A Visit-Based Quantitative Measure of Family Care

Paul J. Murata, MD, MSPH
Torrance, California

Within the discipline of family medicine, providing family care receives varying emphasis. Studies are needed to more strongly link the process of family care to improvements in health outcomes. Such studies require validated measures with which to quantify the amount of care provided to families. This paper proposes a conceptual definition and an operational quantitative measure of family care. This family care measure, which we based on a three-dimensional operational model of family care (frequency of visits, number of family members, number of providers), translates a family's pattern of health care into an easily interpreted index.

Key words. Family health; continuity of patient care; physician-patient relations; physicians, family; health services research. *J Fam Pract 1993; 36:39-44.*

Research has shown that serious illness in a family member can have a dramatic effect on the functioning of the family. The converse, however, that improving family function can improve the course of illness in the individual, has been more difficult to show.[1-3] For the family physician, family care is based on a broader view of the patient-physician relationship that exceeds the traditional and technical aspects of health care. The entire family rather than the individual patient becomes the unit for intervention. This approach is not shared, however, by all family physicians. The issue of what constitutes appropriate family care has been debated at length within the discipline of family medicine. Previous studies indicated that families were not seen as intact units.[4,5] This convinced many physicians to adopt a narrower view of family care, treating the individual within the context of his or her social environment, which may or may not have included a traditional family. More recent studies, however, show that families are indeed seen as units and that family physicians are the most important providers of family care.[6,7]

Given that families are seen as intact units, the family unit becomes a potential target for intervention by family physicians. Taking full advantage of the family unit, however, has been difficult to implement. The persistent efforts of family systems medicine advocates have made those in family medicine and other medical fields better aware of the potential benefits of providing family-centered care. Other studies have shown that chronic diseases such as hypertension and asthma can be more effectively treated by involving the family.[8-11] Nevertheless, further research is needed to show how family care improves health outcomes.

One important factor necessary to link family care with differences in individual patient outcomes is a quantitative measure of family care. Without such a measure, it is difficult to know what process is being studied and to compare results between studies. In this study, we propose and put into operation a quantitative measure of family care that is based on the family's pattern of visits to physicians. It is hoped that this measure of family care, with further validation, can be used in studies to show that family care is an independent variable in disease outcomes.

Conceptual Definition

Developing a conceptual definition of family care depends on what process in providing care to families is thought to have an impact on illness outcomes. Previous studies attempting to measure family care assessed the extent to which all family members shared the same primary care physician.[4-7] (It was this type of measure that was applied to show that families do receive family care; that is, they often share a single primary care physician.[6]) These measures, however, are more qualitative than quantitative. They are generally insensitive to the frequency of visits to physicians by individual family members. The number and distribution of visits by family members were considered only to the extent that the

visits were used to define the primary care physicians. Based on such a limited measure of family care, increasing the number of visits to the family physician does not affect the measured family care.

Other studies have assessed family care simply as an extension of continuity of care. For example, the usual provider continuity (UPC) and the continuity-of-care (COC) indices, which are measures of continuity of individual patient care, have been applied to families to assess family care.[12] These measures reflect the extent to which medical care for a family is provided by a minimum number of providers. Individual visits to each provider by all family members are aggregated and applied to the UPC and COC indices. These measures, however, could result in a high family care score even though all of the family members see separate physicians. For example, one family member could have eight visits to one physician while each of the two other family members could have one visit to separate physicians. Applying the UPC measure would give a score of 80%, the percentage of visits to the most frequently seen provider [8/(8 + 1 + 1)].[13]

The problem of applying continuity measures for individual patient care to entire families highlights an important aspect of family care: care by a shared provider. Can family care be provided if all of the family members see separate providers? Other measures have been proposed that incorporate assessing the amount of shared provider care. One example is the family utilization index (FUI).[13] This measure considers the total number of visits by a family and the proportion of family members seen by the family care provider. The length of time over which the visits occurred and the number of visits by specific family members are also considered. This measure, however, is limited by the arbitrary scaling of its various components, which remains to be validated. The greatest limitation of the FUI is that it takes the perspective of a single provider; prior knowledge is assumed that the physician selected by the evaluator is the family care provider. Thus, although all of the family members may see a single family physician, if this is not the physician for whom family care is being measured, the FUI could indicate that this family receives no family care.

These earlier measures have provided the conceptual framework for developing a visit-based measure of family care. We can now see that the concept of family care has its basis in continuity of care. Continuity of care for an individual is maximized when all of that person's visits are to a single provider. Similarly, family care is maximized when all of a family's visits are to a single provider. Providing care for families, however, has the added dimension of multiple family members receiving care from a shared provider. Family member visits to the same
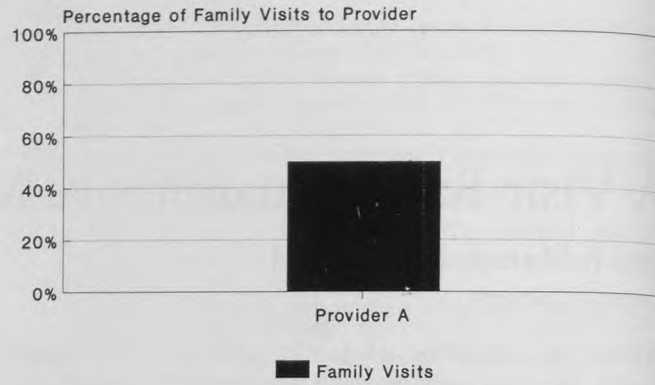

Figure 1. One-dimensional visit-based model of family care: usual provider continuity (UPC). The UPC index measures the proportion of family visits to a specified provider; visits to other providers are not considered. The visit pattern from Table 1A is shown.

provider allow greater opportunities for physician-patient interaction as a result of contact through other family members. For example, if a family member has hypercholesterolemia, the patient's compliance with a cholesterol-lowering diet might be improved by discussing with other family members during their health care visits how they can support and encourage the one with hypercholesterolemia. Sharing of information across family members to influence the overall health of the family is analogous to continuity of care for individuals in which the sharing of information across visits has been shown to provide benefits beyond that which could be achieved through episodic care.

Assessment of Family Care

In putting into operation the concept of shared family care, I extended the methods used in previous family care measures to assess continuity of care for individuals. Both continuity of care and family care can represent the extent to which the unit of analysis, either the individual or the family, is seen by a minimum number of providers. Thus, the simplest means of assessing family care is to measure the proportion of family visits to a specified family physician. The UPC index described above is an example of this type of measure. In Figure 1, the UPC index has been applied to the pattern of visits in Table 1, example A. It can be seen that this measure represents a one-dimensional solution to the problem of measuring family care since it considers only family visits to a specific provider.

The measurement of family care can be expanded to a two-dimensional model by applying a measure such as Shortell's CON index of continuity of care to family

Table 1. Examples of Family Visit Patterns to Physicians

Example A.

Provider (j)	Family Member (i)				
	#1	#2	#3	#4	n(.j)
Provider A	1	2	3	5	11
Provider B	1	1	2	2	6
Provider C	0	0	1	2	3
Provider D	1	0	1	0	2
n(i.)	3	3	7	9	22 = n
		FC = .339			

Example B.

Provider (j)	Family Member (i)				
	#1	#2	#3	#4	n(.j)
Provider A	0	0	0	11	11
Provider B	0	0	6	0	6
Provider C	0	3	0	0	3
Provider D	2	0	0	0	2
n(i.)	2	3	6	11	22 = n
		FC = 0			

Example C.

Provider (j)	Family Member (i)				
	#1	#2	#3	#4	n(.j)
Provider A	2	2	3	4	11
Provider B	1	1	2	2	6
Provider C	0	0	1	2	3
Provider D	1	0	1	0	2
n(i.)	4	3	7	8	22 = n
		FC = .347			

Example D.

Provider (j)	Family Member (i)				
	#1	#2	#3	#4	n(.j)
Provider A	2	2	3	5	12
Provider B	1	1	2	2	6
Provider C	0	0	1	2	3
Provider D	0	0	1	0	1
n(i.)	3	3	7	9	22 = n
		FC = .393			

The family care (FC) measure has been calculated using equation 1 for these four examples of family visit patterns to physicians. Example B shows a family in which no members made visits to a common provider. Example C in comparison with example A shows the effect of increasing shared care as visits to a specific provider are more dispersed among family members. Example D similarly shows the effect of concentrating care by increasing family visits to a common provider.

visits.[14] This measure considers the distribution of family visits across providers; a single family physician need not be identified. The two-dimensional nature of the data elements used to calculate this index is illustrated in Figure 2 (using the same example A in Table 1). Family care increases with this measure as the proportion of family visits are concentrated among fewer numbers of providers.

The CON index, however, still falls short of adequately assessing family care since it does not provide for the concept of shared care. A third dimension, shown in Figure 3 (again using the visit pattern in Table 1), is needed that considers the distribution of visits by indi-

vidual family members across providers. A simpler example of this dimension would be the visit patterns for a two-member family seeing two physicians. The first family has the husband with two visits to Provider A and the wife with one visit to a separate physician, Provider B. The second family has both husband and wife with one visit to a shared physician, Provider A, and the husband with a second visit to Provider B. Using the CON index, both families would have the same measured family care, since they have distributed the same number of visits (three) among the same number of providers (two). Yet, in the first family, no sharing of care occurs, while in the second family two of three visits are to the shared pro-
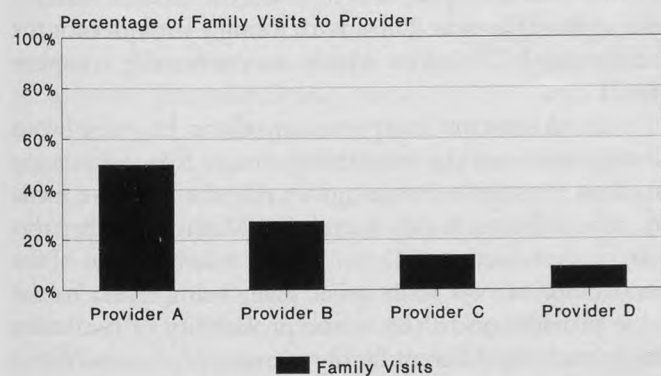

Figure 2. Two-dimensional visit-based model of family care: concentration of care. The concentration of care index measures the concentration of family visits among the fewest number of providers; multiple providers are considered. The visit pattern from Table 1A is shown.
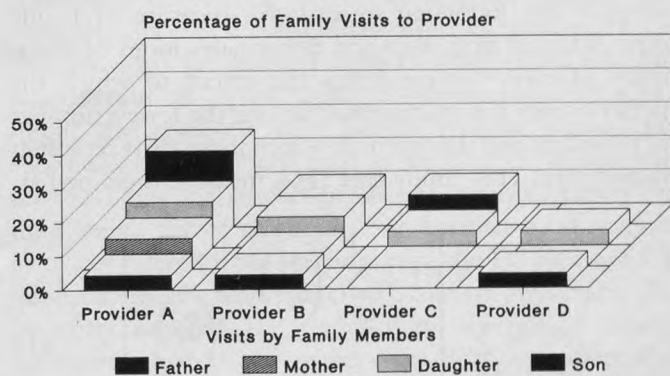

Figure 3. Three-dimensional visit-based model of family care: family care. The family care measure quantifies the concentration of family visits among providers and the extent to which these visits represent shared care. The visit pattern from Table 1A is shown.

vider. Thus, in addition to the number of family visits and their distribution among providers, the third dimension must consider the extent to which visits are made to a shared provider. For a given number of family visits to a specific provider, shared care would be maximized when these visits are dispersed among as many family members as possible. In the above example, both families had seen Provider A for two visits. Shared care was maximal in the second family where the two visits to this provider were split (dispersed), with one visit made by each family member. There was no shared care for the other family in which both visits were by a single family member.

Based on the three-dimensional model of family care shown in Figure 3, we can now predict the desired properties of the measure. The measure should (1) be maximal when all visits by family members are to a single physician, (2) be minimal when no family members visit a common provider, (3) increase as more family members visit a common provider, and (4) increase as the proportion of visits to a common provider increases. The measure will use each family as the unit of analysis so that family care among individual families can be compared. In general, the family unit can be defined as those family members living within a single household, since household members will likely have a greater influence upon each other's health care decisions than nonhousehold family members.[15,16] Nevertheless, the measure should be adaptable to other types of family units, since the family unit of interest may vary depending on the study in which the measure is applied.

Family Care Measure

Based on these desired operational characteristics, we propose the following quantitative measure of family care. Adapted from Bice and Boxerman's index of continuity of care,[17] it quantifies the extent to which the family's visits are concentrated among the fewest number of providers and the extent to which these visits represent shared care. This family care (FC) measure is defined as:

$$FC = \sum_{j=1}^{J} \left[\frac{1 - \sum_{i=1}^{I} \left(\frac{n_{ij}}{n_{.j}} \right)^2}{1 - \sum_{i=1}^{I} \left(\frac{n_{i.}}{n} \right)^2} * \left(\frac{n_{.j}}{n} \right)^2 \right] \tag{1}$$

where (Table 1) n = total number of visits by family; n_{ij} = number of visits by family member i to provider j; $n_{i.}$

= total number of visits by family member i; $n_{.j}$ = total number of visits by family to provider j.

Equation 1 can be simplified to:

$$FC = \frac{\sum_{j=1}^{J} \left[n_{.j}^2 - \sum_{i=1}^{I} n_{ij}^2 \right]}{n^2 - \sum_{i=1}^{I} n_i^2}. \tag{2}$$

The numerator of the first fraction in equation 1 represents the dispersion of visits among family members, ie, shared care for each provider j. When all family visits to provider j ($n_{.j}$) are made by a single family member, then $n_{ij} = n_{.j}$ and the dispersion of visits = 0. The denominator of this fraction standardizes the dispersion of visits for each provider to the overall dispersion of visits among all providers. Assuming that each family member has a fixed need for physician visits, $n_{i.}$, the denominator represents the maximum dispersion possible.

For each provider j, the second fraction weights the standardized dispersion score in the first fraction by the extent to which the family's visits are concentrated with this provider. The overall FC measure is derived by summing these weighted scores for each physician seen by one or more members of the family. As more family visits are concentrated among fewer providers, the weighting will tend to increase as well as the overall FC value. At the limit where only one provider is seen by the family, $n_{.j} = n$ and the weighting for this provider equals one. Also at this limit of a single provider, the dispersion of visits for this provider approaches the dispersion for all providers, ie, the numerator and denominator of the first fraction become equal, and the value of the first fraction also approaches one. Thus, with a single provider for the family, the FC measure equals one, reflecting complete family care.

An alternative interpretation of the FC measure is that it represents the probability of any two visits being made to the same provider, given that the visits are made by two different family members. Mathematically, this can be expressed as FC = P(A|B), where P(A) = the probability of two visits (visit pair) being made to the same provider and P(B) = the probability of two visits being made by different family members.* A more direct means of estimating FC can then be derived by restating this as:

---

*In this notation, P(X) is the probability that X is true and P(X|Y) is the conditional probability that X is true under the condition (|) that Y is true.

$$FC = \frac{\text{No. of visit pairs by different family members using the same provider}}{\text{Total no. of visit pairs by different family members for all providers}}$$

or:

$$FC = \frac{\sum_{j=1}^{J} \left[\sum_{i \neq i'}^{I} (n_{ij} * n_{i'j}) \right]}{\sum_{i \neq i'}^{I} (n_{i.} * n_{i'.})} \qquad (3)$$

As an example of the FC measure calculated using equation 3, we can again use the pattern of visits in Table 1, example A. The number of visit pairs by different family members for each provider is:

Provider A $1 \times 2 + 1 \times 3 + 1 \times 5 + 2 \times 3 + 2 \times 5 + 3 \times 5 =$ 41

Provider B $1 \times 1 + 1 \times 2 + 1 \times 2 + 1 \times 2 + 1 \times 2 + 2 \times 2 =$ 13

Provider C $0 \times 0 + 0 \times 1 + 0 \times 2 + 0 \times 1 + 0 \times 2 + 1 \times 2 =$ 2

Provider D $1 \times 0 + 1 \times 1 + 1 \times 0 + 0 \times 1 + 0 \times 0 + 1 \times 0 =$ 1

Total   57

The total number of visit pairs by different family members for all providers is $3 \times 3 + 3 \times 7 + 3 \times 9 + 3 \times 7 + 3 \times 9 + 7 \times 9 = 168$. FC is then calculated as 57/168, or .339 as previously calculated using equation 1. Thus, given the numbers of visits by members of this family, shared (family) care occurred in 33.9% of the opportunities (visit pairs).

The two methods of deriving the FC measure in equations 1 and 3 can be proven to be equivalent by using Bayes' theorem, which states: $P(A|B) = (P(B|A)*P(A))/P(B)$. $P(B|A)$ is the probability of two visits to a given provider being made by *different* family members. This is also 1 − (the probability of two visits to a given provider being made by the *same* family member), and is the numerator of the first fraction in equation 1. $P(A)$ is the probability of two visits coming from a given provider j, and is the weighting term in equation 1. $P(B)$ is the probability that two visits are made from *different* family members which is 1 − (the probability of two visits being made by the *same* family member); $P(B)$ is the denominator in equation 1.

We can now examine whether this family care measure meets the desired operating properties previously described. We have already seen that this measure has a maximum value of 1 when all visits by family members are with a single provider, regardless of the distribution of visits among family members. The FC measure can be

shown to have a minimum value of 0 when no family members share visits to a common provider (example B in Table 1). For each provider j in this situation, the numerator of the first fraction in equation 1 equals 0, reflecting no dispersion of visits. Consequently, all of the weighted scores for the providers are equal to zero, which when summed yields an overall FC measure of 0. The FC measure increases as more family members visit a common provider. This can be seen in Table 1, where example C has a FC = .347 compared with .339 in example A. Similarly, comparing example D to example A in Table 1 shows that the FC measure increases as the proportion of visits by the family to a common provider increases (FC = .393 vs .339, respectively).

Discussion

In this paper, an operational measure that translates a family's pattern of physician visits into a quantitative index of family care has been proposed. This FC measure reflects the extent of shared family care by expressing the probability of any two visits being made to the same provider given that the visits were made by two different family members. We have demonstrated the face validity of this measure, but further validation of this measure is needed. The concurrent validity of this measure could be assessed by comparing it with other family care measures, although the value of such comparisons would be limited, given the problems described with the other family care measures. This measure will need its performance tested in a representative sample of families to demonstrate how the measured family care varies with factors such as family size, family age, and total number of family visits.

In the future, modifications to the measure could be considered depending on the specific application: for example, Shortell's conceptualization of continuity of care provided for referred visits to other physicians for consultation as contributing to continuity.[14,18] One might also consider more heavily weighting visits by specific family members, such as the mother, to account for the differential impact of various family members on the family's use of resources.[19,20] Another modification to be considered would be adjusting the FC measure for family members who make no visits to physicians. As currently assessed, the presence or absence of family members who do not make visits does not affect the measured family care received by other family members.

Ultimately, this measure would be most useful as an independent variable in epidemiologic or health services studies to relate the process of family care to desired outcomes. Proving the importance of continuity of care

had to go through a similar process. A number of continuity of care measures were proposed and validated before benefits could be shown.[21-23] Subsequent to the development of continuity of care measures, a variety of studies were able to link continuity of care to improved health outcome, better use of health services, and increased patient satisfaction and compliance.[21-25] For family care, studies have supported the use of the family as the unit of intervention in order to improve the health of individuals.[8-11,26] It is hoped that the availability of this measures will lead to studies that show how a more comprehensive approach to family care can be consistently implemented in medical practice to improve the health care provided.

Acknowledgments

References

1. Campbell TL. Family's impact on health: a critical review. Fam Syst Med 1986; 4:135–200.
2. Robertson DL, Stewart JT. Families and health: A review of clinical and research issues for primary care. Fam Pract Res J 1985; 4:128–51.
3. Roland MO. The family doctor—myth or reality? Fam Pract 1986; 3:199–204.
4. McKenna MS, Wacker WEC. Do patients really want "family doctors"? N Engl J Med 1976; 295:279–80.
5. Fujikawa LS, Bass RA, Schneiderman LJ. Family care in a family practice group. J Fam Pract 1979; 8:1189–94.
6. Murata PJ, Kane RL. Do families get family care? JAMA 1987; 257:1912–5.
7. Murata PJ, Kane RL. Who is the family doctor? Relating primary care to family care. J Fam Pract 1989; 29:299–304.
8. Earp JL, Ory MG, Strogatz DS. The effects of family involvement and practitioner home visits on the control of hypertension. Am J Public Health 1982; 72:1146–54.
9. Morisky DE, DeMuth NM, Field-Fass M, Green LW, Levine DM. Evaluation of family health education to build social support for long-term control of high blood pressure. Health Educ Q 1985; 12:35–50.
10. Fireman P, Friday GA, Gira C, Vierthaler WA, Michaels L. Teaching self-management skills to asthmatic children and their parents in an ambulatory care setting. Pediatrics 1981; 68:341–8.
11. Lewis CE, Rachelefsky G, Lewis MA, de la Sota A, Kaplan M. A randomized trial of A.C.T. (Asthma Care Training) for Kids. Pediatrics 1984; 74:478–86.
12. Patten RC, Friberg R. Measuring continuity of care in a family practice residency program. J Fam Pract 1980; 11:67–71.
13. Stamps PL. Toward the evaluation of family practice: development of a family utilization index. J Fam Pract 1978; 7:767–79.
14. Shortell SM. Continuity of medical care: conceptualization and measurement. Med Care 1976; 14:377–91.
15. Herberger L. The demographic approach to the study of family health. Soc Sci Med 1974; 8:535–44.
16. Deeble JS. The economic approach to family health studies. Soc Sci Med 1974; 8:529–33.
17. Bice TW, Boxerman SB. A quantitative measure of continuity of care. Med Care 1977; 15:347–9.
18. Fletcher RH, O'Malley MS, Fletcher SW, Earp JA, Alexander JP. Measuring the continuity and coordination of medical care in a system involving multiple providers. Med Care 1984; 22:403–11.
19. Morris NM, Hatch MH, Chipman SS. Deterrents to well-child supervision. Am J Public Health 1966; 56:1232–41.
20. Houthakker HS. An economist's approach to the study of spending. In: Foote NN, ed. Household decision-making. New York: New York University Press, 1961.
21. Wall EM. Continuity of care and family medicine: definition, determinants, and relationship to outcome. J Fam Pract 1981; 13:655–64.
22. Dietrich AJ, Marton KI. Does continuous care from a physician make a difference? J Fam Pract 1982; 15:929–37.
23. Wasson JH, Sauvigne AE, Mogielnicki RP, Frey WG, Sox CH, Gaudette C, Rockwell A. Continuity of outpatient medical care in elderly men: a randomized trial. JAMA 1984; 252:2413–7.
24. Marquis MS, Davies AR, Ware JE Jr. Patient satisfaction and change in medical care provider: a longitudinal study. Med Care 1983; 21:821–9.
25. Shear CL, Gipe BT, Mattheis JK, Levy MR. Provider continuity and quality of medical care: a retrospective analysis of prenatal and perinatal outcome. Med Care 1983; 21:1204–10.
26. Perry CL, Luepker RV, Murray DM, Kurth C, Mullis R, Crockett S, Jacobs DR Jr. Parent involvement with children's health promotion: the Minnesota Home Team. Am J Public Health 1988; 78:1156–60.