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PHARMACISTS AND PHYSICIANS: THE ISSUE OF ACCESS

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ABSTRACT

This paper presents a causal model for the distribution of pharmacists which asserts, contrary to common assumption, that lower status groups have less access to pharmacists than to physicians. Data for the distribution of pharmacists in Chicago in 1960 are shown to support the model. At the end of the paper, an equation expressing pharmacists' dependence on physicians for their livelihoods is presented which accounts for the success of the causal model. It is argued that the equation is quite general and at once both describes the social organization of a large part of the health care delivery system and provides insight as to its spatial arrangements within the city.

I. INTRODUCTION

Since Koos' report (1954) that the poor substitute pharmacists' advice for physicians' services, it has generally been accepted that pharmacists constitute a significant source of alternative medical care for lower status groups. Presumably, there are two kinds of reasons for this belief. First, it is generally accepted that a pharmacist's advice is both less costly and more accessible than a private physician's (Koos, 1954). Second, willingness to define oneself as requiring medical attention decreases and skepticism as to the value of care increases as social status decreases (Suchman, 1965); consequently, as social status declines, there is probably greater indifference as to where advice should be sought.

Yet, it is quite possible that the very factors that lead the poor to seek the advice of pharmacists may lead to pharmacists being less available to them. First, pharmacists depend on physicians' prescriptions for their livelihoods. Lower status populations use physicians less frequently than higher status groups and consequently, other things equal, generate less business for pharmacists. Second, even when low status populations do see physicians, they are probably less able to afford the prescribed medicine and less likely to make repeated purchases.[1] Third, the inability and/or unwillingness of low status individuals to define themselves as ill and skepticism as to the value of care probably lowers utilization of physicians and, concomitantly, utilization of pharmacists. Taken together, these three points imply that the ability of a population in an area to sustain a pharmacist economically varies directly with its socioeconomic status.

The importance of these alternative views lies less in whether low status groups can consult pharmacists in lieu of physicians than in whether, as now assumed, pharmacists are more accessible to those of lower status than physicians. A number of studies of the distribution of physicians within cities have documented the fact that those with low SES have less access (Chicago Board of Health, 1966; Elesh and Schollaert, 1972; Hambleton, 1970; Roemer, 1966; Terris and Monk, 1956). If those with low status also have less access to pharmacists, then this fact can be interpreted as yet another indication of the ways in which the health care delivery system fails to respond to their needs.

The purpose of this paper is to examine the relative access of various status groups to pharmacists within a city as reflected in the spatial distribution of the latter. It sets forth a model of the demand for and constraints on the supply of pharmacists within which the effect of a market area's status composition net of other areal characteristics can be observed. The distribution of physicians is also examined in order to assess the question of access to pharmacists relative to physicians.

The demand-supply model used here is an extension of one initially developed for the prediction of the distribution of physicians (Elesh and Schollaert, 1972). Pharmacists' locations are taken to be indirectly and directly influenced by the factors which affect the distribution of physicians inasmuch as the former depend upon the latter for their livelihoods. Fifty-one percent of the total sales volume of drugstores is attributable to health products; and of that 51 percent total, 27 percent is directly caused by physicians' perscriptions with a substantial, although unknown, proportion of the remaining 24 percent is undoubtedly due to physicians' advice (American Druggist, 1960a; 1960b).[2] As physicians probably are aware that 70 percent of all pharmacists will charge more than the regular retail price for an item not requiring a prescription if it is prescribed, many probably suggest rather than prescribe the purchase of such items (American Druggist, 1960c). To be sure, to the extent that pharmacists earn their incomes from the sale of nonpharmaceuticals, other locational factors may become involved. However, it seems unlikely that even the so called supermarket drugstore would make higher profits in a low, rather than in a high status, area. There is little that a drugstore might sell that would combine both a sufficiently high profit and differential appeal to low status groups so as to make a store in a low status area more profitable than a comparable store in a high income area. High status consumers are likely to purchase most of a store's products at a higher rate and in greater quantities than low status consumers.

For these reasons, the distribution of pharmacists is here taken to be causally contingent on the distribution of physicians and the factors which affect the distribution of the latter. In other words, these factors both directly and indirectly (through their effects on the distribution of physicians) influence the distribution of pharmacists.

II. THEORETICAL FRAMEWORK

1. Factors Affecting Demand for Physicians' Services and Pharmacists' Products

Ability to pay. That ability to pay should affect the demand for physicians' services seems intuitively reasonable and is documented by National Health Survey data which show that use of physicians increases with income (U.S. National Center for Health Statistics, 1965: Table 7). Accordingly, physicians can be expected to locate in high income areas, although such locations should be more important for specialists as they are used most heavily by high income populations (USNCHS , 1964: Table 5). Not only are high income populations better able to afford the additional cost of specialists, but they also are more likely to use them as their primary physicians (USNCHS, 1968: Table 18).

Correspondingly, ability to pay carries over to the purchase of pharmaceuticals. National Health Survey data indicates a direct relationship between family income and expenditures for medicine (USNCHS, 1967: Table J). Thus pharmacists should locate among high income populations.

Cultural predisposition. Cultural predispositions have been long cited to explain use of physicians in particular and health knowledge, attitudes, and behavior in general. Theoretically, the concept has generally referred to the extent to which a person's culture defines health as susceptible to scientific control, but operationally its meaning is less clear. For some, it has referred to cultural differences between social classes (e.g., Koos, 1954); for others it has meant differences in ethnicity (Saunders, 1954; Paul, 1955; Zborowski, 1956; Croog, 1961; Suchman, 1964), ethnic parochialism (Suchman, 1964; 1965), religion (King, 1962), or education (Feldman, 1966).

But there is growing evidence that education can explain most, though not all, of the differences attributed to the other measures of cultural predisposition. Suchman (1965) found that the relationships between a measure of ethnic variations in health orientations and several health behaviors, including use of physicians, disappeared when an index of socioeconomic status based on education was controlled. Feldman (1966:109) and Samora, et al., (1962) found that when education is controlled, most of the differences in health knowledge due to income or occupation disappear; but when occupation or income is controlled, the differences by education remain.

The sometimes forgotten point of these findings is that formal education creates a common culture, one which places a high value on medical care.

Thus physicians' response to demand created by cultural predispositions is probably mostly engendered by education, and it can be expected that, other things equal, the higher the educational level of an area, the greater the number of physicians serving it. Moreover, since use of specialists implies greater sophistication and knowledge about medical care, specialists can be expected to locate more responsively to a population's educational level than general practitioners.

Pharmacists should also respond to the demand created by a population's educational level inasmuch as family expenditures for medicine are related to education (USNCHS, 1967: Table J). It follows that they should be attracted to highly educated populations.

Need. However else individuals may vary in terms of need for medical care, all find their need for it increases with age. As they age, their health is less likely to be protected by others, their resilience lessens, and their defenses decline; they need increasing care, and they use it increasingly (USNCHS, 1966). Since these facts are learned by physicians in their training and observe them in their practices, they can be expected to influence where practices will be established. While there are doubtless other dimensions of need which affect physicians' locations, none is so visible or so universal.

The impact of age on expenditures for medicine is particularly notable, the average annual expense for those over 64 years of age being more than double that for those under 45 (USNCHS, 1967: Table H). Consequently, pharmacists should be strongly attracted to needy populations as measured by age.

Population size. Other things equal, the number of physicians and pharmacists a fixed area will be able to support will increase with the size of its population. The above three demand factors describe how, given populations of equal size, physicians and pharmacists will distribute themselves with regard to population composition. However, as populations increase in size, the absolute magnitudes of the demand factors also increase; consequently more physicians and pharmacists can be supported.

2. Factors Affecting the Supply of Physicians and Pharmacists

Availability of office space. Although it is a factor so obvious as to be neglected, the relative availability of suitable office space across a city will affect where physicians locate. Other things equal, some areas, by virtue of their devotion to residential or industrial uses, will lack physicians, while other areas, with large commercial sections, will have them in heavy concentrations. Commercial sections offer the physician space and the kind of traffic helpful in establishing and maintaining a successful practice.

The effect of the availability of commercial space on pharmacists is probably largely indirect, operative through its influence on physicians, except for the few pharmacists in professional pharmacies within medical buildings.

Availability of hospital services. There are two opposing arguments for the effect of hospitals on physicians' locations. The first asserts that the supportive facilities of hospitals attract physicians; the second says that the outpatient clinics and emergency rooms of hospitals compete with private physicians, causing them to locate at distance. The first argument follows from the fact that most physicians require the use of hospital facilities, and many spend a substantial fraction of their working hours within them. Consequently, to the extent that physicians depend upon hospitals, it can be expected that they will locate close to them so as to reduce unproductive travel time. In gross terms, this means that specialists are more likely to locate near hospitals than are general practitioners, since the former's dependence upon them is typically greater. Indeed, some spend almost all their working time there, obtaining patients through referrals from physicians throughout the city.

In contrast, the second argument derives from the assertion that physicians cannot compete with the free and low cost outpatient hospital services. However, there is little to support this position. While it is true that use of outpatient facilities increases as income decreases, it cannot be argued, as is sometimes done, that low income people prefer clinics. Indeed, the data support the opposite conclusion: people prefer private physicians and will use them to the extent they can afford them. For example, Kosa (cited in Roth, 1969:221) found that the percentage of clinic patients with repeat visits varies inversely with income. Similarly, USNCHS data show that use of clinics decreases as income increases (USNCHS, 1965: Table B). And some part of the hospital usage among low income blacks is also caused by the referrals of black general practitioners who fear competition from black specialists (Reitzes, 1958).

Hospitals affect the distribution of pharmacists both directly and indirectly. The direct effect lies in the fact that they are a significant employer of the profession. Indirectly, they attract pharmacists by attracting physicians.

Accessibility to supporting population base. Other things equal, all physicians require a population base of some minimum size to support their practices. But a general practitioner, who sees the widest range of complaints, needs a far smaller population base than a specialist, who sees fewer complaints and those which are relatively rare in the population. Since the area of a city most accessible to the largest population is usually its central business district (CBD), specialists can be expected to locate there (Terris and Monk, 1956). Moreover, pharmacists, induced by a large commercial traffic and the proximity of a large number of physicians, should be highly attracted to the district.

The effect of race. Physicians' attitudes toward black patients appear never to have been systematically studied, but few would doubt the existence of considerable prejudice. This feeling is bolstered by studies of physicians' attitudes toward the poor. Fredericks, et al., (1969) found that over 40 percent of a random sample of U.S. physicians surveyed by mail thought that "a dissolute way of life is the cause of many diseases among the poor." Roth (1969:226-28) summarized his studies of physicians' attitudes toward the poor by saying that they thought them dirty, smelly, unreliable with respect to directions and appointments, observing poor health practices, and generally living in unhealthy conditions. Fredericks, et al., (1969) reported that less than 20 percent of their sample though that every physician should serve two years in a poor area before "settling down." Clearly, the general implication is that a practice among the poor is to be avoided. If racial prejudice is added to these views, physicians' reactions can be expected to become even more intense. Consequently, we expect physicians to avoid black areas, other things being equal.

Whether pharmacists share the feelings of physicians is less clear, and given the relative impersonality of the buyer-seller relationship, it would probably require fairly extreme prejudice to cause a pharmacist to actively avoid black areas on these grounds. If pharmacists are less likely to be found in black areas, it is more likely due to their propensity to locate near physicians.

In summary, the discussion above outlines both a predictive model for the distribution of pharmacists which includes all of the above variables and a two equation causal model in which the physician and pharmacist variables are endogenous and the remaining eight variables are exogenous. The first, for physicians, contains only the exogenous variables as independent variables. The second, for pharmacists, includes a physician variable in addition to the exogenous variables. Because some of the exogenous factors are expected to operate differently on general practitioners than on specialists, separate specifications of the model will be examined.

III. THE DATA

The models will be examined in terms of the spatial distribution of pharmacists and physicians in Chicago in 1960. The basic areal unit or market area for physicians and pharmacists in the analysis is the census tract.[3] The data for tracts are the most comprehensive available for subareas of cities, and the measures of the population factors are drawn from the published tract statistics (U.S. Bureau of the Census, 1962).[4] The measure of market area income will be the percent of tract families with $10,000 or more annual income.[5] The measure of market area education will be the percent of the tract's population, 25 years old or older, with at least a high school education.[6] The age of the population will be represented by the percent 25 years old or older. Studies of the location of health services have generally measured the age of an area's population in terms the percent of the population under five and over 65 years of age, since these two groups have the highest rates of utilization (USNCHS, 1966). However, because the latter variable makes the interpretation of results in terms of areal age structure problematic and because, above the age of five, rates of utilization increase with age, the former variable was thought to be preferable. A tract is coded black if at least 90 percent of its population is black; otherwise it is coded white.[7] Market area population is given a tract population.

Data on the location of hospitals were obtained from the directory of the American Hospital Association (1960).[8] The availability of accessible office space is indexed by the percent of a tract's area devoted to commercial use as computed from the Chicago Land Use Map (Chicago Plan Commission, 1961). The Chicago CBD consists of the tracts comprising Chicago's Loop area (Kitagawa and Taeuber, 1963).

Information on physicians and their office locations was drawn from the Directory of the American Medical Association (1961). Data were gathered on all physicians in Chicago who were in private practice and under the age of 71. Thus physicians employed full-time by governmental agencies, hospitals, educational institutions, and private companies are eliminated. Few among the latter make relevant locational decisions that significantly affect the delivery of direct, public medical care. By arbitrarily retiring physicians after the age 70, the analysis is limited to those in full-time practice. These restrictions reduced the population of physicians from 6735 to 4208, and all further references are to this smaller figure.

Because the nature of medical practice differes for general practitioners and specialists, their distributions will be examined separately as well as jointly. General practitioners will be defined as all those who define themselves as general practitioners plus those who call themselves internists, obstetrician-gynecologists, and pediatricians.[9] Although the latter three types of physicians seek identification as specialists, the decline in the number of general practitioners, the increasing restrictions placed upon their use of hospitals, and the growing patient preference for the expertise indicated by specialization increasingly have required these specialists to take on the functions of general practitioners. All other specialists are classified as specialists. In terms of this classification, 2451 physicians were general practitioners and 1757 were specialists in 1960. All the physicians' distributions across census tracts are skewed to the right; consequently they are analyzed in log form.[10]

Finally, data on the business locations of pharmacists were drawn from the Directory of Pharmacists (American Pharmaceutical Association, 1964) and record the population of pharmacists in 1963. While this does make a small difference in the dates of data collection, it is unavoidable as there is no earlier listing of pharmacists. Of greater importance is the fact that the data on pharmacists is neither as detailed nor of such high quality as the data for physicians. The available information gives only the addresses of pharmacists then currently registered with the Illinois Board of Pharmacy, and a small albeit unknown,[11] proportion of these addresses are home rather than business locations. According to the Illinois Board of Pharmacy, the pharmacists who supply only their home addresses are largely employed by the large chain drugstores.[12] Since pharmacists are unlikely to live in low status areas, this problem creates a bias in favor of the hypothesized relationships between the distribution of pharmacists and the distribution of higher socioeconomic status groups. However, there is some evidence that the bias does not significantly affect the results. First, the distribution of chain stores is skewed toward the higher status areas: they are about 10 percent more likely to be in areas above the median income. Thus assignment of pharmacists who gave their home addresses to their places of employment would be unlikely to lead to different results. Second, to anticipate the results a bit, there is no difference between black and white areas in terms of their numbers of pharmacists when supply and demand factors are controlled (in fact, the partial regression coefficient for race is positive). It seems reasonable to suppose that were that bias substantial a substantial negative coefficient should have been found. However, the quality of the data suggest that some caution should be exercised in drawing conclusion from the results below. It is important to bear in mind that the data refer to pharmacists, not their places of employment. Thus if a pharmacy employs three pharmacists, it has a "score" of three. In this way, the analysis controls for the volumen of pharmacies as the enumeration of physicians controls for the volume of physicians' offices; to analyze only the locations of stores or offices is to seriously underestimate access. The total number of pharmacists is 2707.

Having defined the variables, it is now possible to state formally the structural equations for the causal model:

$$D_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + u_1$$

$$(1) \quad P = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 D_1 + u_2$$

where X_1 = Tract population

X_2 = Pct. commercial area

X_3 = No. of hospitals

X_4 = CBD

X_5 = Pct. 25 years or older

X_6 = Pct. H.S. grad. plus

X_7 = Pct. $10,000 plus

X_8 = Black

D_1 = Log of all physicians (+1)

P = Log of pharmacists (+1)

Two other, analogous, systems of equations can be defined which substitute, respectively, general practitioners and specialists for the all physician variable. Note that the second equation of (1) is the aforementioned predictive model; of course, it also has two other forms in which the alternative physician variables are represented.

No significance tests for the results reported below are presented as the data for almost all variables exhaust the population, and the interpretation of statistical significance is unclear under such conditions.

IV. RESULTS

Table 1 gives the correlations among the variables. The first row of the table contains the relationships with the pharmacist variable and they are all consistent with those hypothesized. Columns 10 through 12 give the

Table 1

Zero-Order Correlations for Elements of Pharmacists' Models, Chicago 1960[a]

	(2)[b]	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Pharmacists[c]	.515	.044	.166	.041	.448	.594	.511	-.159	.564	.547	.463
2. Population (in 000s)		-.026	.088	-.092	.026	.203	.153	-.022	.383	.392	.249
3. Pct. Commercial Area			.033	.325	.139	-.096	-.204	.050	.224	.228	.177
4. No. of Hospitals				.025	.095	.155	.047	-.065	.203	.164	.217
5. CBD					.212	.138	-.017	-.036	.205	.172	.293
6. Pct. 25 yrs. old or older						.512	.470	.026	.401	.367	.378
7. Pct. H. S. Grad. Plus							.693	-.205	.415	.378	.407
8. Pct. $10,000 Plus								-.315	.339	.306	.327
9. Black									-.169	-.165	-.133
10. All Physicians										.951	.836
11. General Practitioners											.673
12. Specialists											

[a]N = 792. The 935 Chicago census tracts were combined into 809 comparable from 1940-60; the 17 non-CBD tracts with populations under 200 were eliminated. They represented non-residential and non-commercial land uses and lacked data on social variables.

[b]Numbers refer to variables listed in the row stubs.

[c]All physician and pharmacist variables are normalized by taking $\log_e (X+1)$ as some tracts were without pharmacists or physicians.

correlations with the physician variables and they are, as expected, quite substantial, ranging in value from .463 to .564. It seems clear that physicians' locations are an important predictor of pharmacists'.

But they are not the most important factor. Column 7 reveals a higher correlation (.594) between a tract's educational level and the pharmacist variable, making education the most powerful predictor. Moreover, the correlations of tract income and population with the pharmacist variable--being .511 and .515, respectively--are quite comparable to those involving the physician variables. Thus two conclusions are warranted: (1) the distribution of pharmacists is more highly correlated on the distribution of high status groups than on the distribution of physicians; (2) the substantial size of the relationships between the status and pharmacists' distributions suggests, contrary to Koos' assumption, that lower status groups have considerably less access to pharmacists than the higher status groups.

Table 1 also provides evidence on the question of whether lower status groups have greater access to pharmacists than to physicians and thus on the extent to which they can substitute pharmacists' for physicians' services. A measure of the relative access can be obtained by subtracting the correlations of the status variables with the physician variables from the correlations of these same variables with the pharmacists variable. A positive difference indicates that the status group in question has more access to physicians than to pharmacists. The three measures of areal socioeconomic status are the education, income, and race variables, and the differences between the correlations for these variables are summarized in Table 2. Except for the race variable for which the results are close to zero and of inconsistent sign, the differences are all positive and substantial. Thus, relatively speaking,

Table 2

Difference in Correlations of Status Variables with Pharmacist and Physician Variables (Pharmacist-Physician Correlations)

Chicago, 1960

	Pct. H. S. Grad. Plus	Pct. $10,000 Plus	Black
All Physicians	.179	.181	-.011
General Practitioners	.216	.214	-.007
Specialists	.187	.193	.025

[a]Physician and pharmacist variables are normalized by taking $\log_e (X+1)$ as some tracts are without pharmacists or physicians.

it would appear, contrary to Koos' assumption, that people in low status areas have more access to physicians than they do to pharmacists.

However, these results are crude in that they do not control for constraints on supply or relative demand. Consequently, it is necessary to estimate the effects of the status variables net of these factors. The first step is to estimate a model for the distribution of pharmacists. Subsequently, a similar model will be used to estimate the distribution of physicians in order that the net effects of the status variables can be compared to assess the relative access of the low status groups to physicians and pharmacists.

Table 3 gives the results for the model for pharmacists. Column 1 displays the results for an equation which includes the all physician variable as a predictor. The model accounts for 60 percent of the variance of the distribution of pharmacists. Since Table 1 indicates that, alone, the all physician variable explains 32 percent of that amount, the other eight variables must account for the remaining 28 percent. Examination of the standardized coefficients reveals that areal education continues to be a more important predictor of pharmacists than physicians' locations, and areal income also has an important, although somewhat smaller, effect.

Somewhat surprising are the negative CBD and positive race coefficients. Despite the fact that the CBD enjoys enormous commercial traffic and the presence of 25 percent of all private physicians, it appears that pharmacists are far more decentralized than physicians--albeit to high status areas. And while race is negatively related to the distribution of pharmacists at the zero-order level, it has a positive (although unstable) effect where the remaining eight factors are controlled.

Columns 2 and 3 present comparable equations with general practitioners and specialists as predictor variables, respectively, and the results are

Table 3

Summary of Analyses for Predictive Model for Pharmacists' Distribution

Chicago, 1960[a]

	(1)	(2)	(3)
	A. Coefficients in Raw Form		
Constant	-1.496 (.151)[b]	-1.278 (.151)	-1.342 (.153)
Population (in 000s)	.102 (.006)	.086 (.004)	.096 (.006)
Pct. Commercial Area	.015 (.004)	.008 (.004)	.012 (.004)
No. of Hospitals	.163 (.069)	.117 (.068)	.105 (.070)
CBD	-.335 (.259)	-.483 (.253)	-.631 (.263)
Pct. 25 yrs. old or older	.019 (.003)	.016 (.003)	.017 (.003)
Pct. H.S. Grad. Plus	.019 (.002)	.017 (.002)	.017 (.002)
Pct. $10,000 Plus	.013 (.003)	.011 (.002)	.011 (.003)
Black	.076 (.064)	.098 (.062)	.072 (.063)
All Physicians	.181 (.026)		
General Practitioners		.196 (.028)	
Specialists			.157 (.033)

Table 3 (Continued)

	(1)	(2)	(3)
	B. Coefficients in Standard Form		
Population (in 000s)	.350	.350	.390
Pct. Commercial Area	.057	.056	.081
No. of Hospitals	.032	.040	.036
CBD	-.055	-.048	-.062
Pct. 25 yrs. old or older	.162	.166	.179
Pct. H. S. Grad. Plus	.269	.271	.278
Pct. $10,000 Plus	.149	.154	.155
Black	.036	.039	.030
All Physicians	.202		
General Practitioners		.195	
Specialists			.134
$\bar{R}^2$ [c] =	.597	.597	.585
N =	792	792	792

[a]The physician and pharmacist variables are normalized by taking $\log_e(X+1)$ as some tracts are without pharmacists or physicians.

[b]Standard errors are given in parentheses.

[c]R^2 corrected for degrees of freedom.

quite consistent with those previously mentioned. Comparison of the raw coefficients across the columns reveals few differences. The specialist variable has somewhat less predictive power than the other physician variables, but this is probably an artifact of the greater areal concentration of specialists (Elesh and Schollaert, 1972).

To this point, it has generally been assumed that the effects of the eight variables other than the physician variables operate largely through them, although, of course, inasmuch as these variables are part of the model, their direct effects are measured. But it seems useful to assess their impact on the pharmacists' distribution without considering the location of physicians. In this assessment, the CBD and race variables will be omitted. The CBD variable is unstable in the first equation and merely indicates that pharmacists are decentralized;[13] the race variable is unstable in all three equations. The results for a model containing the remaining six variables are given in Table 4.

Several statements can be made from these data. First, the omission of the three variables appears to have left the raw coefficients of the status variables essentially unchanged from those in Table 3; thus these effects seem to be largely independent of the omitted variables. Second, comparison of the coefficients of determination for the six and nine variable models indicates that the smaller one explains only about two percent less variance than any one of the larger. Quite clearly, one or more of the extra three variables account for much of the same variance as the initial six. Third, since the standardized coefficients for the CBD and race variables in Table 3 indicate that neither contributes meaningfully to the explained variance, it is evidently the explanatory power of the physician variables which overlap with the other six.

Table 4

Revised Predictive Model for Pharmacists' Distribution without Physician Variables

Chicago, 1960[a]

	Raw Coefficients	Standardized Coefficients
Constant	-1.433 (.146)[b]	-
Population (in 000s)	.103 (.006)	.419
Pct. Commercial Area	.015 (.004)	.094
No. of Hospitals	.156 (.070)	.053
Pct. 25 yrs. old or older	.018 (.003)	.185
Pct. H. S. Grad. Plus	.018 (.002)	.291
Pct. $10,000 Plus	.012 (.003)	.173
$\bar{R}^2$ =	.575	
N =	792	

[a]The pharmacist variable is normalized by taking $\log_e (X+1)$ as some tracts are without pharmacists.

[b]Standard errors given in parentheses.

[c]R^2 corrected for degrees of freedom.

Given that the six variables are viewed as causally prior to physicians locations which are, in turn, prior to the pharmacist variable, this overlap is an indication of the extent to which the effects of the six tract characteristics flow through the physician variables to the pharmacist variable. However, further consideration of these indirect effects will be deferred until after the estimation of the direct effects of the model.

Inasmuch as the CBD and race variables have been deleted from the second equation of (1), the structural equations now become

$$D_1 = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + u_1$$

$$(2) \quad P = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_9D_1 + u_2$$

following the notation of equations (1). Table 5 gives the estimates for these equations.

The first three columns of the table present the coefficients for the first equation of (2), differentiated by the three types of physicians being predicted. As noted above, this equation is discussed in detail elsewhere (Elesh and Schollaert, 1972); consequently, only some general statements will be made here. First, there is a clear distinction between general practitioners and specialists in terms of the factors which account for their locations. General practitioners are far more attracted to population concentrations and the availability of local office space; specialists are far more drawn to the CBD and to hospitals. At the same time, and contrary to the initial assumptions, there are few differences in terms of the effects of population composition.

In contrast, there is, as in Table 3, relatively little to differentiate the three equations for pharmacists in columns 4 to 6. The major difference is, once again, that the dispersed locations of general practitioners provide a better predictor of pharmacists' locations than the more concetrated distribution of specialists.

Table 5

Summary of Analyses for Revised Causal Model for Pharmacists' Distribution

Chicago, 1960[a]

	All Physicians (1)	General Practi-tioners (2)	Spe-cialists (3)	Pharmacists with all Physicians (4)	Pharm. with General Practitioners (5)	Pharmacists with Specialists (6)
			A. Coefficients in Raw Form			
Constant	-1.270 (.201)[b]	-1.715 (.185)	-1.165 (.006)	-1.185 (.147)	-1.191 (.147)	-1.279 (.149)
Population (in 000s)	.092 (.008)	.085 (.007)	.042 (.006)	.086 (.006)	.086 (.006)	.096 (.004)
Pct. Commercial Area	.035 (.005)	.034 (.005)	.017 (.005)	.009 (.004)	.008 (.004)	.013 (.004)
No. of Hospitals	.383 (.092)	.232 (.085)	.366 (.074)	.082 (.069)	.104 (.068)	.098 (.070)
CBD	1.218 (.343)	758 (.316)	1.881 (.278)			
Pct. 25 yrs. or older	.020 (.004)	.016 (.003)	.012 (.003)	.014 (.003)	.015 (.003)	.016 (.003)
Pct. H. S. Grad. Plus	.008 (.003)	.008 (.003)	.008 (.002)	.017 (.002)	.017 (.002)	.017 (.002)
Pct. $10,000 Plus	.010 (.003)	.007 (.003)	.009 (.003)	.010 (.002)	.011 (.002)	.011 (.002)
Black	-.082 (.084)	-.111 (.077)	-.024 (.068)			

Table 5 (Continued)

	All Physicians (1)	General Practi-tioners (2)	Spe-cialists (3)	Pharmacists with all Physicians (4)	Pharmacists with General Practitioners (5)	Pharmacists with Specialists (6)
All Physicians				.176 (.027)		
General Practitioners					.191 (.029)	
Specialists						.149 (.034)
				B. Coefficients in Standard Form		
Population (in 000s)	.334	.349	.203	.352	.351	.392
Pct. Commercial Area	.270	.224	.130	.054	.052	.078
No. of Hospitals	.117	.080	.146	.028	.036	.033
CBD	.107	.075	.217			
Pct. 25 yrs. or older	.186	.170	.154	.145	.149	.164
Pct. H. S. Grad Plus	.142	.137	.144	.270	.271	.277
Pct. $10,000 Plus	.131	.105	.151	.145	.150	.154
Black	-.029	-.045	-.011			
All Physicians				.190		
General Practitioners					.185	
Specialists						.119

Table 5 (Continued)

	All Physicians (1)	General Practitioners (2)	Specialists (3)	Pharmacists with all Physicians (4)	Pharmacists with General Practitioners (5)	Pharmacists with Specialists (6)
$\bar{R}^{2}$ [c] =	.397	.360	.326	.597	.597	.585
N =	792	792	792	792	792	792

[a] All physician and pharmacist variables are normalized by taking $\log_e (X+1)$ as some tracts are without pharmacists or physicians.

[b] Standard errors are given in parentheses.

[c] R^2 corrected for degrees of freedom.

However, for present purposes, the importance of Table 5 is that it permits analysis of the question of the relative access of status groups to physicians and pharmacists, controlling for the nonstatus areal characteristics which affect demand and supply. Two measures of relative access are obtainable. First, if the physician and pharmacist equations are compared in terms of either the raw or standardized regression coefficients for the income and education variables, it can be seen that the effects on the pharmacists are substantially higher, confirming the earlier finding on the zero-order level that pharmacists are less likely to be found in low status areas than physicians.

But this procedure actually understates the full impact of the status variables on pharmacists' locations insofar as it ignores their indirect effects which are operative through their determination of the distribution of physicians. These indirect effects can be computed from the standardized coefficients in Table 5 and correlations in Table 1 by means of the path analytic theorem (Wright, 1934):

(3) $$r_{ij} = \sum_k b^*_{ik} r_{jk}$$

where b* is the standardized regression coefficient, i and j index two variables in model of (2), and k ranges over all variables which directly affect variable i. Equation (3) can be rewritten as

(4) $$r_{ij} = b^*_{ij} + b^*_{ik} b^*_{kj} + \sum_t b^*_{it} r_{jt}$$

where k now indexes a variable lying between variables i and j in a causal sequence and t ranges over all variables other than k which directly affect i. As applied to the model of equations (2), i = P, k = D_1, and t ranges from X_1 to X_8.

The first term on the righthand side of equation (4) is, of course, the direct effect of variable j on variable i; the second and third terms distinguish two types of indirect effects. The second term describes the indirect effect of a variable in a direct causal sequence with an ultimate dependent variable; that is, the indirect causal effect of population or pharmacists' locations is the product of the direct effect of population on physicians' locations and the direct effect of the latter on the distribution of pharmacists. The third term describes the indirect effect of a variable as it operates through its correlation with other variables in a causal sequence with the ultimate dependent variable; that is what may be called an indirect correlative effect of population operating through its correlation with the age variable can be computed by multiplying the age-population correlation by the direct effect of the age variable on pharmacists' locations. The distinction between the two types of indirect effects is that, presumably, one is not willing to make a causal assertion where only a correlative relationship between two variables is assumed. Table 6 summarizes the results obtained by using equation (4) to compute the two types of indirect effects. Columns 1 to 3 give the results for the specification of the model involving the all physician variable; columns 4 to 6 and 7 to 9 present the analogous information for the general practitioners and specialist specifications of the model, respectively.

The full causal effects of the variables are shown in columns 3, 6, and 9 which sum the direct and indirect causal effects. Comparison of these effects with the standardized coefficients in Table 5 indicates that, as measured in standard units, the full causal effect of the education of a population is more than twice as large for pharmacists as for physicians while the full causal effect of areal income on pharmacists averages

Table 6
Summary of Indirect Effects of Revised Causal Model for Pharmacists' Distribution
Chicago, 1960

	All Physicians			General Practitioners			Specialists		
	Indirect Causal Effects (1)	Indirect Correlative Effects (2)	Direct + Indirect Causal Eff. (3)	Indirect Causal Effects (4)	Indirect Correlative Effects (5)	Direct + Indirect Causal Eff. (6)	Indirect Causal Effect (7)	Indirect Correlative Effects (8)	Direct + Indirect Causal Eff. (9)
Population	.063	.100	.415	.065	.099	.416	.024	.099	.416
Pct. Comm'l. Area	.051	-.061	.105	.041	-.049	.95	.015	-.051	.093
No. of Hospitals	.022	.116	.050	.015	.115	.51	.017	.116	.050
CBD	.020	.021	.020[a]	.014	.027	.014[a]	.026	.015	.026[a]
Pct. 25 yrs. old or older	.035	.268	.180	.031	.268	.180	.018	.266	.182
Pct. H. S. Grad.Plus	.027	.297	.297	.025	.298	.296	.017	.300	.294
Pct. $10,000 Plus	.025	.341	.170	.019	.342	.169	.018	.339	.172
Black	-.006	-.153	-.006[a]	-.008	-.151	-.008[a]	-.001	-.158	-.001[a]

[a]Sum is equal to indirect causal effect as no direct effect is included in the model.

approximately 35 percent more than for physicians. These differences, inasmuch as they deal with the full causal effects of the status variables, more completely capture the relative access of the lower status groups to pharmacists and physicians than the simple comparison of direct affects.

Finally, it is useful to measure the aggregate indirect effects of the six tract characteristics which directly affect pharmacists' locations (i.e., excluding the CBD and race variables) as they operate through the physician variables. Such measures indicate the proportion of the total variance of the pharmacists' distribution explained by these variables which derives from their determination of physicians' locations. The first step is to assess the contribution of the physician variables to the explanation of pharmacists' locations by subtracting the coefficient of determination in Table 4 from, in turn, the coefficients of determination for the pharmacist equations in Table 5. The resulting differences indicate that the locations of all physicians and general practitioners each add three percent to the explanatory power of the six tract characteristics while the specialist variable adds two percent. If the correlation between a physician and the pharmacist is then squared and the appropriate percentage is subtracted, the resulting difference is a measure of the aggregate indirect effect of the tract characteristics operating through their determination of the distribution of physicians. Thus 29 percent (or roughly half) of the explanatory power of the tract characteristics flows through the all physician variable, and the corresponding figures for general practitioners and specialists are 27 and 19 percent, respectively.

V. SUMMARY AND IMPLICATIONS

Clearly, the data presented here contradict the notion that lower status groups have greater access to pharmacists than to physicians. It can, of course, be argued that a pharmacy's marked area is not adequately represented by a census tract and that if its market area were made larger, the differential in access to pharmacists between high and low status groups would disappear. One way of approaching this problem is to characterize tracts in terms of their proximity to populations with a high demand for pharmacists' services. For example, a measure of the access of a tract, T_1, to the population in another tract can be computed by dividing the population (P_i) in the other tract by the square of the linear distance between T_1 and that tract. Summed over all tracts T_2 through T_N, we have a measure of the "population potential" of T_1 which can be expressed as

$$\text{Pot }(T_1) = \sum_{i=2}^{N} \frac{P_i}{D_i^2} \quad .$$

Every tract will have a potential, and potentials can be defined for specific kinds of populations (e.g., the black population) as well as for population size. The measure defined here differs from the more commonly seen measure of population potential in that the potential figure is a quadratic rather than linear function of distance. Thus tracts close to the tract of reference are given greater weight than would be the case with common measure of population potential. For this analysis, three potential measures were created: a simple population potential, a potential for the population with at least a high school education, and a potential for the population with at least $10,000 annual income. These variables were then separately added to the revised model for pharmacists to see if they provided any additional explanatory power. They did not; in every instance they added nothing to the explained variance. Thus the conclusion with regard to differential access to pharmacists does not seem alterable by consideration of larger market areas. Of course, it is possible for such groups to have less access and yet rely on the available pharmacists for some of their care. But it is unlikely. The most probable condition under which this might occur would be if, despite the maldistribution of pharmacists by status, there were more pharmacists than physicians available to every status group. But this is not the case in Chicago; in the city as a whole, there are only 2707 pharmacists as contrasted with 4208 private physicians. When combined with pharmacists' apparent preference for locating among high status groups, this disparity of numbers makes the likelihood that many low status persons will seek advice from a pharmacist rather low. But perhaps more important is that the disparity makes filling prescriptions more difficult and thus may lower the probability that a patient will follow his physician's prescribed regimen.

It is interesting to note that although ghetto areas are frequently described as lacking services of all kinds, there is little evidence here that they lack the services of pharmacists when other status variables are controlled for. Even in the zero-order case, as Table 1 shows, the relationship between race and pharmacists' locations is rather low, although in the right direction. However, the effect of race net of the other variables is in the wrong direction and is unstable. The indirect correlative effects for race in Table 6 accounts for the reversal: in each case, almost

almost all of the effect of race flows through its correlation with other variables rather than operating directly.

These considerations suggest that if one wishes to preserve or increase access to a pharmacist's services among those of low status, one would do well to encourage the spread of supermarket drugstores--notwithstanding the contrary interests of those who seek to make pharmacy a profession (Brodie, 1966). Because of its ability to generate profits on a large variety of items, a supermarket drugstore can succeed where a pharmacy, relying only on the sale of prescriptions, would not be economically viable. Indeed, insofar as the attempt to professionalize pharmacy succeeds, the result may be to further deny access to pharmacists to low status groups.

At the beginning of this paper, it was assumed that the locations of pharmacists was contingent on the distribution of physicians. Implicit in this assumption is another which may be stated formally as follows: suppose an area contains a pharmacist and a physician; if Z_1 is the number of the pharmacist's physician-generated customers per unit of time and Z_2 is the number of the physician's patients per unit of time, then

(5) $$Z_1 = kZ_2$$

where $k < 1$. Equation (5) says the number of the pharmacist's physician-generated customers is less than the number of the physicians' patients. If this assumption is accepted and taken together with the fact that use of physicians is concentrated among high status groups, then the results of this paper regarding relative access to physicians and pharmacists must follow.[14]

At the same time, equation (5) is a very general model which both describes the organization of statuses in a large part of the health care delivery system and suggests much of its spatial arrangement. First, it asserts that the physician is the "triage officer" or gatekeeper of a system where each of the allied health occupations deals with only a fraction of the cases seen by the physician himself.[15] The size of this fraction is given by the coefficient, k, and conversely, k indexes the degree to which the population base required to support or allied health occupation (e.g., physical therapist) must be larger than that required to support the physician. Second, by comparing values of k for different allied health occupations, one may obtain estimates of the relative sizes of the population bases required to support them.

Third, since, as has been noted above, use of more specialized medical services increases with income, the equation indicates that use of the allied health occupations will be even more restricted to high status populations than use of physicians is. That is, the fraction of a physician's patients that an allied health occupation sees will be predominantly selected from among those of high status, and k may be interpreted as a rough measure of this selection process--the lower the value of k, the higher an allied health occupation's percentage of high status patients.

Finally, taken together with some knowledge about the capital investment in equipment and tasks performed by an allied health occupation, equation (5) provides insight as to where these occupations will be located within the city. For example, a prosthetist's work usually involves patients who have been hospitalized for either a severe trauma or serious illness. Hospitals are more likely than a prosthetist to be able to make the relatively high capital investment for the equipment to manufacture, fit, and train patients to use the devices. Moreover, hospitals, in addition to providing a patient flow by virtue of the patients' associated physical impairments, are usually located in areas accessible to relatively large populations. Consequently, prosthetists may be expected to locate in hospitals.

In general, the allied health occupations may be expected to locate in either hospitals, their immediate environs, or the central business district--the latter area of the city usually being the one with the greatest accessibility to the largest number of people. But the specific prediction of an occupation's location will depend upon the relative importance of capital investment, task performed, and size of the requisite supporting population base for that occupation. The pharmacist is the exception that proves the rule of these assertions. To the extent that pharmacists' locations are not explained by the above considerations, they are to be accounted for in terms of the fact that the vast majority of pharmacists, unlike other allied health professionals, are engaged in a retail trade which has little to do with their professional activity.

FOOTNOTES

[1]Indirect evidence is available from studies of repeated visits to physicians. See Richardson (1970) and Kosa (cited in Roth, 1969:221).

[2]The term, health products, includes prescriptions, over-the-counter ethical drugs, advertised remedies, prescription accessories, and health supports. Since 1959, health products' share of total sales volume has increased. See the <u>American Druggist</u> (1970a; 1970b) and Smith (1970).

[3]The use of larger definitions of market areas, is considered below.

[4]The 935 Chicago Census tracts were combined into 809 comparable from 1940-60; following this, the 17 noncentral business district tracts with populations under 200 were eliminated. They represented nonresidential and noncommercial land uses and lacked data on social variables.

[5]The high cutting point for income was chosen because it has been found that physicians do not respond positively to lower figures. See Elesh and Schollaert (1972).

[6]In 1969 Chicago's median family income was $6738; median years of school completed was 10.

[7]Chicago's index of segregation (dissimilarity index) was 89.8 in 1960, indicating that 89.8 percent of the black population would require relocation if each tract's population contained the same proportion of blacks. There are 115 tracts which are 90 percent or more black.

[8]The number of hospitals per tract is used in preference to the number of hospital beds as the former's zero-order correlation with the dependent variables is slightly higher. Institutions were included if they (1) treated primarily short term, as opposed to chronic or convalescent, cases and (2) were classified as general, maternity, eye, ear, nose and throat, or children's hospitals (i.e., those offering the most widely demanded types of services).

[9]The American Medical Association's classification of physicians into specialties is based solely on physicians' reports as to the character of their practice.

[10]The actual transformation was $\log_e$ (X+1), since some tracts had no physicians. The same transformation was applied to the distribution of pharmacists.

[11]An attempt was made to match a random sample of the pharmacists' addresses with those of drugstores; however, the earliest available listing of drugstores gave their locations as of late, 1967--almost five years after the collection of the data in pharmacists in early 1963. Thus the validity of the matching is somewhat moot. A match of addresses was found in slightly more than 75 percent of the cases. In view of the gap between the dates of data collection, this figure must be viewed as a low estimate of the true proportion of business addresses. If a match is defined as a match of census tract locations rather

than addresses, the proportion of matches increases about 10 percent. Others sometimes reporting home addresses are the semi-retired and those employed by hospitals, private industry, educational institutions, etc.

[12]Using the common definition of chain drugstores as four or more stores under the same ownership, approximately 12 percent of the 1,127 stores in Chicago were chain stores in 1967. Since the proportion of chain stores has been growing, this figure probably overstates the proportion of chain stores in 1960. No data are available on the proportion of pharmacists employed by such chains but given that only 12 percent of all stores are chains and that it is common practice for chains to have only one pharmacist on duty during a shift, it is surely fairly small.

[13]These results are broadly consistent with Bashur et al., (1970), although they examined the distribution of stores rather than pharmacists. Using data for the Cleveland metropolitan area, they found that pharmacies were far more decentralized than physicians or dentists. However, they may have underestimated the extent of the decentralization because they neglected to account for the volume of the stores and stores in the central business district tend to have more limited hours than those further out.

[14]As stated, the model does not control for the amount of time spent per patient by the allied health professional or the physician. To determine the effects of this variable on equation 5, it is necessary to examine two additional equations. First, assume that the unit of time specified for equation is a week; Z_1 and Z_2 are therefore expressions for the number of patients per week seen by the physician and allied health professional, respectively. Now define T_2 as the number of hours worked per week by the allied health professional and T_1 as the number of hours worked per week by the physician. The relationship between the two can be written as

(6) $$T_2 = mT_1 .$$

From census and other figures, we know that the median number of hours worked per week by physicians is greater than the median number of hours worked by other health professionals; that is, m is always less than one. The time spent per patient per week can be expressed as

(7) $$V_2 = rV_1$$

where V_2 is the time spent as an allied health professional and V_1 is the time spent by a physician. Dividing equation 6 by equation 7, we get

$$T_2/V_2 = mT_1/rV_1 = m/r \cdot T_1/V_1$$

but

$$P_1 = T_1/V_1$$

thus

$$k = \frac{m}{r}$$

and $k \geq 1$ if and only if $m \geq r$. Since $m < 1$, and allied health professionals typically spend more time per patient than the physician, the cases in which m will be greater than r are likely to be quite rare.

[15]The term, allied health occupations, is here used more restrictively than is sometimes the case and includes those who, with the physicans, provide direct patient care. Thus, for example, dentists, mathematicians, sociologists, and administrators are excluded.

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