Nurse practitioners in primary care. V. Development of the Utilization and Financial Index to measure effects of their deployment

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The new Utilization and Financial Index (UF-Index) was developed to measure the economic effects of deployment of new health professionals or of other changes in the provision of health services. By means of several steps, information on concurrent use of various categories of health service is converted into a single quantitative index. The index has been used to evaluate the financial effects of introduction of nurse practitioners into primary care practices by means of two complementary studies.

Le nouvel Indice Economique et d'Utilisation (Indice EU) a été mis au point dans le but de mesurer les effets économiques découlant de l'arrivée de nouveaux professionnels de la santé. Ce même indice permet d'évaluer aussi d'autres changements survenant dans la distribution des soins de la santé. A travers plusieurs étapes, l'information recueillie sur l'emploi simultané de diverses catégories de services sanitaires est transformé en un seul indice quantitatif. Cet indice a été utilisé dans deux études complémentaires pour évaluer les effets économiques de l'introduction d'infirmières cliniciennes dans la pratique des soins de première ligne.

Deploying nurses to provide primary care services has been one response to the unavailability of family physicians and other primary care doctors in North America.[1,5-7] This approach to augmenting and realigning primary health care manpower* stems in part from the recognition that producing more family physicians is not likely to alleviate either shortages or maldistribution of such doctors.[8-11] In Canada, particularly in Ontario, the long-lasting surplus of nurses[12-14] led governmental planners, educators and investigators to agree that the nurse is the most appropriate professional to supplement and augment primary care rendered by a physician or, in situations such as the remote North,[15] to replace the physician.[16-18]

To evaluate family health care provision by nurse practitioners (or family practice nurses), a McMaster University interdisciplinary research group and its clinical collaborators established two major projects and developed methods for assessing both the clinical and the economic aspects of the care. The projects concerned a suburban group practice and a rural family medical centre. In the suburban practice (in Burlington, Ont.) a randomized trial permitted comparison of effects of the performance of conventional physicians with that of teams that included nurse practitioners. In the rural family medical centre (in Smithville, Ont.) a before-and-after study focused particularly on financial performance.

Accounts have already been reported of the educational program for the family practice nurses,[1] the research settings,[2,4,19-21] the household interview surveys and special medical ledgers (day-sheet journals) that were used to obtain the research data,[20,21] the standards and criteria devised to grade the quality of care,[22] and the results of the evaluation of health status.[23]

In this report we describe the new Utilization and Financial Index (UF-Index), which allows different categories of health care utilization to be expressed in common units.

Research settings

Brief summaries of the general plan of the two research settings in which the methods were developed and applied follow.

The Burlington randomized trial[19]

The general outline of the trial is shown in Fig. 1.† A total of 1598 eligible families (4325 individuals) were

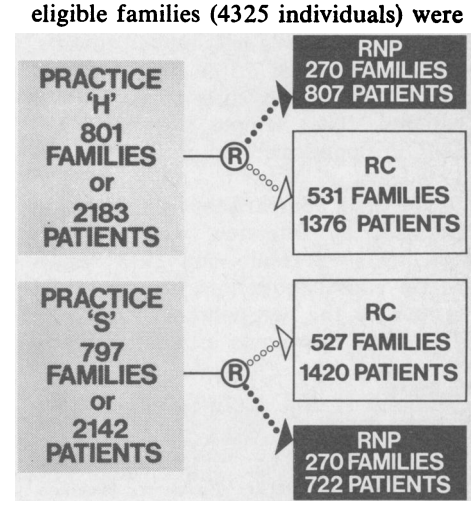

FIG. 1—Design of the Burlington randomized trial,[19] comparing conventional practices (C) with teams including nurse practitioners (NP). R represents the randomization process.

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This is the fifth in a series of articles published in *CMAJ* on nurse practitioners in primary care. The preceding articles appeared in the Apr. 21, 1973 issue[1-3] and the June 21, 1975 issue.[4]

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*Although "personpower" may be a more appropriate term for discussing human resources, we have used "manpower" in its conventional generic sense. The pronouns used throughout this paper have been chosen according to the present numerical predominance in the field, and do not exclude reference to the opposite sex.

assigned to receive primary care from either the doctor or the associated nurse practitioner. Randomization was planned so that each doctor continued conventional care for two thirds (or about 530) of the families, and each nurse practitioner became responsible for 270 families. The two groups were compared thoroughly from July 1, 1971 to June 30, 1972 and financial observations were continued for 1 year afterward.

The Smithville-McMaster project[4]

Smithville is part of the Township of West Lincoln, a rural area of the Niagara peninsula, approximately 50 km from Hamilton. At the request of community leaders a family medicine satellite teaching centre (FMC) was introduced in late 1970 when the last family doctor left the town. A key feature of the centre was the team approach, which incorporated the family practice nurse. The plan of the study is shown in Fig. 2.

The research strategy was to obtain data about pertinent variables before the FMC was able to get under way as a service practice, through household interviews of a stratified random sample of 1501 respondents drawn from all 8000 persons living in the township. The data included information about sociodemographic "descriptors", morbidity, use of health services, physical functional capacity and attitudes.‡ After 2 years, when the growth of the FMC had stabilized, the household survey was repeated. Analysis of data in the second (or "after") survey made it possible to classify the respondents as patients registered in the FMC (FMC users) and those who identified other accessible practices in or near the township as their central source of primary care (TWP patients). The population of the township could then be classified in two self-selected cohorts, one consisting of 2300 FMC patients and the other consisting of 5700 TWP patients. The sample included 310 FMC respondents and 820 TWP respondents.

The main comparisons using the data gathered by interview were between baseline 1971 results and 1973 results within each cohort, and between 1973 results for the two cohorts.

Because the results on clinical safety and efficacy, quality of care, and acceptance and satisfaction in both studies produced an unequivocal verdict of satisfactory performance for interdisciplinary primary care incorporating the nurse practitioner,[19,22,23] the economic efficiency of the new forms of practice from the standpoint of society, as disinct from the profits, became particularly pertinent.

Development of the index

Sampling, assignment of study subjects, self-selection of cohorts and techniques of acquisition of economic data

For the financial and economic comparisons that follow, the costs of health care for patients in the practices were assessed before, during and after the experimental projects. In Burlington, for at least 2 years before the trial began, the study practices had been "saturated" and the family physicians had not been accepting new patients because of inability to provide any increase in volume of service. In contrast, the Smithville FMC filled a vacuum caused by the departure of the last family physician.

The economic data were part of larger bodies of information that had been obtained in two different ways.

Interviewed cohorts: Before the Burlington trial began in 1971, 954 families were randomly selected to receive household interviews about the baseline use of clinical or other health services. After the families were stratified by age of members (to ensure an adequate number of children in the sample) one member of each eligible family in the trial was randomly chosen to receive the interview. The assignments of interviewers and interview dates were also randomly allocated. In 1972, 1 year after the trial began, the same patients received the same household interviews. The refusal rates in these interview surveys were 11% in 1971 and 5% in 1972, so that 817 patients constituted the Burlington interview cohort of people who were successfully interviewed on both occasions.§

In Smithville and the Township of West Lincoln 1616 persons from 402 dwelling units were randomly selected to receive similar interviews to those used in Burlington, with identical field survey techniques. In 1973, 2 years after the baseline survey, the same respondents were administered the same household interviews. The refusal rate was 7% in 1971, resulting in 1501 completed interviews. Of those respondents, 253 had moved away or were untraceable in 1973 and 15 had died. Among the remaining 1233 the refusal rate was 8%. Therefore, 1130 respondents — the Smithville interview cohort — were successfully interviewed twice.

Since the "before" and "after" surveys were conducted in both projects at exactly the same time of year, seasonal adjustments were not necessary for any of the variables.

Burlington office practices: All pertinent events that occurred in the practices themselves were recorded in day-sheet journals and in the usual business records of a medical office. For each visit or encounter with a doctor or nurse practitioner a separate entry was made in the journal, including the following information: patient's identification number; age and sex; date; type of service; whether the patient was new to the practice; presenting complaint(s) or problem(s); diagnosis(es); procedure(s), if any; principal professional person who provided service at the particular visit; whether the doctor was involved in the visit or whether the service was provided by the nurse practitioner alone, without consultation; whether the patient was referred outside the practice; whether the patient was hospitalized; whether a prescription was given to the patient; and dollar value of the service according to the provincial medical association's fee schedule. The information on these day-

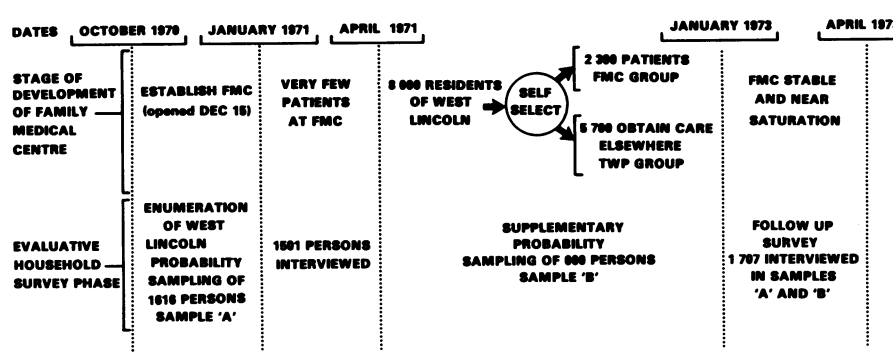

FIG. 2—Design of the Smithville-McMaster project,[20] a study of patients' attitudes before and after introduction of nurse practitioners.

§For 228 pages of questionnaire instruments used in this project, order NAPS Document 02178 from Microfiche Publications, 305 East 46th St., New York, NY 10017, remitting $1.50 for microfiche-copy reproduction or $34.70 for photocopies. Cheques or money orders should be made payable to Microfiche Publications. Alternatively, selected documents are available in the manual cited in footnote †.

†Additional extensive details on methods, data-gathering instruments and results are found in "The Burlington Randomized Controlled Trial of the Nurse Practitioner: Methodological Manual and Final Report" (300 pages), available from the McMaster University Bookstore, Hamilton, ON L8S 4L8 for $8.

‡Additional extensive details on methods, data-gathering instruments and results are found in the "Smithville-McMaster Family Medical Centre: Methodological Manual and Final Report on Demonstration Project" (240 pages), available from the McMaster University Bookstore, Hamilton, ON L8S 4L8 for $7.50.

sheets was used in the clinical analyses mentioned earlier and was also available for economic analysis. The daysheet journals were maintained during the 1-year experimental period of the trial and for an additional 6 months of follow-up from January to June 1973. The total number of encounters recorded for the Burlington study practices was 58 093.

Smithville-McMaster Family Medical Centre: Similar daysheets to those described for Burlington were completed in Smithville from January to June in 1972 and the same months in 1973. The total number of encounters was 3955 in 1972 and 4397 in 1973 but only results from the latter period, after growth had stabilized, are presented here. Although business records were compatible with the university's accounting system, they were also maintained in a manner that simulated those of a private family practice to the greatest feasible extent.

Construction of the Utilization and Financial Index

The main advantage of the household survey information was its provision of data about health services that had been given to respondents by all providers, including those not in the medical practices under assessment. The main advantage of daysheet journal data was the identification of distinctive components of care according to professional criteria of health professionals rendering care. To analyse this massive amount of information, a composite index of health care costs (the UF-Index) was created and other methods of summarization were used.

The most effective way to analyse data from the household survey was to convert all health care cost information to a single form of expression — the UF-Index. The conversion required four successive analytic steps:

1. Of the 12 categories of health services to be asked about during the interview, not all would be reliably recalled after too long a period. The duration of the period of reliable recall can vary from 6 months for remembering a hospitalization, to 1 month for a visit to a dentist, to 1 week for purchase of a prescription.[24-26] Consequently, when patients were asked about use of each category of health service, the period of inquiry was restricted to the reliable duration of the "recall span". Thus, the questions might be "Have you been hospitalized in the past 6 months?" or "Have you purchased a pharmaceutical prescription in the past 48 hours?"

2. The number of units reported in answer to questions for the "recall span" would then be multiplied by an appropriate factor that would convert the data to an annual number of units. Such a conversion might be obviously incorrect for an individual patient whose single visit to a doctor during the antecedent 2 weeks would be magnified into 26 annual visits. On the other hand, magnifications of this type would be reasonably counterbalanced by the zero responses given for the immediate "recall span" by patients who might have obtained an associated health service at some other time of the year. Since the total results were expressed as a mean for the randomly selected group rather than for individual patients, the conversion procedure was considered a reasonable estimate of the annual rates.

3. These tactics would provide an estimate of the count or number of annual units of each health service that had been used by the patients. Next, the cost per unit was determined. For this, each of the 12 different health services listed in Table I was valued (or weighted) at a cost that was the average for all such units throughout Ontario. Data for most of these average costs could be determined from information assembled by the Ontario plan administering Canadian universal health insurance (OHIP). Other sources of appropriate data were selected professional associations, regional public health and welfare authorities, and our research data about nurse practitioners and other nurses.¶

4. Since it was important to retain financial comparability of the "before" and "after" surveys, all health service costs in the follow-up surveys (1972 for Burlington and 1973 for Smithville) were expressed on the basis of the dollar value used for the corresponding service in 1971.

As an example of the calculations, suppose a respondent had visited a physician twice in the preceding 14 days. The factor to convert the 2 weeks to a year is 26, and the average cost of a physician visit in 1971 (according to OHIP) was $7.30. The respondent would thus be estimated to have consumed $379.60 (2 x 26 x $7.30) in the category of physician visits. With such calculations, the sum of physician costs for all 817 survey respondents in Burlington was found to be $39 777.18. The mean annual cost of physician utilization would be $48.69 per patient. Analogous calculations were made for each of the other 11 categories of service in the two study settings.

Data from the daysheet journals: The daysheet journals identified each patient visit to the practice, permitted calculations of counts and values of ambulatory services, and provided rates of hospitalization. They also permitted the involvement of the copractitioners in each visit to be classified as "nurse alone", "physician alone", or "both". Unlike the household survey, the journal surveillance included only the activities actually provided or controlled in the study practices.

Statistical issues

Although the statistical interpretation of changes in utilization is not emphasized in this report, the statistical importance of observed changes has not been overlooked. In assessing simultaneous change in a number of categories of service, the usual approach is to consider each category separately, with an appropriate univariate statistical test. Multivariate techniques are available but in our experience the results are difficult to interpret in a meaningful way. Often, as was the case in the reported studies, few of the observed changes reached statistical significance themselves, yet their combined effect appeared to be substantial.

The UF-Index provides at least half a solution to this problem. By bringing counts of services to a common time denominator and combining them in a

¶For detailed descriptions of sources and methods of calculating the components of the index of health costs order NAPS Document 02347 (65 pages) from Microfiche Publications, 305 East 46th St., New York, NY 10017, remitting money order or cheque (payable to Microfiche Publications) of $1.50 for microfiche or $10.25 for photocopies.

Table I—Categories of health services explored by household survey, with recall spans and empirical dollar weights

Category of service	Recall time span (days)	Unit	Dollar weight per unit
Physician (all subcategories)	14	Visit	7.30
Nurse practitioner	14	Visit	3.35
Nurse (all remaining subcategories)	14	Visit	2.50
Hospital and extended care	183	Night	66.85
Dentist	30	Visit	9.80
Social/welfare worker	14	Visit	20.00
Optometrist/optician	14	Visit	29.35
Chiropractor	14	Visit	6.45
Podiatrist	14	Visit	8.50
Laboratory	14	Services per visit	11.20
Diagnostic radiography	14	Services per visit	13.10
Direct cash expenditures including drugs	7	Dollars	1.00

dollar-weighted sum, the index has obvious interpretation and "face" validity. Clearly, it cannot produce accurate annual utilization estimates on an individual basis but one could anticipate that the mean value of the UF-Index for a population would be quite accurate compared with an equivalent index calculated from actual yearly utilization within each service category.

While gross over- and underestimates of individual annual utilization balance out in the mean, the variance is highly inflated. Since variance is the yardstick by which we assess change, statistical tests based on the UF-Index will lead to conservative conclusions. A number of possibilities exist for improving the estimate of variance but further research and statistical methodologic development are required.

Discussion

A weighted index is a standard tactic to create compatible measures of output for heterogeneous goods or services.[27] We have found that the technique is practical for a health care experimental situation and particularly useful for epidemiologic or health care investigators who lack access to the expensive resources of governmental data-gathering and processing bureaus. A household survey can be used to make one or two probes of a relatively small sample from a population of interest.[28] One can then ascertain utilization rates simultaneously for several heterogeneous categories of health service, convert reported counts to estimated annual rates in equal measuring units for all categories, and express the results in terms useful to administrative decision-makers. In addition, the ability to report utilization for the various categories in identical units of output gives an opportunity to assess the impact of an innovation on total utilization and to determine whether and how the mix of rendered services is altered.

The technique has been proposed as the fundamental tactic in a strategy for evaluation of primary health care services in Ontario for which the targets of assessment include conventional and innovative modalities of practice.[29] The data to be used in a province-wide surveillance method would be those generated for the health insurance information system rather than those obtained by research surveys.

With some modification, determined by the problem to be solved in each case, the UF-Index can be an important tool in the evaluation of ambulatory health care services.

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