A SIMULATION MODEL OF THE PRIMARY HEALTH CARE SYSTEM OF INDIANA

ABSTRACT

A combined discrete/continuous simulation model of the primary health care system of Indiana has been developed and implemented in the GASP IV simulation language. The purpose of this model is to project the supply of and demand for primary health care in Indiana from 1970 through 2000. The model has been developed to evaluate the need for additional primary care supply in Indiana, and to assess the effect of exogenous policy changes on performance measures of the Indiana primary health care system. This paper describes the model and its use, however, an emphasis is placed on the data collection aspects of model building.

The data to support the model was obtained from many sources. Extensive problems existed in converting the data to a consistent basis. A description of the data sources, the data reduction requirements and the parameter estimation procedures are included in the paper.

The primary health care system of Indiana is modeled as having four major components: 1. the providers of primary care; 2. the volume of services of the providers; 3. the population of Indiana; and 4. the volume of services the population demands.

Model outputs involved the projection of the four components over time. In working with health manpower policy-makers, it was determined that the following two performance measures were of significant interest:

1. Ratio of the supply of visits to the demand for visits.
2. A normalized difference between the supply of visits and the demand for visits.

INTRODUCTION

There is a controversy today concerning the state of the need for additional physicians and other providers of primary care in Indiana. Loosely defined, primary care can be viewed as first contact or non-specialty care. In addition, the meaning of a shortage or deficit of primary care physicians must be clearly stated. The view taken in this research is expressed by Confrey [3], that a shortage is the difference between the supply of and demand for physician services. This view requires that, in addition to the numbers of physicians, their ability to supply services must also be assessed. Also needed are a determination of the population, its demand for these services and its geographic distribution.

Policy decisions and legislation, at both the federal and state level, affect the primary health system of Indiana. Evaluation of proposed policies before they are initiated would allow insight into their effects on various components of the primary health care system. In addition, there is a need for policy setters and decision makers in the medical profession to be able to evaluate the long-term effects of changes in policy which they propose. This research is directed at providing a method to assist in making such evaluations.

AN EXAMINATION OF HEALTH MANPOWER PLANNING LITERATURE

Extensive literature exists on health manpower planning. Therefore, it is impossible to provide even a summary in a short paper. The reader is referred to books by Reinhardt [17] and Donabedian [6] for complete literature reviews.

Models for making manpower projections may be loosely grouped into three classes. The first is that of "simple" models which use simple algebra to project the future numbers of physicians or other health care providers. The second is that of statistical models which use techniques such as regression to relate demographic characteristics to health systems variables. The third class is composed of system models. These seek to impose a mathematical-logical structure on the health care system in order to make projections. In this research, a system model was developed. The reader is referred to the theses of Dierckman [5], Macal [10] and Standridge [19] for a review of these modeling approaches.

A SYSTEM'S MODEL OF PRIMARY HEALTH CARE IN INDIANA

A simulation model has been constructed to describe the primary health care system of Indiana and to evaluate policies which affect it. Concepts concerning the four components of the primary health care system of Indiana, the providers of primary care,

*This research was done under a contract with the Regenstrief Institute.

the volume of services of the providers, the population of Indiana and the volume of services the population demands, are integrated into a model which projects each component over time. Model outputs are quantities which characterize the performance of the primary health care system of Indiana. The GASP IV simulation language [13] was chosen as the modeling vehicle because it allows both discrete events and continuous changes to the system to be modeled. Discrete events change a population size at a precise point in time, for example, graduation from medical school. Continuous changes modify a population size gradually as time passes, for example, the retirement of physicians.

PROVIDERS OF PRIMARY CARE

For this research, primary health care providers were considered to be non-federal office based physicians who are of one of the following specialties: General and family practice, general internal medicine, obstetrics and gynecology, pediatrics, or general surgery, and the physicians extenders who assist such physicians in the supply of patient visits. Furthermore, it was assumed that all of the care supplied by these providers was primary care.

Characteristics of Providers: In Standridge [19], the volume of visits supplied by the providers of primary care was shown to depend on three physician characteristics: Age, practice location (SMSA or non-SMSA) and specialty. The characteristics of physician extenders which were included in the model were practice location and specialty. The characteristic, practice location, was based on the county in which the physician practiced. Indiana was divided into two sets of counties: The metropolitan set consisted of all counties within standard metropolitan statistical areas (SMSA) defined by the U.S. Office of Management and Budget. The rural or non-metropolitan set of counties consisted of all Indiana counties which are not in SMSA's. In general, non-metropolitan counties have relatively more of their primary care needs met by family and general practitioners than metropolitan counties.

Data from the 1970 and 1973 AMA directories [1,2] were aggregated by primary care specialty and location as was data from the 1975 AOA directory [20]. This last data was used to approximate the number of osteopaths in Indiana in 1970 and 1973. This assumption was made since the net change in the number of practicing, non-federal osteopaths between 1967 and 1974 is only 12. Table 1 gives the number of primary care doctors of medicine and osteopathy in Indiana in 1970 and 1973. Table 1 shows an increase of 69 primary care physicians in metropolitan areas in the three years and a decrease of 11 in non-metropolitan areas.

Furthermore, assuming the age distribution of osteopaths at the beginning of 1975 to be identical to that at the end of 1970, the age distribution of the primary care physicians could be generated by specialty and location.

Projection of Primary Care Physicians: The number of physicians can change in three basic ways. New physicians completing their training and entering practice increase the number of physicians. Physicians terminating their practice due to retirement or death decrease the number of physicians. Also, affecting the number of physicians is the in-migration and out-migration of physicians. In this research, only the net migration, the difference between in- and out-migration, was considered.

Changes in the characteristics of the physicians must also be considered. Obviously, the age of a physician changes with time. Changes in the other two physician characteristics of interest, location of practice and specialty, were considered in the light of the Indiana Physician Profile [9]. Preliminary analysis from this survey showed that the number of changes in location of practice within Indiana was not significant. Changes in specialty, other than from general to family practice, also appeared to be small in number [18]. General and family practice were grouped together, and hence changes in specialty, as well as intra-Indiana movement of practice, could be assumed to be negligible.

A drawing of the model of the movement of physicians in Indiana is given in Figure 1. The retirement-death rate of Indiana primary care physicians is the percentage per year of those physicians 65 and over that retire or die. It is assumed that this rate is independent of specialty and location of practice. Standridge [19] estimates this rate from the Indiana Physicians Profile [9] as 14.66%.

The retirement-death process is considered on a continuous basis. For the period of time τ, the number of physicians which retire or die is computed as

$$RETR_{ijk}(\tau)=PHYS65_{ijk}(t) * (1 - (1 - RDR)^{\tau}) \qquad (1)$$

where $RETR_{ijk}(\tau)$ is the number of physicians in specialty i, in age group j, in region k who retired during the period t to t + τ; $PHYS65_{ijk}(t)$ is the number of physicians of at least 65 years of age in specialty i, in age group j, in region k at time t; and RDR is the annual rate of retirement of physicians.

The "birth" process for Indiana physicians begins with college graduates becoming first-year medical students and progressing through medical school. The enrollment in Indiana University Medical School at the beginning of the projection period, 1 January 1971 was compiled. The number of first-year students admitted to the Indiana University Medical School for each of the school years 1971-1972 through 1976-1977 was then obtained. It has been estimated that between 1 and 2 percent of those entering medical school drop-out before graduation. Between 55% and 60% of Indiana University medical graduates remain in Indiana for their post-graduate training [9]. It was assumed that those who remain in Indiana are distributed among the various specialties in proportion to the number of interns and residents in that specialty in Indiana in the academic year following their graduation from medical school. The number of graduates of medical schools other than Indiana University who entered graduate medical training in Indiana per year was also estimated [19]. The "birth" of an Indiana primary care

physician was modeled as a series of discrete events using the process of moving through medical school and residence programs.

Little data was available concerning the portion of graduates of Indiana residencies remaining in this state to practice. An examination of family practice residency graduates from 1969-1972 [7] showed that about two-thirds remained in Indiana. This proportion was assumed to hold for all primary care specialties. Those remaining in Indiana were assumed to locate in each of the two areas of the state according to percentage of the total number of physicians of the same specialty in that area as of December 1970. The age distribution of graduating residents was estimated from the age distribution of all residents in 1970.

Data concerning the number of primary care physicians in Indiana by specialty and location was available from the American Medical Association for December 1970 and December 1973 [1,2]. A computer program was written to simulate the "physician birth" process and retirement-death process as previously described for the three year period from December 1970 through December 1973. Thus, the change in the numbers of physicians due to these two components was estimated. The difference between the actual change in the numbers of physicians and the estimated change in numbers due to newly educated physicians and retirements and deaths was used to estimate the net migration of physicians. The results from the simulation and the calculation of net migration are given in Table 2. The net migration of physicians is given as the annual number of migrants by specialty and practice location. It was assumed that these migrants were between 35 and 54 years of age. Migration is considered as a continuous process and is modeled by

$$NMGRT_{ijk}(\tau) = (ANM_{ijk} * PHYS35\text{-}54_{ijk}(t) * \tau) / \sum_{j} PHYS35\text{-}54_{ijk}(t) \quad (2)$$

where $NMGRT_{ijk}(\tau)$ is the number of net migrants in a time period t to $t + \tau$ of specialty i, in age group j in location k; ANM_{ijk} is the annual number of net migrants of specialty i, in age group j in practice location k; and $PHYS35\text{-}54_{ijk}(t)$ is the number of physicians between 35 and 54 years of age of specialty i, in age group j in practice location k.

Movement of Physician Extenders: The movement of physician extenders was modeled as a pure birth process. Data was collected and assumptions made similar to those for doctor movement. Details concerning the assumptions made are given in Standridge [19].

THE SUPPLY FUNCTION

Full-Time Equivalent Physicians: In order to construct a function giving the volume of patient visits supplied by the providers, the concept of full-time equivalent (FTE) physician was developed. A full-time equivalent physician is defined to be the number of patient visits given in one week by a general or family practitioner in the 35-39 age group with his practice located in the metropolitan area.

The number of visits supplied by a physician is expressed relative to the full-time equivalent.

$$y_{ijk} = a_{ijk} * FTE \quad (3)$$

where y_{ijk} is the volume of visits supplied by a physician of specialty i in age group j whose practice is in location k; a_{ijk} is the proportion of the full-time equivalent volume of visits supplied by a physician of specialty i, in age group j whose practice is in location k; and FTE is the full-time equivalent volume of visits by a GP/FP with age 35-39 with a metropolitan practice location.

Data is published by the AMA concerning the number of office visits supplied by physicians in a week according to their specialty and practice location [14,15,16]. Assuming that the full-time equivalent volume does not vary with time, data from three years concerning the number of office visits per week supplied by those in general practice was used. It is necessary to convert these average values to an estimate of the full-time equivalent volume of visits. The following expression for a_{ijk} was hypothesized:

$$a_{ijk} = V_i * V_{j|i} * V_{k|ij} \quad (4)$$

where V_i is the relative volume of visits supplied by specialty i; $V_{j|i}$ is the relative volume of visits supplied by age group j allowing for specialty i; and $V_{k|ij}$ is the relative volume of visits supplied in location k allowing for specialty i and age j. Substituting for a_{ijk} in equation 3 and rearranging yields

$$FTE = y_{ijk} / (V_i * V_{j|i} * V_{k|ij}) \quad (5)$$

Now, it is necessary to estimate the values of V_i, $V_{j|i}$ and $V_{k|ij}$. To do this, a survey of Indiana physicians by Delcher, Raykovich and Murray [4] was utilized. Table 3 shows the volume of visits supplied per day by specialty. Next, physicians were classified into nine categories according to their age. Because of the small sample size for their specialties, non-GP/FP's were excluded from the study of the Delcher-Raykovich-Murray data. Table 4 presents office patients/day by age from this data source. The age group assigned a relative value of one was 35-39.

Table 5 shows the volume of patient visits supplied per day by the location of the physician practice. Table 6 gives the volume of patient visits per day adjusted for age. The adjustment was computed using the Statistical Package for the Social Sciences procedure: Multiple classification analysis. Given two or more interrelated factors, this procedure computes the net differences in the response measure among the levels of one factor allowing for differences in the levels of the other factors. Using equation 5, an estimate of FTE was determined as 174.23 visits per week.

Volume of Visits in One Year: The supply of primary medical care in Indiana was expressed as the number of patients visits which the providers of primary care located in Indiana on January 1 of any year could supply in that year. This may be considered in two parts, that supplied by physicians

and that supplied by physician extenders. Using the same concepts as developed in the discussion of the full-time equivalent volume of visits:

$$SUPPLY_{PHYS}(t) = \sum_i \sum_j \sum_k PHYS_{ijk} * (FTE(t) * V_i * V_{j|i} * V_{k|ij}) * WPY_{ik} \quad (6)$$

where $PHYS_{ijk}$ is the number of physicians of specialty i, in the age group j with a practice location in region k; and WPY_{ijk} is the number of weeks worked per year by physicians of specialty i in region k. The number of visits supplied by physician extenders can be expressed as:

$$SUPPLY_{P.E.}(t) = \sum_i (\overline{SUPPLY_{PHYS,SPEC_i}}(t) * PIPE) * P.E._i(t) \quad (7)$$

where $\overline{SUPPLY_{PHYS,SPEC_1}}(t)$ is the average number of visits supplied by a physician in specialty i at time t; PIPE is the percent increase in patient visits due to one physician extender; and $P.E._i(t)$ is the number of physician extenders working with physicians of specialty i at time t. It follows from equation (6) that

$$\overline{SUPPLY_{PHYS,SPEC_i}}(t) = [\sum_j \sum_k PHYS_{ijk} * (FTE(t) * V_i * V_{j|i} * V_{k|ij}) * WPY_{ik}] / \sum_j \sum_k PHYS_{ijk} \quad (8)$$

Field studies reviewed in [12] show actual values of PIPE ranging from 0.10 to 0.35. PIPE was estimated as the mid-point of this range, 0.225.

Data were available for studying the number of weeks worked per year for the years 1970, 1972 and 1973 [14,15,16]. The calculated averages of these values are given in Table 7.

The data concerning the number of visits supplied was assumed to represent the volume of visits at a fixed point in time t_0. For this research, t_0 was set to 1971. As previously pointed out, it has been hypothesized that the number of visits provided by an individual physician is increasing with time. Estimates of the size of this increase have been expressed as a percentage increase in the number of visits per year,

$$FTE(t) = FTE(t_0) * (1+ALPHA)^{t-t_0} \quad (9)$$

where ALPHA is the percent annual increase in the number of visits supplied per year.

This completes the description of the model, equations and data concerning the ability to supply primary care visits to the population of Indiana.

POPULATION OF INDIANA, 1970-2000

For this research, it was desired to have population projections by age, sex and location within Indiana. The population projections made for Indiana by Marcus [8,11] considered these three factors. Age was divided into five year cohorts 0-4 through 70-74 and 75 and over. In addition, population was specified for each county. For this research, population was desired by the following five age groups: 1) 0-14; 2) 15-24; 3) 25-44;4) 45-64; and 5) 65 and over. Two sets of locations were considered, counties which are part of an SMSA and those that are not.

A computer program was written to aggregate the original population projections to those desired for this research. The population for years between the five projections points was calculated by linear interpolation between the appropriate two projection points.

DEMAND OF THE POPULATION FOR PRIMARY CARE VISITS

The unit of product which is demanded by the population (and supplied by the providers) is one patient visit. All primary care patient visits are grouped into a single indistinguishable category. Two types of demand of the population are of interest. The expressed demand is the volume of visits for which the population is willing and able to pay all monetary and non-monetary costs. The potential demand is the volume of visits which the population would demand if all costs associated with a visit were zero. In this research, changes in the volume of visits demanded is hypothesized in terms of an annual percentage growth. The one year demand of the population for physician visits is given by the following equations.

$$EXDMD(t) = \sum_i \sum_j \sum_k POP_{ijk}(t) * (EXDPP_{ijk}(t_0) * (1+BETA)^{t-t_0}) \quad (10)$$

$$TLDMD(t) = \sum_i \sum_j \sum_k POP_{ijk}(t) * (TLDPP_{ijk}(t_0) * (1+BETA)^{t-t_0}) \quad (11)$$

where EXDMD(t) is the expressed demand at time t; TLDMD(t) is the total demand at time t; $POP_{ijk}(t)$ is the population at time t in age group i, of sex j in practice location k; $EXDPP_{ijk}(t_0)$ is the per person expressed demand at time t_0 in age group of sex j in practice location k; $TLDPP_{ijk}(t_0)$ is the per person total demand at time t_0 in age group i, of sex j in practice location k; and BETA is the annual growth rate of demand.

The demand model developed by Dierckman [5] was selected as the model of primary health care demand in Indiana to be used in this research. Space limitations do not allow for a detailed description of the application of Dierckman's model to this research. Data from both the 1971 National Health Survey and the National Ambulatory Medical Care Survey were employed. The results of this modeling effort were the yearly potential and expressed primary care demand rates shown in Table 8.

BASELINE SCENARIO

In keeping with the future intention to evaluate policies affecting the primary health care system of Indiana†, a benchmark was needed for comparison purposes. This benchmark consisted of a baseline or no-change scenario. For this case, it was assumed that all provider training programs, that is, Indiana University Medical School, Indiana internships and residencies, and physician extender programs, would continue to admit the same number of students each year in the future as were admitted in 1976. In addition, it was assumed that the volume of visits supplied per physician and the volume of visits demanded per person would not vary with time. Finally, all parameters associated with the movement of providers were assumed to be invariant.

NUMBER OF DOCTORS

Table 9 shows the number of physicians in Indiana by specialty and region for the years 1971, 1980, 1990 and 2000. This table contains several interesting results. The number of primary care physicians in Indiana is projected to increase to 3771 in the year 2000 from 2600 in 1971 an increase of 45%. However, this increase is not seen in all specialties. The number of general and family practitioners was projected to decrease by 184. The other primary care specialties have increases in their numbers projected. The largest increase is in internal medicine. It was projected that the number of doctors in this specialty would increase by 534 between 1971 and 2000. It is interesting to note that the increase in primary care physicians does not occur uniformly over the 29 year time horizon. The total projected increase of 1171 doctors involves an increase of 368 between 1971 and 1980, 520 between 1980 and 1990 and 283 between 1990 and 2000. Similar information was obtained on physician extenders.

SUPPLY/DEMAND INFORMATION

Detailed information on the supply and demand for primary care visits is given by year and region in Table 10. Two quantities not previously described are introduced in this table. These are the expressed demand requirement factor and the total demand requirement factor. The expressed (total) demand requirement factor is the number of general or family practitioners in the 35-39 age group which could provide the additional number of visits needed to make the supply equal to the expressed (total) demand.

Several items can be noted from Table 10. For the metropolitan region, supply/expressed demand ratio increased from 0.846 in 1971 to 0.938 in 2000. Thus, in this region, 84.6% of the expressed demand was met in 1971 and 93.8% of this demand is projected to be met in 2000. At the same time the expressed demand requirement factor decreased from 202 in 1971 to 105 in 2000. It is interesting to note that this factor is increasing from 1990 to 2000 indicating that an increasing number of providers are needed to meet all the expressed demand for the visits. However, during the same time the ratio of people to doctors is decreasing. This observation shows the weakness of assuming that fewer people per doctor indicates a lessening need for additional providers.

Similar observations can be made for the non-metropolitan region. Overall, it appears that the primary health care situation in the non-metropolitan region will become worse between 1971 and 2000. The supply/expressed demand ratio decreases, the expressed demand requirement factor increased and the number of people per doctor increased. However, in 1971, it is estimated that 99.4% of the expressed demand is met and only 4 more full-time equivalent physicians would have been needed. This seems inconsistent with the generally held idea that there exists a significant shortage of supply in the non-metropolitan area. This result should be viewed in the following light. In the non-metropolitan region, the travel distance to the providers of care is an important factor. The expressed demand takes this travel distance into account. This is reflected in a supply/total demand ratio of 74.5% in 1971 since the total demand is not lessened to allow for travel distance. In addition, a significant part of the rural health care problem is the unavailability of non-primary care. The results of this research do not reflect these problems.

Observations like those made for each of the regions can be made for the entire state. The large difference between the expressed demand requirement factor and the total demand requirement factor should be noted. This indicates that if all costs of receiving primary care were reduced to zero, many more providers would be needed to meet the demand which would then be expressed.

TRENDS IN SUPPLY/DEMAND QUANTITIES

Plots were made to show the trends in various quantities of interest in each region. Figures 2 and 3 show the supply, the expressed demand, and the expressed demand requirement factor for the metropolitan and the non-metropolitan region respectively. In the metropolitan region, it appears that the supply gains on the expressed demand from 1974 through 1990. From that point on, the ratio of the two remains about the same and the difference between the two is increasing. This latter point explains why the requirement factor is increasing after 1990. In the non-metropolitan region, the ratio of the supply to the expressed demand varies over time, declining from 1971 to 1977, increasing through 1986 and declining thereafter. The requirement factor varies inversely but in the same pattern as the supply to expressed demand ratio.

CONCLUSIONS

A combined discrete/continuous simulation model of the primary health care system of Indiana has been presented. The purpose of this model was to make a baseline projection of the supply of and demand for primary health care in Indiana from 1971 through 2000. The significant results and conclusions from the effort are summarized below:

1. If the baseline or "no-change" case hold, the shortage of primary care supply in the

†Policies which have been evaluated to date but not included in this paper due to space limitations are: increased size of family and residency programs; decreased monetary cost of health care; and increased primary care demand rate.

metropolitan area will decline until 1990 and begins growing before 1995. In the non-metropolitan region, the shortage will grow steadily beginning between 1985 and 1990.

2. General and family physicians, their numbers declining beginning in the 1980's, will provide a smaller and smaller portion, less than half by the year 2000, of the primary care specialties, their numbers increasing, each provide a greater portion of the care than previously.
3. Physician extenders provide only a small portion of the primary care supply which in the year 2000 is the equivalent of44 full-time equivalent physicians.

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Table 1. Medical Doctors, Non-federal and Office-Based, 1970 and 1973.

Specialty	Doctors of Medicine[1,2] Metropolitan 1970	1973	Non-Metropolitan 1970	1973	Doctors of Osteopathy[3] Metropolitan 1970/1973	Non-Metropolitan 1970/1973	All Doctors Metropolitan 1970	1973	Non-Metropolitan 1970	1973
GP	901	762	609	515	67	61	968	829	670	576
FP	4	115	3	70	0	0	4	115	3	70
GS	229	245	120	126	3	0	232	248	120	126
IM	200	242	77	75	2	0	202	244	77	75
PED	98	120	35	42	2	0	100	122	35	42
OBGYN	140	157	47	52	1	1	141	158	48	53
TOTAL	1572	1641	891	880	75	62	1647	1716	953	942

Sources: [1]AMA Directory of Physicians, 1970 (1)
[2]AMA Directory of Physicians, 1973 (2)
[3]AOA Directory of Osteopathic Physicians, 1975 (20)

Table 2. Components of Change for Indiana Primary Care Physicians, 1970-1973.

Specialty	Region	1 Actual 1970	2 Actual 1973	3=2-1 Δ1970, 1973	4 New Interns	5 Retirements	6=4-5 Net Change	7=3-6 Net Migration	8=7/3 Net Migration/ Year
GP & FP	Metro	972	944	-28	15.4	61.2	-45.8	17.8	5.9
	Non-Metro	673	646	-27	10.7	53.3	-42.6	15.6	5.2
IM	Metro	202	244	42	45.5	6.4	39.1	2.9	0.97
	Non-Metro	77	75	-2	17.3	1.4	15.9	-17.9	-6.0
OBGYN	Metro	141	158	17	14.5	4.9	9.6	7.4	2.5
	Non-Metro	48	53	5	4.9	1.0	3.9	1.1	0.37
PED	Metro	100	122	22	12.4	2.9	9.5	12.5	4.2
	Non-Metro	35	42	7	4.4	0.3	4.1	2.9	0.97
GS	Metro	232	248	16	15.9	13.4	2.5	13.5	4.5
	Non-Metro	120	126	6	8.1	7.4	0.7	5.3	1.8
Total	Metro	1647	1716	69	103.7	88.8	14.9	54.1	18.0
	Non-Metro	953	942	-11	45.4	63.4	-18.0	7.00	2.3
TOTAL		2600	2658	58	149.1	152.2	- 3.1	61.1	20.3

Table 3. Primary Care Patient Visits Per Day, Solo Practitioners.

	GP/FP	IM	OBGYN	PEDS	SURG
Mean	39.51	20.95	27.34	36.51	18.73
Relative Mean (V_i)	1.000	0.530	0.692	0.924	0.477
No. of Cases	511	73	38	36	66

Source: Delcher-Raykovich-Murray (4)

Table 4. Primary Care Patient Visits Per Day by Age, Solo GP/FP.

Statistic	Age -34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Mean	39.68	48.84	46.26	43.47	39.51	43.03	34.18	29.17	24.84
Relative Mean ($V_{j\|i}$)	0.812	1.000	0.947	0.890	0.809	0.881	0.700	0.597	0.509
From Regression Equation	0.812	1.024	0.958	0.892	0.825	0.759	0.693	0.626	0.527
Std. Dev.	11.25	19.95	16.24	17.01	14.11	20.28	15.18	13.80	11.74
Std.Dev.Mean	2.58	2.85	2.15	1.99	1.60	2.48	1.74	2.13	1.91
No. of Cases	19	49	47	81	78	67	76	42	38

Source: Delcher-Raykovich-Murray (4)

Table 5. Primary Care Patient Visits Per Day by Practice Location, Solo Practitioners.

Specialties	Statistic	Patients/Day Metro	Patients/Day Non-Metro	Relative Patients/Day Metro	Relative Patients/Day Non-Metro
GP/FP	Mean	38.37	42.43	1.00	1.11
	No. of Cases	237	151		
All	Mean	33.22	37.97	1.00	1.14
	No. of Case.	356	204		
Non GP/FP	Mean	22.50	26.03	1.00	1.16
	No. of Cases	119	53		

Source: Delcher-Raykovich-Murray (4)

Table 6. Primary Care Patient Visits Per Day by Practice Location Adjusted for Physician Age, Solo Practitioners.

Specialties	Statistic	Patients/Day Metro	Patients/Day Non-Metro	Relative Patients/Day Metro	Relative Patients/Day Non-Metro
GP/FP($V_{k\|ji}$)	Mean	38.53	42.18	1.00	1.09
All	Mean	33.63	37.23	1.00	1.11
Non GP/FP($V_{k\|ji}$)	Mean	22.25	26.79	1.00	1.20

Source: Delcher-Raykovich-Murray (4)

Table 7. Average Weeks Per Year by Specialty and Practice Location

Location	SPECIALTY GP/FP	IM	GS	OBGYN	PED
Metro	47.7	47.2	47.0	47.7	47.7
Non-Metro	47.8	47.0	46.8	47.5	48.8

Source: Reference Data on the Profile of Medical Practice, 1973, 1974, 1976-76 (14,15,16)

Table 8. Potential and Expressed Primary Care Demand by Age, Sex and Location.

Demand Type	Location	Sex	AGE 0-14	15-24	25-44	45-64	65+
Potential	SMSA	Male	3.2	2.4	2.8	4.3	6.1
Expected			2.6	2.0	2.3	3.5	5.0
Potential		Female	3.2	4.6	5.7	6.1	7.0
Expected			2.6	3.8	4.7	5.0	5.8
Potential	Non-SMSA	Male	3.9	2.5	2.5	4.1	5.8
Expected			2.9	1.9	1.9	3.1	4.4
Potential		Female	3.5	4.7	4.7	5.4	7.8
Expected			2.6	3.5	3.5	4.1	5.8

Table 9. Number of Primary Care Physicians in Indiana by Specialty and Region.

	1971	1980	1990	2000
Metro Region				
Gen & Fam	972	930	919	847
Gen Sur	232	290	364	404
Int Med	202	360	541	706
OBGYN	141	203	273	313
PEDS	100	189	297	372
TOTAL	1647	1972	2394	2643
Non-Metro Region				
Gen & Fam	673	637	647	614
Gen Sur	120	147	175	194
Int Med	77	84	93	107
OBGYN	48	65	83	97
PEDS	35	63	96	116
TOTAL	953	996	1093	1128
State of Indiana				
Gen & Fam	1645	1568	1566	1461
Gen Sur	352	437	539	599
Int Med	279	444	634	813
OBGYN	189	267	356	409
PEDS	135	252	393	489
TOTAL	2600	2968	3488	3771

Table 10. Supply/Demand Information

Metro Region	Supply/ Exp.Demand	Supply/ Ttl.Demand	People/ Doctor	Expressed Req Factor	Total Req Factor
1971	0.846	0.695	1960	202	489
1975	0.848	0.697	1880	204	498
1980	0.887	0.729	1733	159	465
1985	0.929	0.762	1619	106	428
1990	0.945	0.776	1555	85	423
1995	0.946	0.776	1533	88	441
2000	0.938	0.770	1523	105	473
Non-Metro Region					
1971	0.994	0.745	2095	4	232
1975	0.942	0.806	2184	41	276
1980	0.937	0.702	2167	47	293
1985	0.943	0.707	2140	44	302
1990	0.932	0.698	2161	55	326
1995	0.914	0.685	2207	73	354
2000	0.890	0.668	2268	96	399
State of Indiana					
1971	0.900	0.714	2010	206	721
1975	0.882	0.700	1987	245	774
1980	0.905	0.719	1879	205	758
1985	0.934	0.741	1787	150	730
1990	0.940	0.746	1745	140	749
1995	0.934	0.741	1739	161	794
2000	0.921	0.731	1746	201	861

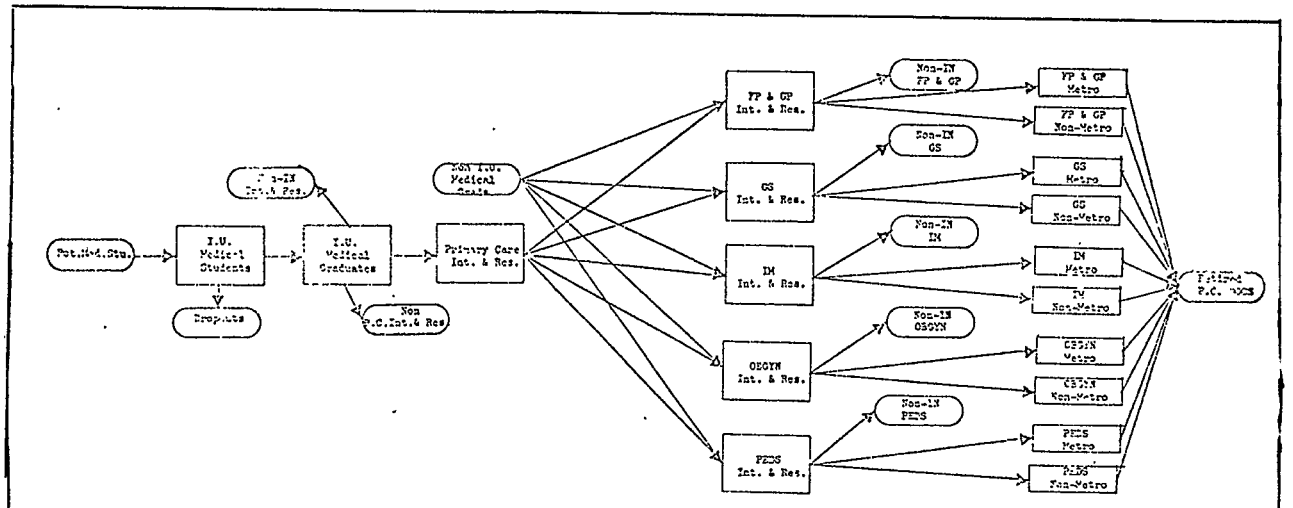

Figure 1. Movement of Primary Care Physicians in Indiana.

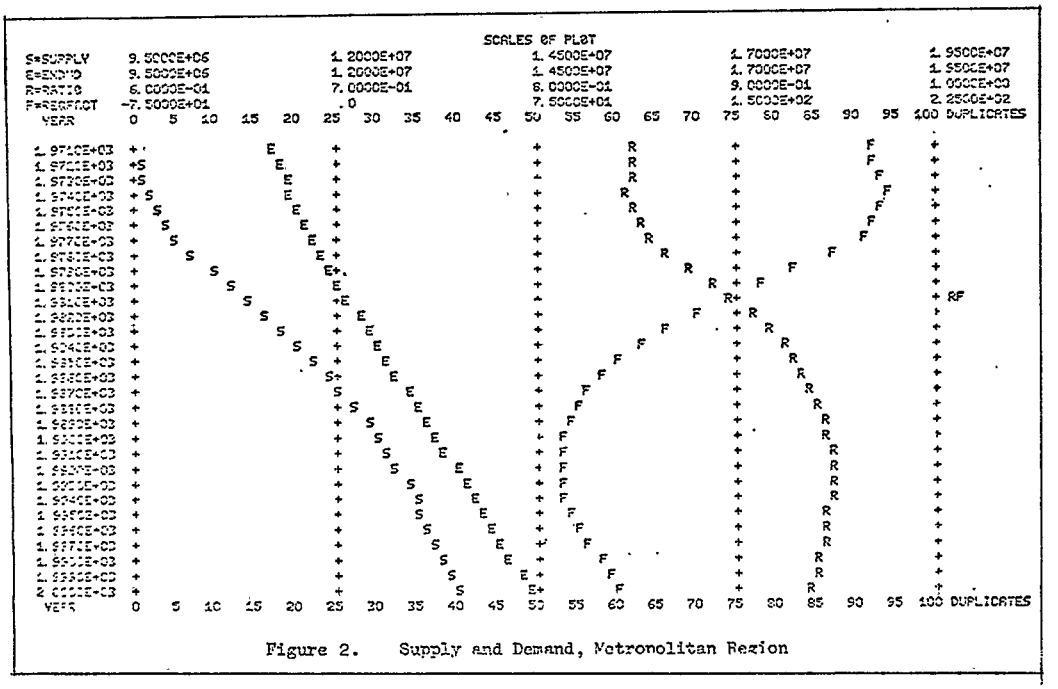

Figure 2. Supply and Demand, Metropolitan Region

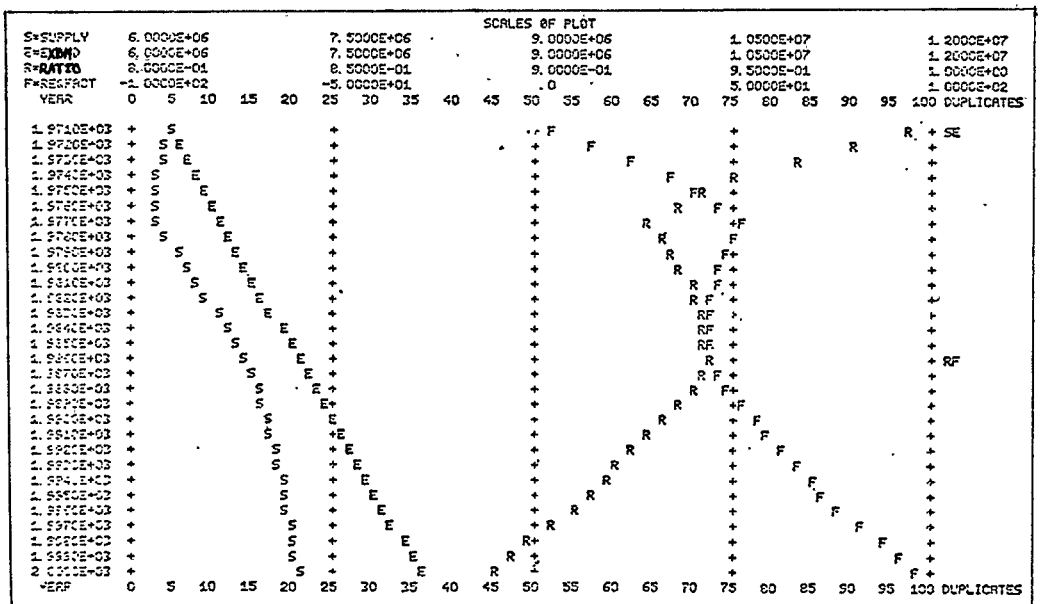

Figure 3. Supply and Demand, Non-Metropolitan Region