Exploring Dimensions of Access to Medical Care

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This paper examines the dimensions of the access concept with particular attention to the extent to which more parsimonious indicators of access can be developed. This process is especially useful to health policy makers, planners and researchers in need of cost-effective social indicators of access to monitor the need for and impact of innovative health care programs. Three stages of data reduction are used in the analysis, resulting in a reduced set of key indicators of the concept. Implication for subsequent data collection and measurement of access are discussed.

INTRODUCTION

Improved access to medical care has been a major goal of much health legislation and planning. However, efforts to conceptualize and measure access have varied. Operational measures of access have included the availability of health personnel, patient linkages with a regular source of care, the convenience of services, actual use rates, the use of services relative to some standard of need, and consumer satisfaction with services.

Using data from a national survey of access to medical care, we explore both the extent to which access is indeed a multidimensional concept and the feasibility of representing those dimensions through a relatively parsimonious set of empirical indicators.

Limited data-gathering resources often constrain the extent of the information available to health policy decision makers who must nonetheless make judgments about resource allocation and programs or

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policies likely to achieve the greatest access benefits. Via various data reduction methodologies our purpose in this paper will be to identify a core set of items which could effectively describe the access profile for a given population of interest, but be measured in a relatively cost-efficient way.

Efforts to obtain parsimonious data sets are particularly relevant in the current climate of programmatic governmental cuts which affect not only the delivery of services, but the ability to gather information about those services. In such times, it is necessary to be judicious in the selection and use of information for planning and monitoring health services delivery.

A FRAMEWORK FOR THE STUDY OF ACCESS

Figure 1 outlines the approach we will use in conceptualizing and measuring the access concept. It is based on a framwork elaborated elsewhere [1,2].

Two main themes regarding the access concept appear in the literature. Some researchers tend to equate access with characteristics of the population (family income, insurance coverage, attitudes toward medical care) or of the delivery system (the distribution and organization of manpower and facilities, for example). Others argue that access can best be evaluated through outcome indicators of the individual's passage through the system, such as utilization rates or satisfaction scores. These measures, they argue, permit "external validation" of the importance of the system and individual characteristics [1,2]. In recent years, there have been a number of summaries of the research on the indicators and correlates of health services utilization, which should also be considered in various approaches to measuring access [3,4,5,6,7,8,9].

In general, the model in Figure 1 implies that characterisitcs of the delivery system (the availability of health care providers and facilities, for example) and characteristics of individuals in the area (such as age, insurance coverage and health status) reflect the probable or *potential* levels of access to medical care; utilization and satisfaction may be more appropriately considered objective and subjective indicators, respectively, of actual or *realized* access to services. The potential of individual entry to the health care system is influenced by structural characteristics of the delivery system itself and the nature of the wants, resources, and needs that potential consumers may bring to the care-seeking process. The realization of entry is reflected in a population's reported rates of utilization and in subjective descriptions of the care eventually obtained. The

Figure 1: Dimensions of Access to Medical Care and Their Indicators

Potential Access		*Realized Access*	
System (County)	*Individual*	*Objective*	*Subjective Satisfaction*
Availability	*Predisposing*	*Use*	*Convenience*
MD/Population	Age 6 or Less	Time Since Exam*	Travel Time
Bed/Population	Age 65 or Over	Preventive Exam	Travel Cost*
Dentist/Population	Sex	MD Visits	Appointment Time*
Community (County) Characteristics	Race	Hospital Admission	Waiting Time
	Education	Dental Visits	Visit Cost
Predisposing	*Enabling*	*Use Relative to Need*	*Provider Behavior*
% 65 or Over	Financing	Symptoms Response	Time with MD*
Enabling	Income	Use Disability	Information*
% below Poverty	Group Insurance*	Dental Want	MD Courtesy*
Region	Major Medical*		RN Courtesy
Rural Residence	Hospital Insurance		Receptionist Courtesy*
Central City Residence	Dental Insurance		MD Concern*
	MD Office Insurance*		Quality
Need	Visit Cost		Overall*
Infant Mortality	Organization		
	Regular Care Source*		
	Particular Provider		
	Specialty of Provider		
	Travel Time		
	Prior Appointment		
	Appointment Time		
	Waiting Time		
	Time with MD		
	Need		
	Perceived Health		
	Worry about Health*		
	Symptoms*		
	Dental Symptoms		
	Disability Days		
	Illness Episode*		

*signifies a deleted variable.

traditional availablility or convenience aspects of access are, in this framework, considered predictors of the realized (or utilization and satisfaction) outcomes.

Access may be defined as those dimensions which describe the potential and actual entry of a given population group to the health care delivery system.

The availability component of the delivery system refers to the volume and distribution of medical resources in an area. This characteristic of the delivery system is an aggregate, structural property. It is based on data available at a geopolitical level of aggregation (the county in

which individuals reside) rather than on attributes of individuals themselves. Similarly, the community characteristics are, in this case, summary measures for the county in which the respondent lives.

Predisposing, enabling and need factors refer primarily to attributes of individuals which ultimately influence their health care-seeking behavior. Predisposing variables include those factors which exist prior to the onset of illness and describe the "propensity" of individuals to use services. These include such things as age, sex, race and ethnicity, and educational levels. The enabling component describes the "means" individuals have available to them for the use of services. Both financial and organizational factors are relevant here. The need for care refers to the level of experienced illness, which may be reflected in perceived health, levels of symptoms or activity-limiting morbidity.

In our original framework [1], we noted that the population characteristics and organization descriptors may be classified as either system-level or individual-level properties, depending on the particular level of aggregation used in empirically operationalizing the dimension. In this particular analysis, the system organization features (characteristics and convenience of regular source of care) are primarily available to us through individual respondents' self-reports of the structure and convenience of the places they usually use for medical care. Certain predisposing, enabling and need factors descriptive of the population were, on the other hand, also available as aggregates of the geopolitical unit of the individual's county of residence. The "organization" and "community characteristics" dimensions are then divided, in this particular framework, according to the level of aggregation (measurement) they best represent empirically—the individual or the system (county), respectively.

Both types of information are relevant and important for understanding community access. The aggregate measures may be more readily available from published sources and provide an overview of the socio-environmental profile of the area; individual measures are more difficult and costly to obtain, but permit more of an opportunity to examine the relationship between particular attributes of the population-at-risk in an area and their access "performance."

Utilization rates are objective measures of realized access to the services provided by physicians, hospitals, dentists, and so forth. These services may be measured in a variety of ways—a simple proportion of those who did or did not have contact with a provider within a given period of time, or an overall volume of services consumed, once contact is made. Visits with physicians or dentists may be preventive or the result of symptoms or activity-limiting illness.

Of particular interest in our approach to measuring access are the

rates of illness-related use. "Equity of access" may be said to exist when services are distributed on the basis of people's need for them [10,11]. To the extent that rates of seeing a physician are, for example, a function of the number of disability days experienced or the severity of reported symptoms, then the system for distributing services is said to be an "equitable" one. "Inequity" exists when one's race, income level or level of insurance coverage, for example, are important predictors of realized access.

Subjective indicators of realized access are concerned with consumer evaluations of various aspects of their care-seeking experience, such as the convenience, cost, provider behavior, or overall quality of the care they receive.

We have generally argued that the complexity of the access concept makes it necessary to look at the various components outlined in Figure 1 separately, even though they are interrelated [1,12]. Our past emphasis implies that information would be lost if variables representing the various components were not explicitly considered. Further, we have suggested that various dimensions and the variables representing them may not be readily combined into summary scales and indices. The large number of indicators resulting have caused problems in method and in policy planning. Methodologically, the analyses are much more cumbersome and complicated than they might be, had more data reduction been done. For policy-planning, administrators are interested in identifying a single or limited number of indicators of access that would allow them to use these scores to assess quickly how communities compare on access, or determine whether particular health services delivery programs had improved access over time. Ideally, many health care policy makers would prefer an access indicator similar to the Consumer Price Index, Department of Labor Employment Statistics, or the Dow Jones Stock Average to monitor precisely the performance of the health care delivery system at any point in time. Our framework and approach up to this time has precluded the development of such summary measures [13]. Also, efforts of others to reduce the complexity of the access concept or to explore the utility of data reduction techniques in describing it have, in fact, been limited. There is evidence that aggregate summary measures of medical underservice may not necessarily highly correlate with individual-based measures of access [14,15,16,17].

A number of studies have focused on the development of summary indicators of aspects of the access framework. Hulka et al. [18], Roghmann et al. [19] and Ware and Snyder [20], for example, have developed relatively sophisticated summary scales of patient satisfaction. The empirical indices of the continuity concept operationalized by Bice

and Boxerman [21] and Shortell [22] represent useful data reduction approaches to that aspect of care-seeking. The Index of Medical Underservice (IMU) developed at the University of Wisconsin has been a widely applied summary indicator of the availability of required services in an area [23]. Kane [24] and Hewitt and Milner [25] suggest indicators of "inequality" based on units of services received by defined population groups. There is concern at present, as well, that due to programmatic cuts some of the previously favorable access trends—for the poor and elderly, for example—may, in fact, be reversed. Preliminary analyses of cross-sectional and trend data on access suggest that concerns about the unfavorable access impact of these changes may well be warranted [11].

More sophisticated analyses have applied multiple regression techniques to analyze a variety of potential and realized access indicators [26,27,28]. Some researchers have gone further in modeling the process of obtaining care through path-analytic or latent structure analysis building approaches [12,29,30,31,32]. These analyses attempt to identify those factors which most fully describe how care is obtained. They are not, however, aimed at reducing the number of variables necessary to operationalize effectively the access concept per se.

This paper, on the other hand, begins to explore our previously articulated assumptions that a multidimensional approach to measuring access is required and to pursue, in a way which has not been accomplished to date in the literature, the feasibility and utility of more parsimonious empirical indicators of this complex concept.

THE DATA

These analyses are based on a national survey of access to medical care conducted in late 1975 and early 1976 by the Center for Health Administration Studies (CHAS) and the National Opinion Research Center (NORC), University of Chicago. The national sample involved interviews with 5432 families representing the civilian non-institutionalized population of the United States. In each household, one adult and one child under 17 years of age (if there was a child in the family) were randomly chosen, yielding a sample of 7787 people. The selected adults were personally interviewed and a responsible adult, usually the mother, was interviewed about the child.

In addition to a general sample of the U.S. population, the sample design included oversampling of persons experiencing episodes of illness, rural Southern Blacks, and Hispanic persons residing in the Southwest. The oversampling allowed detailed analysis of the access problems of

these special groups. The data were then assigned weights to correct for the oversampling and to allow estimates to be made for the total non-institutionalized population. Details on the variables used in the analyses are summarized in Table 1.

The realized subjective satisfaction measures are based on people's evaluations of their most recent medical visit which must have occurred within a year of the interview date. People without a visit in the past year are excluded from all analyses including these measures. The means and standard deviations of the system variables are computed using the number of individuals in the denominator. For example, the $\overline{X}$ of 13.809 for percent below poverty indicates that on the average, each individual lives in a county where 14 percent of the population is below poverty.

METHOD

For planning purposes, the relative availability, inexpense and ease of data collection make measures of potential access attractive. Often, policy makers have data available from a variety of sources on the characteristics of the general population and the geographic distribution of medical resources. For example, the U.S. Census provides county information on age, income and residential characteristics, and the American Medical Association, on the number and type of physicians and the number of hospital beds by county [23]. Measures of realized access are, typically, less available from secondary sources and more difficult and costly to collect. Thus, to get number of physician visits in most communities one must obtain data from the numerous providers of service or survey the population. To find out, in any systematic way how people feel about the care they receive, there is no substitute for asking them directly. However, ultimate judgments about health care system performance must be based on the realized access attained by the population, suggesting that the realized dimension should be the one emphasized in a parsimonious data set.

Figure 2 summarizes these trade-offs for each of the four access dimensions. It suggests that multiple criteria should be used to achieve a parsimonious data set which minimizes information loss and the resources needed to collect and process the desired data.

Our methodological approach involved three stages. The first stage focused on the identification of factors within each of the access dimensions. The purpose of this stage was to eliminate variables listed in Figure 1 which apparently tell us little beyond what is shown by other variables in the data set. The reduction of the original group of variables to a

Table 1: Descriptions, Means, Categories and Standard Deviations of the Variables Presented in Figure 1

Variable Name/ Description (N)	*Means/ Categories*	*Standard Deviation*
Potential Access: System (County)		
Availability		
MD/Population (7787)—Total number of MDs (general practitioners and medical and surgical specialists) in county per 100,000 population (log) [33].	-2.280	.638
Bed/Population (7787)—Total number of hospital beds in county per 100,000 population (log) [33].	- .888	.625
Dentist/Population (7787)—Total number of dentists in county per 100,000 population (log) [34].	-2.978	.569
Community (County) Characteristics		
Predisposing		
% 65 or over (7787) among county population according to 1970 Census.	9.802	2.604
Enabling		
% below poverty level (7787) among county population according to 1970 Census.	13.809	8.293
Region (7787) by Census designation	0.327 0 = Other 1 = South	.469
Rural Residence (7787)—Rural/nonrural location	0.260 0 = Other 1 = Rural	.439
Central City Residence (7787)—according to 1970 census	0.256 0 = Other 1 = Central City	.437
Need		
Infant mortality (7787) per 10,000 live births [23]	21.542	4.256
Potential Access: Individual		
Predisposing		
Respondents aged 6 or less (7787)	0.093 0 = Other 1 = Less than 6	.291
Respondents aged 65 or over (7787)	0.100 0 = Other 1 = 65 or Over	.300
Sex (7787)	0.469 0 = Female 1 = Male	.499

Table 1: Continued

Variable Name/ Description (N)	*Means/ Categories*	*Standard Deviation*
Race (7787)	1.120 1 = White 2 = Nonwhite	.325
Education (7683)—Head of household (category)	2.808 1 = 8 years or less 2 = 9 to 11 years 3 = 12 years 4 = 13 years or more	1.098
Enabling		
Financing		
Income (7787): family income	$13,989.314	$10,430.602
Group health insurance (7773)	0.677 1 = Yes 0 = No	.468
Major medical coverage (7674)	1.440 1 = Yes 2 = No	.497
Hospital insurance (7705)	1.121 1 = Yes 2 = No	.326
Dental insurance (7672)—visits	1.820 1 = Yes 2 = No	.385
MD office visit insurance coverage (7,696)	1.441 1 = Yes 2 = No	.497
Visit cost (3903)—out-of-pocket cost of most recent visit (log)	2.509	.706
Organization		
Regular care source (7701): Based on response to the question, "Is there one person or place in particular you usually go to when you are sick or need advice about your health?"	1.122 1 = Regular source of care 2 = No regular source of care	.328
Particular provider (7701): Regular doctor based on regular care source and the response to the question, "Is there one doctor you usually see at (PLACE)?"	1.215 1 = Particular MD 2 = No regular source of care, or regular source but no particular doctor	.411
Specialty of provider (6751)—regular source of care	0.432 0 = General Practitioner 1 = Other	.495

Continued

Table 1: Continued

Variable Name/ Description (N)	*Means/ Categories*	*Standard Deviation*
Travel time (7070): Length of travel time from home to source of care in minutes—based on recent visit and regular source (log)	2.595	.826
Prior appointment (7209): Appointment system for visit—based on recent visit and regular source	1.213 1 = Appointment 2 = Walk-In	.409
Appointment time (4799): Length of time to get appointment with source of care in days—based on recent visit and regular source (log)	1.112	1.160
Waiting time (7156) in minutes for one office visit—based on recent visit and regular source (log)	3.043	1.168
Time with MD (7143) during office visit in minutes—based on recent visit and regular source (log)	2.767	.685
Need		
Perceived health (7759): Based on the response to the question, "Would you say your health, in general, is excellent, good, fair, or poor?"	1.803 1 = Excellent 2 = Good 3 = Fair 4 = Poor	.818
Worry about health (7766): Based on the response to the question, "Over the past year has your health caused you a great deal of worry, some worry, hardly any worry, or no worry at all?"	3.056 1 = A great deal 2 = Some worry 3 = Hardly any worry 4 = None	1.013
Symptoms (7655): Severity of symptoms of illness experienced in past year [2]	1.477	1.627
Dental symptoms (7614): Number of symptoms in past year—toothache and/or bleeding gums (log)	0.118	.276
Disability days (7701): Total number of days respondent had to stay in bed or cut down on usual activities in past year because of illness or injury excluding days in hospital (log)	-.343	2.293
Illness episode (7787): Episode that began this year causing 3 or more disability days and/or considerable pain or worry	0.315 0 = Episode 1 = No episode	.465
Realized Access: Objective		
Use		
Time since exam (7764)	3.553 1 = Within last 2 weeks	1.541

Table 1: Continued

Variable Name/ Description (N)	*Means/ Categories*	*Standard Deviation*
	2 = 2 weeks to 6 months 3 = > 6 months to 1 year 4 = > 1 year to 2 years 5 = > 2 years to 4 years 6 = > 4 years 7 = Never	
Preventive exam (7725)—in past year	0.257 0 = No 1 = Yes	.437
MD visits (7787): Total number in past year excluding phone calls (log)	0.304	1.696
Hospital admission (7759)—in past year	1.889 1 = Yes 2 = No	.314
Dental visits (7614): Total number in past year (log)	-.823	1.607
Use Relative to Need		
Symptoms response (5693): Symptoms response ratio—whether person saw doctor more or less often for symptoms than doctor thought necessary [10]	-14.647	76.327
Use disability (3649): Use disability ratio [10]	104.630	252.483
Dental want (7629): Respondent wanted to see a dentist but did not	1.797 1 = Yes 2 = No	.403
Subjective Satisfaction		
Respondents were asked how satisfied they were with the following aspects of their most recent medical visit. Each variable has the same five categories of responses.	1 = Completely satisfied 2 = Mostly satisfied 3 = Moderately satisfied 4 = Slightly satisfied 5 = Not at all satisfied	
Convenience		
Travel time (5321)	1.488	.926
Travel cost (5278)	1.511	.964
Appointment time (2699)	1.645	1.059
Waiting time (5310)—office waiting time	2.035	1.339
Visit cost (3566)—out-of-pocket cost	2.276	1.361
Provider Behavior		
Time with MD (5265)	1.637	1.028
Information (5306)—information provided	1.686	1.090
MD courtesy (5300)	1.337	.747
RN Courtesy (5047)	1.339	.739
Receptionist courtesy (4868)	1.405	.808
MD concern (5316)	1.509	.940
Quality (5311)—quality of care	1.529	.923
Overall (5316)—overall satisfaction with visit	1.545	.898

Figure 2: Criteria for Judging Importance of Variables for Parsimonious Data Set Describing Access

	Criteria	
Category of Access Variable	*Ease of Collection*	*Represents Goal of Delivery System*
Potential System	High	Low
Potential Individual	Intermediate	Low
Realized Objective	Low	High
Realized Subjective	Low	High

smaller, yet representative group, was accomplished through the use of factor analysis. A principal-factor solution factor analysis with varimax rotation was performed on the set of variables for each dimension. We used a varimax rotation in an effort to obtain a maximum "loading" for each variable on a single factor. Since we wish to use the original measures—not computed factor scores—to represent the underlying dimensions, this method seemed more appropriate than a different rotational approach which might have resulted in certain variables having significant loadings on more factors.

Three criteria were used to decide whether or not to eliminate a variable. The first elimination criterion focused on the relationships of variables within each dimension. Thus, potential and realized measures were eliminated if they were highly correlated with another variable and loaded on similar factors of the factor analysis, but showed lower factor loadings. The second criterion for eliminating variables was applied when variables had similar relations in the correlation matrix and factor analysis. The variable which was substantively less interesting, more difficult to measure and/or more complex to understand was eliminated. Finally, potential measures were *not* eliminated when they had no association with other potential measures, since they may be related to the realized measures. Realized access measures were *not* eliminated when they had no association with other realized measures, since we had made a priori judgments that each of the realized measures represents some important outcome.

In the second stage of the analysis, we related the potential measures to the realized measures. Here we were interested in further reducing the number of potential measures under consideration. None of the realized measures of access were considered for elimination in this stage. Potential measures that demonstrated a zero order correlation coefficient of less than .05 with all remaining realized measures were eliminated.

In the third stage of the analysis, those potential variables exhibiting the required level of correlation (.05 or higher) with one of the realized measures were included in a multiple regression analysis with the relevant realized variable as the dependent variable. In this final stage of the analysis, we were able to combine both the data reduction and the relational concerns of our analysis. We could examine those potential measures which appeared to have effects on the realized measures, and begin to make an effort at identifying potential measures, or sets of potential measures, which can be used as proxy measures to eliminate more difficult to obtain realized measures. We could also further eliminate some of the potential variables exhibiting no significant relationships with the realized measures, once the effects of other potential measures were considered.

Interaction terms were not included in these regression analyses. While inclusion would potentially increase variance explained, the major purpose of this study is to reduce the number of variables necessary to represent the access concept rather than to maximize explained variance. Earlier analysis of some of the variables in this data set which systematically examined interaction effects found none which caused major bias in the coefficients for the main effects [10,12]. Further, the large number of variables in this analysis causes special problems if interaction terms are included: the number of possible interactions is very large relative to the number of "main effects," thereby exacerbating estimation problems arising from colinearity.

FINDINGS

Figure 1 lists all of the initial candidate variables representing the various dimensions of access discussed above. They are not an inclusive set of the variables which might have been selected. They do, however, represent a wide range of concepts typically used to describe access. These variables are described in more detail in Table 1.

STAGE 1

Stage 1 attempts to reduce the data set by examining the relationships among variables within the four major dimensions of access. Table 2 shows the factor analyses for the two dimensions of potential access. The first analysis of system indicators (Table 2A) reveals three factors: the first representing health personnel and place of residence; the second loading on poverty and region; and the third combining bed supply and age

Table 2A: Varimax Rotated Factor Loading Matrices of Indicators of Potential Access: Potential System Indicators

Variable	*Factor** 1	2	3
MD/Population	.93	-.15	.14
Bed/Population	.34	.20	.68
Dentist/Population	.72	-.55	.06
% 65 or over	-.21	-.04	.77
% below poverty	-.27	.81	.22
Region	-.05	.77	-.15
Rural residence	-.56	.17	.28
Central city residence	.47	.01	.01
Infant mortality	-.05	.65	.14
Eigenvalue	3.26	1.82	1.48
Percent of Total Variance Explained	36.22	20.22	16.44

Note: *For each factor analysis, factor loadings are shown for factors with eigenvalue ≥ 1.

distribution in the county of residence. Candidate variables likely to stand as proxies for these factors are MD/Population, Percent below Poverty and Percent 65 or Over, respectively. However, because all of the system variables tend to be fairly readily available and are frequently used in aggregate level analysis, we decided not to delete any of them in Stage 1. We retained them to see how they would relate to the outcome variables in the latter stages of the analysis.

Table 2B shows seven factors for the individual indicators of potential access—Visit Cost and Waiting Time—were not included in the Stage 1 factor analysis because of the larger number of missing observations on these variables. The factors emerging at this stage appear to represent some reasonable concepts of potential access including health insurance coverage, perceived illness, regular source of care, disability from illness, old age, socioeconomic conditions and specialty of the regular source of care. On the basis of this analysis, a number of variables were deleted. These included: (1) all of the insurance variables except Hospital Insurance, retained because it represents the type of insurance most commonly held in the population, and Dental Insurance, which finances a special service and is far less commonly held; (2) Worry about Health and Symptoms, leaving Perceived Health (health reported as excellent, good, fair or poor) to represent the perception of health factor; (3) a variable generally indicating if there was a regular source of care (Regular Care Source), leaving a measure indicating that the respondent could identify a

Table 2B: Varimax Rotated Factor Loading Matrices of Indicators of Potential Access: Potential Individual Indicators

Variable	*Factor* 1	2	3	4	5	6	7
Age 6 or less	.02	-.10	-.07	.06	.13	.07	.09
Age 65 or over	.23	.13	-.05	-.04	-.74	.03	.03
Sex	-.06	-.14	.09	-.02	-.00	-.01	-.10
Race	.03	-.00	.06	-.03	.05	.37	.07
Education	-.24	-.17	.04	.09	.13	-.43	.18
Income	-.26	-.10	.00	-.01	.11	-.45	.10
Group insurance	-.75	-.05	-.03	-.02	.09	-.21	-.01
Major medical	.56	.06	.05	.02	-.03	.33	-.05
Hospital insurance	.67	.01	.11	-.02	.36	.08	-.04
Dental insurance	.35	.05	-.02	-.04	-.05	-.00	-.05
MD office insurance	.28	-.01	-.01	-.10	.39	-.11	-.10
Regular care source	.08	-.08	.72	-.04	-.01	-.00	.02
Particular provider	.01	-.08	.98	-.00	.02	.18	.05
Specialty of provider	.04	-.02	-.03	-.07	-.00	.10	-.53
Travel time (log)	.03	.09	.01	.02	-.00	.17	.25
Prior appointment	.03	-.01	.09	-.00	.03	.22	-.27
Appointment time (log)	-.07	-.04	.06	-.03	.05	-.06	.32
Time with MD (log)	-.03	.07	-.04	-.05	-.07	.07	.24
Perceived health	.09	.74	-.03	.04	-.14	.25	-.02
Worry about health	-.02	-.66	.09	-.28	.03	-.04	-.10
Symptoms	.06	.66	-.02	.26	-.09	-.02	.04
Disability days (Log)	-.04	.32	-.03	.75	.04	-.08	.01
Illness episode	-.04	.16	-.02	.70	-.02	-.02	-.03
Eigenvalue	2.99	2.61	1.69	1.53	1.41	1.17	1.08
% of Total Variance Explained	13.00	11.35	7.35	6.65	6.13	5.09	4.70

particular person as a regular source (Particular Provider) to represent that factor; and, (4) presence of a disabling illness episode (Illness Episode), leaving an indicator of total disability days for the year (Disability Days).

Rather than develop an index based on factor scores to represent a given factor, we generally chose a single measured variable. Despite the possible loss of some information, this strategy was chosen because a prime purpose is to minimize the measured variables necessary to represent access. Also, for policy and planning purposes, factor scores may be unduly complex to construct and difficult to explain.

No other variables were eliminated on the basis of the analysis shown in Table 2B. Factor 6 shows the highest loadings on a number of social class-related variables, but none clearly dominates in a way to suggest

deletions. It might also be noted that several conceptually and substantively important variables representing various aspects of convenience of care did not have high loadings on any of the factors (Travel Time, Prior Appointment, Appointment Time and Time with MD). All of these variables were consequently retained for the next stage of the analysis.

Table 3 shows the results of the factor analyses for the realized access variables. Three significant factors emerge for realized objective indicators of use and use relative to need (Table 3A). The first factor is dominated by MD Visits, the second by Preventive Exam and the third by Dental Want (an indication of whether people wanted to see the dentist and did not). The only variable eliminated on the basis of this analysis was the time since last physical examination (Time Since Exam). It contributed to both the first and second factor and was thought to be adequately represented by MD Visits and Preventive Exam. The variable Use-Disability was originally included in the factor analysis, but was taken out when the matrix failed to converge because of communality between the variable and MD Visits. Use-Disability was retained, however, for subsequent stages of the analysis.

Table 3B presents the factor analysis for the subjective measures of patient satisfaction. A major factor emerges related to quality of care. This result along with those of previous studies [2,10,20] suggests that quality of care is strongly linked by the patient to the nature of interaction with the physician. The amount of time and information the physician gives and his apparent courtesy and concern, as well as overall patient satisfaction with the visit, are strongly associated with judgment about quality. Consequently, all these variables except quality were deleted from subsequent stages of the analyses.

The second factor representing patient attitudes toward health personnel other than the doctor shows high loadings for RN Courtesy and Receptionist Courtesy. The latter was consequently eliminated.

The last factor represents two resources for travel: time and cost. Travel Cost was deleted because Travel Time appeared to be of much more salient concern to respondents. Neither satisfaction with Appointment Time (days of waiting after calling for an appointment) nor Waiting Time (in doctor's office) loaded heavily on any of these factors. Since these queuing issues are important concerns in access policy questions, the decision was made to retain Waiting Time for later stages of the analysis.

Figure 1 provides a summary of the variables deleted in Stage 1. Each deleted variable is indicated by an asteisk(*). From a total of 56 variables, 16 were deleted through the preliminary screening process.

Table 3A: Varimax Rotated Factor Loading Matrices of Indicators of Realized Access: Realized Objective Indicators

	Factor		
Variable	*1*	*2*	*3*
Time since exam	-.43	-.45	-.10
Preventive exam	.10	.96	.07
MD visits (log)	.92	.22	.01
Hospital admission	-.37	-.01	-.01
Dental visits (log)	.06	.05	.29
Symptoms response	.57	.11	.08
Dental want	-.04	.01	.72
Eigenvalue	2.31	1.22	1.03
% of Total Variance Explained	33.00	17.43	14.71

Table 3B: Varimax Rotated Factor Loading Matrices of Indicators of Realized Access: Realized Subjective Indicators

	Factor		
Variable	*1*	*2*	*3*
Travel time	.15	.09	.72
Travel cost	.07	.07	.81
Appointment time	.34	.26	.33
Waiting time	.39	.26	.33
Visit cost	.38	.17	.30
Time with MD	.77	.23	.22
Information	.79	.16	.18
MD courtesy	.66	.40	.10
RN courtesy	.34	.80	.10
Receptionist courtest	.29	.72	.17
MD concern	.81	.27	.10
Quality	.81	.26	.15
Overall	.83	.30	.18
Eigenvalue	6.31	1.52	1.01
% of Total Variance Explained	48.54	11.69	7.77

STAGE 2

In Stage 2 we begin to examine relationships between potential and realized dimensions of access. The purpose is to eliminate indicators of potential access not validated as significantly related to measures of

realized access. Table 4 includes all of the variables not deleted by Stage 1. An asterisk (*) indicates the simple correlation coefficient between the potential and realized measure is less than .05. This criterion will be used to reduce further the number of indicators of potential access which will be used as independent variables in the regression equations of Stage 3 and thus simplify the interpretation of those regressions.

One half of the correlations between the potential and realized measures did not reach .05 and thus these potential measures were deleted from the regression equations of Stage 3. As indicated in Table 5, the system variables were much more likely to be eliminated by this process than the individual variables.

STAGE 3

In Stage 3, regressions were run for all remaining realized access measures on all remaining potential access measures. The purposes of this stage were: (1) to suggest what additional measures of potential access might be deleted because they are not significantly related to realized measure when other potential measures are taken into account; and, (2) to explore the possibility that these are measures of potential access which might serve as substitutes or proxies for realized measures.

Table 4 provides the results of these regressions. Ordinary Least Squares (OLS) regressions were run for each of the realized access measures. In addition, Logistic regressions were run for the three dichotomous dependent variables—Hospital Admission, Preventive Exam and Dental Want [35]. However, we chose to report the OLS BETAS in Table 4 because: (1) the substantive results from the two approaches were similar and reporting OLS results for all regressions would provide more comparability; and, (2) there were difficulties adjusting for the design effects and standardizing the regression coefficients using the Logistic results. The standardized regression coefficients (BETAS) not significant at the .05 level are indicated as "NS" (not significant). These show the potential measures we suggest deleting in order to reach a more parsimonious data set.

Screening on the basis of the significance level of the BETA coefficients resulted in the deletion of a large proportion of the remaining indicators of potential access. Especially affected were the systems indicators. Table 5 shows that when entered into regression equations with the individual indicators, all but four of the systems indicators were eliminated. This does not necessarily mean that system level information would not be useful to the policy maker and planner in the absence of

individual level information. However, the system indicators of potential access do not appear very useful as part of a parsimonious data set designed to predict the realized access of the individuals living in the geographic regions these system variables represent.

One reason for the lack of success of the system variables may have to do with measurement. The county which is the unit of aggregation for our system level variables has been criticized as an inappropriate market area definition for health services. The Graduate Medical Education National Advisory Committee concludes, for example, "that geopolitical boundaries such as states or counties are inadequate for analysis of medical services" [36]. The Committee advises that a smaller geographic unit within which the larger majority of the residing population receives a specified health service be adopted. However, the Committee also emphasizes that systems of data collection for this purpose do not currently exist. Until such data systems may be developed, the best strategy seems to be to use what is available and note the limitations.

Of the individual indicators 30 might be deleted because of their lack of significance in the regressions. This leaves a substantial number (89) which appear useful for understanding the realized access of the population. Generally, however, the modest magnitudes of the BETAS and the variance explained suggest we must be cautious about using the potential individual indicators as substitutes for the realized measures.

The contributions of the different types of individual indicators to the development of a parsimonious data set vary. The *need* variables are most closely associated with physician and dental visits and hospital admissions. This tells us, as much previous work has, that the best predictors of who gets service are illness indicators. However, this is not sufficient for developing proxy measures since we probably would not want to equate high need with high access. A more appropriate strategy is to attempt to control for need and examine the relationships between predisposing and enabling variables and realized access.

The individual *predisposing* variables (particularly the demographic variables) show some linkages to the objective realized access measures. These relationships are helpful for targeting groups with potential need. These variables might serve as proxies for realized access measures but the BETAS are generally not of sufficient magnitude to provide policy makers with clear directives.

The individual *enabling* variables also show some relationships to the objective access indicators. In addition, a subset of these variables (the convenience measures) show some relatively strong associations with the subjective satisfaction indicators of access. These associations suggest that

Table 4: Potential Indicators of Access Regressed on Realized Indicators of Access**

	Realized Access: Objective						
Potential Access	*MD Visits*	*Hospital Admission*	*Dental Visits*	*Preventive Exam*	*Symptoms Response*	*Use Disability*	*Dental Want*
System Availability							
MD/Population	*	*	*NS*	*NS*	*	*	*
Bed/Population	*	*	*	*	*	*	*
Dentist/Population	.04	*	*NS*	*NS*	*	*	*
System Community							
% 65 or over	*	*	*	*	*	*	.05
% below poverty	*NS*	*	*NS*	*NS*	*	*	*
Region	*NS*	*	*NS*	*	*	*	*
Rural residence	*NS*	*	*NS*	*	*	*	*
Central Residence	*	*	*NS*	*NS*	*	*	*
Infant mortality	*	*	*NS*	*	*	*	*
Individual Predisposing							
Age 6 or less	.10	*	−.15	.17	.09	.09	.06
Age 65 or over	.05	−.06	−.05	.09	*	*	.08
Sex	−.09	*NS*	−.07	−.13	−.08	−.07	*
Race	*	*	−.04	*	*	*	*
Education	.06	*	.15	*NS*	*	*	*
Individual Enabling							
Income	*	*NS*	.11	−.05	*	*	.08
Hospital insurance	−.05	*	−.06	*NS*	*NS*	*NS*	−.07
Dental insurance	*	*	*NS*	*	*	*	*
Visit cost (log)	—	—	—	—	—	—	—
Particular provider	−.13	*NS*	−.07	−.11	−.15	−.12	−.05
Specialty of provider	−.09	.07	*NS*	−.05	−.07	−.08	*
Travel time (log)	.03	−.05	*NS*	.05	*NS*	*	*
Prior appointment	*	.03	*NS*	−.07	*	*	*
Appointment time (log)	*	*	*NS*	.11	*	*	*
Waiting time (log)	−.13	*	−.04	−.05	−.07	−.11	*
Time with MD (log)	*	*	*	.09	.06	*	.04
Individual Need							
Perceived health	.20	−.14	−.07	*	—	—	—
Dental symptoms	—	—	.16	—	—	—	—
Disability days (log)	.35	−.31	.04	*	—	—	—
R^2	.30	.17	.17	.13	.06	.05	.03

*Potential access measure deleted from regression because zero-order correlation with realized access measure in Stage 2 was less than .05.

**Values given are the standardized regression coefficients or betas. For Stages 2 and 3 the relationships between the need measures of potential access and the use-need measures of realized access (Symptoms Response, Use Disability and Dental Want) were not examined because of identity problems. Also, the enabling variable, Visit Cost (the actual cost of the visit), was

Table 4: Continued

Potential Access	Realized Access: Subjective				
	Travel Time	*Waiting Time*	*Visit Cost*	*Quality*	*RN Courtesy*
System Availability					
MD/Population	-.07	•	•	•	•
Bed/Population	•	•	•	•	•
Dentist/Population	.08	*NS*	*NS*	*NS*	•
System Community					
% 65 or over	•	•	•	•	•
% below poverty	*NS*	*NS*	*NS*	*NS*	*NS*
Region	•	*NS*	*NS*	*NS*	*NS*
Rural residence	*NS*	•	•	•	•
Central city residence	*NS*	•	*NS*	•	•
Infant mortality	•	*NS*	*NS*	*NS*	*NS*
Individual Predisposing					
Age 6 or less	•	•	•	•	•
Age 65 or over	•	•	•	-.06	-.05
Sex	•	•	•	•	•
Race	*NS*	.05	*NS*	.05	.06
Education	•	.04	*NS*	*NS*	•
Individual Enabling					
Income	*NS*	*NS*	-.05	*NS*	*NS*
Hospital insurance	*NS*	*NS*	.05	*NS*	*NS*
Dental insurance	•	•	•	•	•
Visit cost (log)	—	—	.33	—	—
Particular provider	.05	.06	.07	.12	.13
Specialty of provider	•	•	•	.06	•
Travel time (log)	.33	•	•	•	•
Prior appointment	•	*NS*	•	*NS*	•
Appointment time (log)	*NS*	.08	*NS*	.07	.05
Waiting time (log)	.10	.60	.19	.19	.16
Time with MD (log)	•	-.10	-.19	-.20	-.11
Individual Need					
Perceived health	*NS*	.04	.08	.12	.06
Dental symptoms	—	—	—	—	—
Disability days (log)	•	•	•	•	•
R^2	.14	.39	.18	.13	.80

considered only for its relationship to the subjective satisfaction measure Visit Cost and the need variable, Dental Symptoms, was considered only for its relationship to the use measure, Dental Visits.

NS:Regression coefficient not significant at .05 in Stage 3. The significance tests were adjusted for the design effect which results from the multi-stage, area probability sample design according to the following formula: $F_{adjusted} = F[(\text{Unweighted n})/(\text{Weighted n})][1/(\text{design effect})]$.

Table 5: Summary of Number of Variables Deleted in Stages 2 and 3

	Number of Variables					
Potential Measure	Initial	Deleted in Stage 2 ($r<.05$)		Deleted in Stage 3 (BETA, *NS* at .05)		Final	
System	108	71	(65.7%)*	33	(30.6%)*	4	(3.7%)
Availability	36	26	(72.2%)	7	(19.4%)	3	(8.3%)
Community	72	45	(62.5%)	26	(36.1%)	1	(1.4%)
Individual	200	81	(40.5%)	30	(15.0%)	89	(44.5%)
Predisposing	60	29	(48.3%)	6	(10.0%)	25	(41.7%)
Enabling	121	45	(37.2%)	23	(19.0%)	53	(43.8%)
Need	19	7	(36.8%)	1	(5.3%)	11	(57.9%)
Total	308	152		63		93	

*Percent of initial number of variables.

people's experience with medical care do have significant and measurable impacts on their levels of satisfaction. For example, satisfaction with waiting time and cost of visit is fairly strongly associated with actual waiting time and out-of-pocket cost.

Even though we attempted to reduce the number of realized access indicators in Stage 1, we were left with a considerable number of variables apparently representing heterogeneous aspects of realized access. The regressions in Table 4 suggest quite variable ways in which the potential access measures relate to or might be substitutes for the various realized measures:

1. *Use Measures.* Of all the realized measures, *Preventive Exam* shows the strongest association with the individual age and sex variables. This suggests that the demand for preventive care in the population would increase as the proportion of young children and women increased and the population aged. Also, the presence of a regular source of care apparently tends to encourage seeking preventive exams. The relatively low R^2 suggests difficulty in substituting potential measures for indicators of preventive care.

   MD Visits is explained primarily by need indicators, although the demographic and enabling variables are also relevant predictors. The enabling conditions which appear particularly important in facilitating physician visits are regular source of care and short office waiting times. The relatively large R^2 (.30) suggests the possibility of substitution of potential access

indicators, but since the R^2 is contributed to by the need variables primarily, substitution opportunities are, in fact, limited.

Hospital Admission determinants are largely limited to the need variables. This suggests the current difficulty of substituting potential access measures for hospital admissions rates.

Dental Visits shows more significant associations with predisposing and enabling factors than any other realized measure. *Dental Symptoms* also shows a fairly strong relationship but *Dental Insurance* does not appear related. In general, a combination of low income and education suggests underutilization of dental visits but the relationships are not strong enough to substitute those variables for dental visits.

2. *Use Relative to Need Measures.* These measures are explained least well by the potential access measures. This is discouraging since they may be the most policy-relevant measures of access. People without a regular source of care and with long waiting time have the least use relative to need. Young children and females tend to do better than the rest of the population on use relative to need for somatic illness. Conversely, young children and the elderly appear more likely to have dental needs which are not fulfilled.

3. *Subjective Satisfaction Measures.* The R^2s for the satisfaction items tend to be higher than for the other realized measures. This is largely because relevant experiences represented by the potential enabling variables are quite highly associated with the realized measures. For example, longer travel times are associated with lower levels of satisfaction with travel time; longer waiting times are associated with less satisfaction concerning waits; and, higher visit costs predict less satisfaction with costs.

   These associations are of sufficient magnitude to suggest that managers, in the absence of satisfaction measures, might take a close look at queuing measures. They might initiate programs to reduce queuing time and increase provider time with patients, if their goal is to increase consumer satisfaction. Experiences do not tell the whole story concerning satisfaction but they seem to tell part of it.

   Other informative, if less substantial, associations with satisfaction suggest the elderly tend to be more satisfied than younger people, Non-Whites tend to be less satisfied than Whites, and people with a regular provider are consistently more satisfied than those without one.

CONCLUSIONS

Our efforts to simplify the measurement of access and substitute more readily available measures for those difficult to obtain met with mixed results. The interrelationships of variables *within* the major dimensions of access suggest that some components might be represented by fewer variables than the number in our original set. In particular, reductions might be possible to represent insurance coverage, illness and satisfaction with services received. To reduce the number of variables and to emphasize those most readily available or least expensive to collect, our explorations of relationships *among* dimensions of access, suggest the following:

1. The system variables representing both availability and the community do not seem to tell us much about realized access at the individual level. At best, the elimination of these variables from a more parsimonious data set is a mixed blessing since they tend to be the information most readily available to policy makers and managers.
2. While a substantial number of individual variables representing potential access can be deleted because of their lack of association with realized access, others do predict realized access. However, the associations are generally not of sufficient magnitude to allow us to recommend comfortably that they might be substituted for the realized measures.
3. The area where some substitution seems most feasible is the use of the enabling convenience measures to represent certain aspects of consumer satisfaction. In some circumstances, this type of information may be available or could be more easily collected than direct information on patient satisfaction.

The preceding analyses have been intended to suggest policy-relevant and parsimonious data sets for evaluating the profile of access to care in those instances where extensive data do not presently exist or the resources required to obtain them are limited. This multidimensional look at the access concept has also served to refine and delimit further the critical empirical indicators of what has traditionally been a complex, multifaceted, and often difficult to measure health policy goal.

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