the higher level units is maintained by a reduction in the average severity of the illnesses treated. Illnesses treatable at lower cost inpatient institutions or on an ambulatory basis receive higher quality treatment than necessary, yielding a higher $[s_d]$ at one level of the system than another. This would be signalled by case-mix differences between the patients in the higher and lower level units which are too narrow to warrant the differential cost per patient. A cutback in the higher capacity units would be warrented.

Although such a disequilibrium is unlikely in most LDC's, a similar result may arise, even with $\beta_{ij}^{i+q} > \alpha_{ij}^{i+q}$. With bottlenecks to referral, the actual percentage of patients referred, $\gamma_{ij}^{i+q}$ may be less than both $\alpha_{ij}^{i+q}$ and $\beta_{ij}^{i+q}$. A low severity of cases at the i+qth level would not reflect the absence of complex cases at lower levels, but rather obstacles to their referral. Such factors as inadequate communication facilities, high patient-borne referral costs, negligible public ambulance capacity, cultural resistance to hospitalization, etc. may block the referral process.

Alternatively, $\gamma_{ij}^{i+q} < \alpha_{ij}^{i+q}$ may arise from differences in the perceptions of sending and receiving institutions. If higher level units perceive a different role for their institution, they may refuse referrals for residents of other regions or other units. If the lower level units, cannot adequately diagnose or treat their patients due to incompetence and refer them excessively, this may engender resistance at the receiving level institution.

Finally, $\beta_{ij}^{i+q} > \gamma_{ij}^{i+q}$ may arise at the inital point of demand for services. Let $\beta_{oj}^{1}$ serve as a morbidity index, where $\beta_{oj}^{1}$ equals the fraction of the population of an area j that ought to appear at an outpatient clinic on the basis of morbidity. If $\gamma_{oj}^{1}$ equalled the percentage of people who actually go to the outpatient clinic, then $(\beta_{oj}^{1} - \gamma_{oj}^{1})$ equals the fraction of the population who are not reached by the medical system. This residual is determined by the medico-cultural perceptions of the population, by the quality of medical care provided and by the cost of obtaining care. The equality of $\beta_{oj}^{1} = \gamma_{oj}^{1} = \alpha_{oj}^{1}$ is obviously necessary for optimality, though it is less amenable to strictly technological intervention.

## IV. The Referral Structure in Tunisia in Practice: Referrals to Higher Levels of the Pyramid

In this part, we shall evaluate the structure of Tunisia's medical referral system as well as the efficiency with which referral occurs. Our focus will be on the principal referral units--the Regional and General Hospitals and Specialty Institutes, since they absorb such a significant share of the government's health budget. Is there sufficient referral to partially rationalize the present structure of expenditure?

Institutionally, there are several kinds of referral options realistically available. At a primary outpatient (P.O.P.) clinic, the physician may recommend (i) further diagnostic tests, (ii) examination at a specialty outpatient (S.O.P.) clinic and/or (iii) hospitalization. Since the P.O.P. clinic could be a weekly rural dispensary or a daily clinic at a General Hospital, application of the referral option will imply differing referral scenarios.

For example, the decision to hospitalize will be made at the P.O.P. clinic level only for obvious emergencies, for ordinary general medicine cases and perhaps for simple cases in pediatrics and obstetrics. Every hospital is presumably staffed to treat this class of medical problems, and most have an ambulance capacity to transport patients referred from nearby clinics. For all other problems, patients are referred to an S.O.P. clinic where the decision to hospitalize in a specialty inpatient service (S.I.P.) is made.[1] If further diagnostic tests cannot be performed at the P.O.P. clinic, (e.g. at a rural dispensary), the patient must be referred to the nearest hospital. Complex diagnostic tests or referral to an S.O.P. clinic or specialty inpatient service (S.I.P.) would necessitate referral to a Regional or General hospital.

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[1] In cases where referral requires the patient to be sent outside of the region, each hospital unit has a limited budget to cover the patient's transport costs.

Usually, the referral process is sequential, with a patient referred initially to the Regional Hospital and then, if necessary, to a General Hospital or Institute.

Measures of Referral Capacity

One proxy measure of $\alpha$ is the actual absorptive capacity of higher level referral units relative to the pool of potential demand. Estimates of $\alpha$ can indicate whether the probability of access to higher level referral units is equal across regions within the system. Specifically, one corollary of our theoretical analysis is that the probability of referral from any level i to level i + 1 should be equal throughout the system. If not, patients would have unequal access to the higher level units.

One measure of $\alpha_i^{i+1}$ is the ratio of the patients at a given level i + 1, to the number of patients at level i that, in principle, could be referred to the higher level. For example, if a referral system operates efficiently on a regional basis, it should encompass any referrals within the region. If i = 1 and 3 represents care at a P.O.P. and S.O.P. clinic, respectively, then

$$\hat{\alpha}_{1,g}^{3} = \frac{\text{total specialty outpatients for all units in region g}}{\text{total primary outpatients for all units in region g}}$$

This measures the probability that a random outpatient at any P.O.P. clinic will be referred to an S.O.P. clinic in the region. Assuming the case mixes are similar across regions, $\hat{\alpha}_{1,g}^{3}$ should be equal for all g.

In Table 2, we present regional estimates of $\hat{\alpha}$ for the following referral options within each region:

(i) an outpatient at a P.O.P. clinic referred to an S.O.P. clinic (other than obstetrics-gynecology) (col. 1);

(ii) an outpatient at a P.O.P. clinic hospitalized in the inpatient service of general medicine (GM-IP) (col. 4);

(iii) an outpatient at an S.O.P. clinic hospitalized in an S.I.P. service (other obstetrics-gynecology) (col. 2);

Table 2

Measures of the Capacity for Referral, α: Tunisia 1971

| Probability of Admission From: | At Regional Level | | | | | | For Multiregional Groupings[2] | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) P-OP[1] To S-OP | (2) S-OP[1] To S-IP | (3) P-OP To S-IP | (4) P-OP[1] To GM-IP | (5) GO-OP To GO-IP | (6) P-OP To IP | (7) S-OP To S-IP | (8) P-OP To S-OP | (9) P-OP To S-IP |
| Tunis | 42.0% | 10.1% | 4.2% | 1.6% | 7.0% | 5.8% | 8.7% | 40.7% | 3.6% |
| Tunis (including Institutes) | 74.8 | 9.6 | 7.2 | 1.6 | 7.0 | 8.8 | 8.8 | 64.8 | 5.6 |
| Nabeul | 36.9 | 4.0 | 1.5 | 3.8 | 7.3 | 5.3 | | | |
| Sousse | 21.0 | 16.3 | 3.4 | 2.0 | 17.8 | 5.4 | 17.0 | 16.0 | 2.7 |
| Kairouan | 8.2 | 25.1 | 2.1 | 3.2 | 9.1 | 5.2 | | | |
| Kasserine | 3.9 | 16.8 | .6 | 1.7 | 3.3 | 2.3 | | | |
| Bizerte | 37.9 | 11.5 | 4.3 | 2.6 | 8.6 | 6.9 | 11.4 | 23.9 | 2.7 |
| Jendouba | 11.2 | 30.3 | 3.4 | 3.2 | 10.2 | 6.8 | | | |
| Beja | 8.0 | 22.0 | 1.8 | 3.0 | 15.7 | 4.8 | | | |
| Le Kef | 29.1 | 5.5 | 1.6 | 1.8 | 7.9 | 3.3 | | | |
| Sfax | 37.8 | 11.9 | 4.5 | 1.8 | 12.4 | 6.2 | 17.7 | 15.6 | 2.8 |
| Gafsa | n.a. | n.a. | 1.8 | 1.9 | 16.4 | 3.7 | | | |
| Gabes | 11.7 | 19.2 | 2.2 | 2.0 | 6.1 | 4.2 | | | |
| Medenine | n.a. | n.a. | 1.7 | 4.7 | 16.2 | 6.3 | | | |

[1]P-OP--outpatient consultation at a clinic of General Medicine. S-OP--outpatient consultation at a specialty clinic (excluding gynecology-obstetrics). GM-IP--inpatient admission in a service of General Medicine. S-IP--inpatient admission in a specialty service (excluding gynecology-obstetrics). GO-OP--outpatient consultation at a clinic of gynecology-obstetrics. GO-IP--inpatient admission in a service of gynecology-obstetrics.

[2]Represents the sum of visits for all institutions of the region.

Source: Heller (1975); République Tunisienne (1973, 1970); unpublished materials from Ministère de la Santé Publique, and Ministère de la Finance, République Tunisienne.

(iv) an outpatient at a P.O.P. clinic hospitalized in a specialty service (col. 3);

(v) an outpatient at a gynecology-obstetrics outpatient clinic (G.O.O.P.) hospitalized in a G.O. inpatient service (col. 5).

Our measures are imprecise since the data relates to outpatient visits rather than outpatients.[1] We have grouped the regions according to whether they refer patients to the same General hospital outside their own region.[2]

For each referral option involving specialty services, there appears considerable variance in the probability measures. The probability of hospitalization directly from an S.O.P. clinic varies from 5.5% in Le Kef to 30.3% in Jendouba; in a P.O.P. clinic from 1.7% in Tunis to 4.7% in Medenine. Even if one attempts to explain intra-group variation by referrals across regions within any group, the multi-group probabilities are still considerably different (col. 6-8).[3] The probability of referral to an S.O.P. clinic varies from 16% in Sousse and Sfax to 41% in the Tunis grouping. Similarly, the probability of specialty hospitalization varies from 9% to 18%. Only the overall probability of hospitalization for a P.O.P. outpatient is fairly uniform across the regions, with a mean of 5.1%.

There is a clear pattern to these variations. For a region with a General Hospital, the probability of referral to an inpatient service (whether from an S.O.P. clinic to an S.I.P. service or a P.O.P. clinic to a G.M. inpatient service) is clearly lower than for the other Regions in its multi-regional grouping. Conversely, the probability of referral to the S.O.P. clinic from the P.O.P. clinic appears considerably higher.

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[1] If there is reasonable homogeneity in the case mixes among outpatients across regions this will not prove too much of a distortion.

[2] For example, patients in the southern regions of Sfax, Gafsa, Gabes and Medenine will be referred to the Sfax General hospital for complex illnesses which cannot be treated within their Regions. Only rarely will patients from a multi-Regional grouping be referred outside this grouping and then primarily to the Institutes or General Hospitals in the Tunis region.

[3] In columns 6-8, we've assumed that there is an equal probability of referral across levels for all regions within a multi-regional grouping.

This may simply indicate that given the case mix at the General hospital S.O.P. clinics, a larger fraction can receive ambulatory treatment. Alternatively, if the General Hospitals receive a considerable flow of referred outpatients from other regions within their grouping, this might be reflected in these measures. The major urban centers may also have a higher ratio of skilled medical staff to bed capacity, thus allowing more frequent and accessible outpatient clinics both for specialty and primary care. Although consistent with the previous explanation, it does presume these facilities serve as referral units to the other regions.

In calculating these measures, we assumed that the probability of referral to an i + 1 institution is the same within a region and independent of the choice of a particular i institution. Only capacity differences explain differences in probability across regions. If one assumes referral occurs with difficulty, the probabilities reveal larger variation. When the probabilities of referral are calculated, assuming referral occurs only at a district level (Table 3), there remains considerable variation in the probability of referral to a GM-IP ward. Similarly, tasks (injections, bandaging, etc.) per outpatient visit also varies sharply.

What is the probability of referral by particular specialty units? In Table 3 we have also measured the probability of a specialty outpatient's referral to the specialty ward at each institutional level of the pyramid, under the assumption of a fully efficient referral structure. As expected, the probability falls for referral to higher levels. If the referral only operates within institutions, the probability of hospitalization is highest at the General hospital level and lowest at the Institute level (with the exception of opthalmology).

Though not fully conclusive, these results suggest that the capacity of Tunisia's referral structure is not optimally distributed across regions and districts. However, they do not reveal whether referral is actually occurring to a significant extent. One test of this is to examine whether the inpatient pool of a referral unit is representative of its client population.

Table 3

## Part A: Measures of Referral Possibilities for General Medical Care

| District | Ratio of PARA-ACTS To P-OP[2] | Ratio of GM-IP To P-OP[3] | District | Ratio of PARA-ACTS TO P-OP[2] | Ratio of GM-IP To P-OP[3] |
|---|---|---|---|---|---|
| Kairouan [1] | | | Sousse [1] | 1.38 | 1.7% |
| Haffouz | 5.62 | 4.1% | Enfida | .29 | .3% |
| Ouseltia | 2.60 | 7.7% | Mahdia [1] | 2.28 | 1.3% |
| Sidi Amor | 1.87 | 3.9% | Souassi | 1.68 | 4.4% |
| Hadjeb | 2.10 | 4.6% | Le Kef [1] | 1.14 | 1.3% |
| Beja [1] | 1.35 | 3.2% | Makthar | 1.36 | 3.1% |
| Teboursouk | .97 | 2.8% | Tadjerouine | 1.53 | .5% |
| Medjez-El-Bab | 1.39 | 3.9% | Ebba Ksour | 1.89 | .9% |
| Bou Arada | 1.82 | 3.3% | Habib Thameur [1] | 1.18 | 1.2% |
| Kesserine [1] | 1.09 | .5% | Zaghouan | 1.84 | 6.9% |
| Sbeitla | .99 | 1.0% | Pont du Fahs | 1.29 | 1.0% |
| Sbiba | 1.27 | 1.5% | Gafsa[1] | 2.25 | 1.5% |
| Thala | 1.19 | .5% | Gamouda | 1.71 | 2.7% |
| Feriana | 1.11 | 1.2% | Maknassy | .93 | .9% |

## Part B: Measures of Referral Possibilities for Specialty Medical Care

Probability of Referral from S.O.P. to a S.I.P. Service in:

| Hospital Level | Tuberculosis | | Pediatrics | | Opthalmology | | Otolaryngology | Surgery |
|---|---|---|---|---|---|---|---|---|
| | At Same Instit. Level[4] | To a Higher Instit. Level[5] | At Same Instit. Level[4] | To a Higher Instit. Level[5] | At Same Instit. Level[4] | To a Higher Instit. Level[5] | At Same Instit. Level[4] | At Same Instit. Level[5] |
| Specialty Institute | 14.7% | 8.0% | 4.9% | 2.4% ( .49%)[6] | 4.2% | 1.0% | -- | -- |
| General Hospital | 19.0% | 14.2% | 6.3% | 9.3% (1.07%)[6] | 2.6% | 1.8% | 6.4% | 21% |
| Regional Hospital | 20.7% | 16.5% | 18.9% | 11.2% (1.12%)[6] | 6.2% | 4.8% | 1.7% | 20% |

[1]Relates to the specific district of . . . . It is not a summary statistic for the entire Region.

[2]The ratio of all "soins divers" (includes bandaging, injections, etc.) performed at outpatient clinics by paramedical personnel to total outpatient consultations at hospitals and dispensaries

[3]The ratio of general medicine inpatients in 1970 to all P-OP consultations in hospitals in 1971 and dispensaries in 1972.

[4]The probability of hospitalization for a S-OP in the same hospital level.

[5]The ratio of the number of specialty inpatients at level i to the number of specialty outpatients at the same or lower levels.

[6]Includes all pediatric outpatient visits at maternal-child health centers.

Source: République Tunisienne (1973a, b).

Table 4

Measures of the Extent of Actual Referrals in the Tunisian Medical System: 1971

| Sousse General Hospital ($\alpha$=2.31%)[3] | | | |
|---|---|---|---|
| Client Areas | % of Pop. | % of S.I.P.[1] From Area | $\nu$[2] |
| Sousse Municip. | 16.4% | 34.1% | 2.1% |
| Enfida | 5.1 | 3.3 | 1.2 |
| Souassi | 10.2 | 4.4 | 3.4 |
| Msaken | 8.7 | 8.3 | 1.3 |
| K. Kebind | 8.1 | 16.6 | 4.6 |
| Mahdia H. Region | 18.3 | 5.5 | .8 |
| Monastir H. Region | 27.6 | 10.4 | 1.0 |
| Kairouan H. Region | | 3.9 | .3 |
| Kasserine H. Reg. | | 1.7 | |

| Kairouan Regional Hospital ($\alpha$=5.05%) | | | |
|---|---|---|---|
| Client Areas | % of Pop. | % of[4] S.I.P. From Area | $\nu$ |
| Kairouan Municip. | 30.6% | 51.6% | 7.7% |
| Haffouz | 15.2 | 8.3 | 2.5 |
| Hadjeb El-Aioun | 6.4 | 2.7 | 1.0 |
| Sidi Amor | 16.8 | 10.3 | 2.2 |
| Sidi Ali | 10.5 | 1.1 | .4 |
| Outside Region | | 5.5 | |

| Kasserine Regional Hospital ($\alpha$=.64%) | | | |
|---|---|---|---|
| Client Areas | % of Pop. | % of[5] S.I.P. From Area | $\nu$ |
| Kasserine Municip. | 18.5% | 47.6% | .80% |
| Skeitla | 25.0 | 13.9 | .50 |
| Thala | 27.9 | 22.9 | .80 |
| Rest of Kasserine | 28.6 | 16.0 | .37 |

| | | Ophalmology Institute ($\alpha$=.05) | | Psychiatric Institute | | Pediatric Institute ($\alpha$=.12) | |
|---|---|---|---|---|---|---|---|
| Client Area | % of Pop. | % of S.I.P. | $\nu$[6] | % of S.I.P. | $\nu$[6] | % of S.I.P. | $\nu$[6] |
| Tunis | 22.3% | 46.5% | .15% | 44.6% | .34% | 84.3% | .72% |
| Nabeul | 6.5 | 10.5 | .12 | 7.1 | .19 | 3.5 | .10 |
| Bizerte | 6.3 | 1.7 | .01 | 8.1 | .16 | 1.8 | .04 |
| Sousse | 11.6 | 9.7 | .03 | 8.9 | .10 | 1.3 | .01 |
| Beja | 5.8 | 4.4 | .05 | 8.9 | .23 | 2.6 | .07 |
| Jendouba | 5.5 | .9 | .01 | 7.1 | .02 | .5 | .02 |
| Le Kef | 6.7 | 4.4 | .03 | 4.5 | .06 | .5 | .01 |
| Kasserine | 4.5 | .9 | .01 | 1.9 | .06 | 2.1 | .07 |
| Kairouan | 6.0 | 1.7 | .03 | 8.9 | .31 | 1.8 | .06 |
| Sfax | 9.6 | 6.1 | .03 | 0.0 | .00 | 1.8 | .01 |
| Medenine | 5.3 | 3.5 | .03 | 0.0 | .00 | 0.0 | .00 |
| Gabes | 4.4 | 1.7 | .01 | 0.0 | .00 | 0.0 | .00 |
| Gafsa | 7.2 | 7.9 | .05 | 0.0 | .00 | 0.0 | .00 |
| | 100.0 | 100.0 | | 100.0 | | 100.0 | |

[1] Includes services of general surgery, pediatrics, otolargyngology, and opthalmology.

[2] $\nu$ = the ratio of specialty inpatients from an area to total primary outpatient visits in hospitals and dispensaries in that area.

[3] $\alpha$ = the ratio of total specialty inpatients to all primary outpatients visits in the region.

[4] Includes services of pediatrics, surgery, gynecology-obstetrics, opthalmology, tuberculosis, dental surgery.

[5] Includes services of pediatrics, surgery and maternity.

[6] Razi Manouba Hospital.

[7] $\nu$ = ratio of inpatients from a given region to the total number of general medicine outpatients consultations in that region.

To test this hypothesis, we collected a sample of inpatient records for different hospital units and classified inpatients according to their town or region of residence. This yields a rough picture of the population groups actually served by each hospital.[1] In Table 4, we relate the share of each area in the total "client" population to the share of inpatients from each area. Implicitly, these results are the product of the probabilities that an ill person will seek outpatient care and the probability, $\gamma$, (as discussed above) that an outpatient will be referred to a higher level unit. A measure of $\gamma$ may be calculated by relating the number of specialty inpatients from an area to the number of primary outpatient visits in this area. This may be compared with our measure of $\alpha$ for the relevant client population, as calculated above. The results may be summarized as follows:

(1) Each of the Institutes cited are located in Tunis and are national institutions, handling the most complex cases associated with their particular specialty.[2] In all cases, but particularly for the Pediatrics Institute, the Tunis region's population is disproportionately represented. The value of $\gamma$ for Tunis far exceeds the national value for $\alpha$.

(2) There are three Regional and General hospitals in the gouvernorat of Sousse. Although each supplies specialty inpatient services, the Sousse General Hospital dominates, providing 80%, 100%, 62% and 53% of capacity in opthalmology, otolaryngology, surgery and pediatrics, respectively. It is difficult to judge

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[1] One difficulty with this data is that it may overestimate the fraction of inpatients residing in the city of the hospital unit. Admittants to a Tunis hospital may give as their address the home of a friend or relative in Tunis rather than their actual address. The magnitude or significance of the bias is unclear.

[2] One must assume that the Institutes are intended to have a national focus. The Tunis region has more than twice as many pediatric beds per capita, for the under 14 population, than any other region. The ratio of the under-age 14 population to pediatric beds is 1032 for the Tunis region relative to a national average, exclusive of Tunis, of 5547. Similarly, Tunis has more than half of all opthalmological beds in the country. Similarly, there are only two psychiatric services in the country: Razi Manouba Hospital in Tunis (1018 beds) and Sfax (117 beds).

whether the residents of the city of Sousse consume a disproportionate share of the inpatient services of the Sousse General hospital. By comparing the $\alpha$ value for the Sousse Region with the district specific values of $\gamma$, the residents of the Sousse municipality do not appear to be differentially favored. Since the region of Sousse is well-endowed with hospital beds, one would expect this hospital to serve as a referral unit for other regions in central Tunisia in order to justify its higher recurrent and investment expenditure per bed. In all the services surveyed, less than 9.3 per cent of inpatients were from outside the Sousse region.

(3) The Kairouan Regional Hospital primarily supplies specialty inpatient and outpatient services to its own regional population. With the exception of the services of surgery, tuberculosis and opthalmology, the Kairouan residents occupy a disproportionate share of inpatient capacity. Compared to a Regional value of $\alpha = 5.05\%$, the residents of Kairouan municipality have a higher probability of actual usage.

(4) Kasserine is the poorest region of Tunisia. The city of Kasserine is itself new (cir. 1954) and contains no more than 20 per cent of the region's population. Although it also appears heavily skewed in its inpatient data, this reveals less about the referral structure's inadequacy in the region than about the small number of its bed stock. Since the services of pediatrics and gynecology have only nine and eight beds respectively, it is not surprising that these are overwhelmingly used by Kasserine residents. Surgery is the largest service (22 beds) and this is more equitably utilized within the region.

Case Mix Differences at Different Levels of the Referral Pyramid

Another test of the referral system's performance is whether there is an increase in the medical severity of inpatient cases at the upper levels of the system. Ostensibly, a General Hospital should treat medical cases sufficiently complex as to warrant its higher expenditure per patient. If the case mix of patients was invariant for institutions across different levels of the pyramid, this would suggest, at best, a malfunctioning referral system. At worst, it would belie the efficiency of the distribution of resources in the system.

A comparison of case mix differences across institutions is fraught with hazards. If a District hospital only has a service of general medicine, its caseload will obviously differ from a Regional hospital with additional services in obstetrics-gynecology, pediatrics and surgery and this applies *a fortiori* for General Hospitals. Presumably, the existence of a specialty service implies cases that are substantively different from hospitals without such a service. One can only compare the case mixes of medical services found at more than one level of the referral system.[1]

From a sample of cases drawn from a small number of hospitals, we categorized the disease problems encountered (Table 5). In the service of general medicine, clear differences emerge in the case mixes. In the District hospitals, respiratory illnesses, intestinal infections and digestive illnesses account for 58 per cent of total cases, as opposed to only 39 and 27 per cent at the Regional and General hospitals, respectively.[2] The share of patients with tuberculosis, rheumatism and urinary illnesses, respectively, is largest at the Regional Hospital level, which may suggest they receive many cases on referral from the District hospitals. The smaller share at the General Hospitals would indicate that their cases are primarily drawn from the urban populations.

As one moves up the pyramid, there is also a rise in the shares of such

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[1]The alternative task of determining whether the hospital has more or less than the inputs necessary for an adequate diagnosis of treatment is equally impractical.

[2]Complications associated with pregnancy are also common (5.38 per cent of total cases), but the small percentage of cases at the other levels reflects their treatment in a service of obstetrics-gynecology.

Table 5

CASE — MIX OF A SAMPLE OF INPATIENTS IN THE GENERAL AND SPECIALTY MEDICAL SERVICES IN A SAMPLE OF TUNISIAN HOSPITALS

| Percentage of Each Disease Problem in the Case Load of of the Following Medical Services | INSTITUTIONAL LEVEL OF REFERRAL PYRAMID | | |
|---|---|---|---|
| | General[a/] Hospitals | Regional[b/] Hospitals | District [c/] Hospitals |
| **In Service of General Medicine:** | | | |
| Intestinal infections | 3.97 | 5.50 | 7.52 |
| Tuberculosis | 2.27 | 4.83 | 0.80 |
| Viruses | 1.63 | 0.94 | 1.04 |
| Endocrine illnesses (including diabetes) | 5.03 | 0.85 | 0.00 |
| Illnesses of the blood (anemia) | 4.04 | 2.01 | 1.79 |
| Rheumatism | 3.35 | 9.26 | 4.57 |
| Heart Disease | 14.52 | 7.63 | 3.30 |
| Hypertension | 3.67 | 4.08 | 0.51 |
| Respiratory illnesses | 11.84 | 25.63 | 43.52 |
| Digestive illnesses | 11.63 | 8.59 | 6.35 |
| Stomach Ulcers | 6.59 | 0.00 | .75 |
| Illnesses of annexes of digestive tube | 7.76 | 2.15 | 2.65 |
| Urinary illnesses | 6.71 | 9.17 | 4.55 |
| Complications associated with pregnancy | 0.00 | 1.31 | 5.38 |
| Total | 100.0 | 100.0 | 100.0 |
| **In Service of Maternity Care:** | | | |
| Deliveries with no complications | 65.28 | 53.51 | 79.13 |
| Abortion or delivery with complications | 13.90 | 22.00 | 1.08 |
| Total | 100% | 100% | 100% |
| **In Service of Surgery:** | | | |
| Respiratory illnesses | 3.25 | 3.23 | |
| Appendicitis | 8.38 | 2.07 | |
| Hernias | 6.94 | 9.30 | |
| Urinary dieases | 6.29 | 3.60 | |
| Skin diseases | 20.26 | 8.07 | |
| Fractures | 16.80 | 14.00 | |
| Trauma internal | 3.35 | 4.94 | |
| Trauma superficial | 6.10 | 11.50 | |
| Bone diseases | 1.70 | 1.74 | |
| Total | 100% | 100% | |
| **In Service of Pediatrics:** | | | |
| Intestinal infections | 43.90 | 14.00 | |
| Malnutrition and metabolic troubles | 5.25 | 18.00 | |
| Maladies of nervous system | 11.25 | 3.73 | |
| Respiratory illnesses | 18.70 | 31.80 | |
| Bronchial pneumonia | 7.94 | 5.50 | |
| Urinary infections | 5.05 | 6.06 | |
| Total | 100% | 100% | |
| **In Service of Opthalmology:** | | | |
| Cataracts | 33.00 | 60.81 | |
| Total | 100% | 100% | |

a/ Habib Thameur, Sousse

b/ Kairouan, Kasserine

c/ Enfida, Haffouz, Hadjeb El Aioun, Sidi Amor, Ousseltia, Sbiba, Thala, Feriana, Sbeitla

SOURCE: Records of *fiches medicales* kept by Ministère de la Santé Publique.

medical problems as (i) endocrine illnesses, (ii) blood diseases, (iii) heart disease, (iv) stomach ulcers, and (v) illnesses of the digestive tube. Others, such as urinary illnesses, hypertension and digestive diseases are clearly higher at the General and Regional hospital levels.

In the service of obstetrics-gynecology, District Hospitals clearly have a smaller share of complicated deliveries or abortions. The remaining specialty services exist exclusively at the Regional and General hospitals. In surgery, General Hospitals have a higher fraction of appendicitis, urinary and skin diseases. In pediatrics, they dominate in the treatment of intestinal infections and nervous system diseases. Regional hospitals dominate in the treatment of respiratory illnesses, malnutrition and metabolic deficiencies. In opthalmology, cataracts are a larger share of the regional hospital's opthalmological case load.

A more complete analysis of the significance of these differences in the absence of morbidity data for different areas of the country is impossible. The case mix differences in General Medicine may simply reflect differences in morbidity in the client populations of the respective areas of the country. The higher socioeconomic status of urban groups may lead to less respiratory and intestinal illnesses. Alternatively, urban groups may receive treatment for many such common problems on an ambulatory basis from private physicians. The rural population lacks access to private sector physicians and the environmental conditions in the rural areas may preclude adequate ambulatory care for the more common disease problems, thus necessitating a higher hospitalization rate.

Summarizing Tables 4 and 5, the data suggest that inpatients in the higher level units of the referral system are disproportionately from the <u>same</u> urban area as the hospital. Population groups from more distant areas are underrepresented. Nevertheless, the case mixes of these hospitals do suggest a more complex mix of disease problems, which is encouraging. One cannot conclusively assert whether the referral structure is adequately working without knowledge of (1) the number of cases that ought to have been referred and were not, and (2) the number of cases at the higher levels who are receiving too costly a level of care.

For example, if there are major differences in the morbidity characteristics of the urban and rural populations, the rural groups may be accurately represented in the higher level referral units in terms of their share of particular types of disease problems. Alternatively, if morbidity differences are not significant, it suggests that the referral system is working badly for patients distant from a given hospital unit. In this case, the case mix for the higher level referral units is perhaps not complex enough. Referrals are more likely from the primary outpatient clinic of a General Hospital than from a rural dispensary thirty miles away. A disequilibrium between the $\beta_{ij}^{i+q}$ and $\gamma_{ij}^{i+q}$ is implied for rural patients with complex disease problems.

This appears a reasonable explanation. Many of the more complex cases do not appear related to socio-economic status (for example, anaemia, stomach ulcer, urinary illnesses, deliveries with complication, appendicitis, hernias, fractures, pediatric intestinal infections or cataracts). In fact, some are more likely to be overrepresented by lower income groups. Moreover, another study by the author has shown that the poor are not underrepresented in the urban hospitals, relative to their share in the population.[1] Thus, these are not disease problems only manifested by the affluent. The weak access of the rural poor reflects a breakdown at some point in the referral system.

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[1] From a survey of inpatient records, we classified patients according to their payment class. This allowed us to identify the proportion of hospital users in the "indigent" class, which encompasses the bottom 42% of the population in the income distribution. We found that the indigent class (1) was adequately represented in the Pediatrics Institute, and over-represented in the Opthalmological and Psychiatric Institute; (2) dominates in the use of the District hospitals (constituting 82-97% of inpatients; and (3) substantially utilizes the facilities of the Regional and General Hospitals (ranging from 50% to 70% of all inpatients). See Heller (1975a).

This suggests one of the problems characterizing a referral system in an LDC. The cost of a referral option will differ according to the level and location of the referring unit. The cost to a rural resident of a referral for outpatient services, in terms of the cost of transportation and time, may significantly exceed that to an urban resident of comparable socio-economic status. Similarly, the referral act will take longer in the rural areas. The time lag between the initiation of a diagnostic decision and the response from the laboratory may take as long as two weeks. In the interim, further medical action is temporarily stalled, and contingent on the return of the patient to the clinic.[1] Particularly when the patient is a child or is very ill, the latter is not inevitable. Moreover, for cultural reasons, patients may resist going far from home for diagnostic tests, and particularly for hospitalization. Particularly where the health system does not internalize this referral, either through direct transport or transport subsidies, there are obvious sources of breakdown in the system's actual operations.

These costs arise in any referral system and are primarily a function of the degree of modernization of the society. In a society with a large rural population, it is crucial that the referral linkages be designed with the pattern of rural demand in perspective. The linkage mechanisms for diagnostic referral that are efficient in the urban areas may not be equally efficient when transplanted to rural areas. This may suggest a need for an increase in the level of services provided at the base levels, through mobile specialist clinics or laboratories, or an increase in the ease with which referral may occur. For example, increased frequency of regular ambulance runs between different levels of the referral system may be necessary.

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[1]If a patient cannot be expected to return within a period of time to obtain the results of a laboratory test, etc., then any significant time lag in obtaining such results--as may occur if a lab test must be referred to another more distant hospital unit--may render the test irrelevant. Similarly, if the cost to a low-income patient of transporting himself to another unit, either for further tests or for hospitalization is prohibitive, then the existence of a referral capacity is irrelevant.

Other Issues Underlying a Possible Breakdown of the Referral System

Finally, the efficiency of resource allocation in a medical referral system will obviously hinge on the optimality of the distribution of effective operating capacity across levels of the pyramid. Although it is theoretically and empirically difficult to specify the "optimal" distribution, policy analyses can focus on the operational effectiveness of specific units in the pyramid. If analytical measures reveal the existence of striking forms of disequilibrium, they may suggest the direction in which specific policies should be focused. In Tunisia, two such conditions--excessive congestion at primary outpatient clinics and severe capacity underutilization at the district hospital levels--are such measures of disequilibrium. Since these issues are discussed in more depth elsewhere, we shall only briefly allude to the types of problem that may arise.

Two obvious bottlenecks to an efficient referral structure are an insufficiency of primary care capacity and a lack of outreach to the client population. Most medical systems operate on a self-referral basis. The latter creates problems in an LDC with a traditionally-oriented population. The decision to seek modern medical services depends on whether the individual perceives the illness as unusual or dangerous and on what are the accepted means of treatment for given symptoms within the society. Use of modern medical services may be initially deferred when traditional medicine is valued highly and a traditional practitioner is at hand. The demand decision is also influenced by the cost and perceived quality of the alternative sources of care. The importance of this "choice" as a public policy issue does not derive wholly from the public good and externality value of improving the health status of those consciously choosing traditional sources of medical care. In many cases the groups who fail to reach the system may be the elderly, the dependent child population or other sociological groups unable to act for themselves. The development of a mechanism (e.g. the village health worker) for rooting out these groups in the population would seem to be necessary.

The former bottleneck is equally serious. If the random patient does not have easy access to a minimal level of primary diagnostic and treatment services, there is a barrier to effective access to the higher level sources of care in the rest of the system. In Tunisia, significant levels of congestion and excess demand are manifest at the primary outpatient clinics, particularly in the rural areas. This is a complex phenomenon, often involving sociological factors (e.g. hypochondria, the status of women in an Arab society, etc.) as well as actual morbidity. The current technology of providing outpatient services exacerbates the problem. Tunisia's requirement that all outpatients be seen by a physician guarantees that any diagnosis or medical guidance will be cursory, under present manpower supply constraints. With the obvious exception of emergency cases, for which diagnosis is easily made and critically urgent, the quality and adequacy of the diagnostic and treatment process at the primary level is highly questionable, particularly in the rural areas. Severe medical problems may be detected only after subsequent patient visits trigger re-examination.

Opposed to the congestion bottleneck is the disequilibrium implied by extreme underutilization of a pyramid level. For example, a striking aspect of the operations of Tunisian health care units is the low level of inpatient capacity utilization at the District Hospital level, averaging 59%, and to a lesser extent in the Regional Hospitals,[1] averaging 74%. This may be compared to a norm rate of 85% and the 79% utilization rate in the General Hospitals. The cause of this phenomenon could be on the demand or supply side. Clearly, cultural or economic factors may limit the direct demand for inpatient services. Bottlenecks in the referral mechanism from

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[1]Within the Regional Hospitals, underutilization is particularly high in the services of opthalmology (49%) and otolaryngology (19%).

lower level units would preclude an adequate flow and constitute an indirect demand factor. We have argued elsewhere[1] that underutilization reflects a conscious response by the managers of public sector medical units to underfinancing of their recurrent operations. Rather than lower quality standards below a minimal level [$\hat{s}_d$], the activity level of the units is correspondingly reduced, particularly in the District Hospital units.

In the supply-induced case, the pattern of capacity underutilization at the lower level inpatient units implies that their effective treatment capacity is correspondingly reduced. The nominal stock of beds shown in Table 1 yields a misleading picture of actual capacity, and places greater pressure on the referral mechanism's ability to adequately discriminate among potential users of the higher referral units. It may also imply disequilibrium between the marginal quality of care at the different pyramid levels, relative to the marginal severity of the caseload (inadequate quality at the lower level units, excessive quality at the upper level units).

## Conclusion

Our analysis suggests that the Tunisian medical system only partially justifies its current pattern of resource allocation. The referral of complex cases to the higher levels of the referral system clearly occurs and is perceived as an available option by the physicians at the primary clinic level. Although not fully representative, patients from outside the cities of the major hospitals do have effective access to them. Moreover, the complexity of cases treated also appears to rise as one moves up the pyramid. There are two principal structural deficiencies.

First, rural patients distant from the upper level referral units do appear at a disadvantage in terms of their probability of referral, compared to their urban

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[1]Heller(1975a).

counterparts (of whatever economic status). This primarily reflects an inadequate linkage mechanism between the referral units, which raises the cost to the patient of exercising the referral option. Second, congestion at the primary clinic level and inadequate capacity utilization of the District Hospitals suggests the need for an expansion in the resources allocated to the base level institutions.

What is the cost to the Tunisian government of providing the higher level referral capacity? Suppose that the difference in the average cost per inpatient day or outpatient visit between the higher level and lower level units approximates the marginal recurrent cost associated with providing specialty care. Given the volume of hospital admissions and outpatient visits, we may estimate the marginal recurrent cost of higher quality treatment in the Regional and General Hospitals and Institutes as:

**Inpatient Care**

| | |
|---|---|
| (1) Marginal cost of inpatient treatment above the quality of District Hospitals: | D 3,794,416 |
| (2) Marginal cost of inpatient treatment above the quality of Regional Hospitals: | D 1,775,229 |
| (3) Marginal cost of inpatient treatment above the quality of General Hospitals: | D 69,340 |
| Total Inpatient Expenditure: | D 8,343,659 |

**Outpatient Care**

| | |
|---|---|
| (4) Marginal cost of outpatient treatment above the quality of District Hospitals: | D 1,078,395 |
| (5) Marginal cost of outpatient treatment above the quality of Regional Hospitals: | D 589,181 |
| Total Outpatient Expenditure: | D 2,638,976 |

In other words, a reduction in the quality and range of inpatient services provided in the Regional Hospitals could save approximately 21 per cent of the inpatient budget and 15 per cent of the total institutional health budget. These funds could be used to upgrade the quality of services at the primary outpatient and inpatient levels, and still allow for a further increase in expenditure per unit of output at all levels of the system.

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