Nurse practitioners in primary care III. The southern Ontario randomized trial*

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Summary: A group of nurses who formerly had performed office functions received a special university-based educational program designed to prepare them to assume much of primary care management as nurse practitioners. The associated family physicians would shift their role to general supervision and attention to difficult clinical problems. To test this new form of practice, two complementary randomized trials have been conducted in south-central Ontario. The particular trial reported here was intended to assess the influence of the educational program on the changing roles of the professional personnel. The nurses of 14 family medical practices, with the physicians' support and commitment to participation, applied for the new training. Seven applicants were randomly selected to receive the training and their corresponding practices became the experimental group, while the remaining nurses and practices were retained as controls. During the subsequent year of investigation important changes occurred in professional roles of the experimental group. Nurse practitioners spent more time in clinical activities than conventional office nurses. The shift was not at the expense of time devoted to clinical work by physicians. Doctors delegated more professional activities to nurse practitioners than to conventional nurses. Except for remuneration (affected by legal constraints) job satisfaction among experimental physicians and nurses remained high after one year of experience with the new method.

It is generally acknowledged that doctors in Canada need help to meet the public's demand for ready access to primary medical care. In Ontario, despite a satisfactory overall ratio of one family physician to 1720 persons, access to doctors in various areas is seriously hampered both by population dispersion and by a much lower ratio of physicians to persons.[1]

In recent years the existence of a surplus of nurses in Ontario[2,3] reinforced an emerging multidisciplinary consensus among planners, educators and investigators at McMaster University and at other centres. The belief was that a nurse is the most appropriate professionally trained person to supplement physician care and, in some instances, to replace the doctor.[4,5]

The McMaster University Educational Program for Nurse Practitioners[6,7] was designed to implement this concept. After completion of the program, registered nurses, who had been performing conventional functions in offices of southern Ontario family physicians, have qualified as nurse practitioners or family practice nurses. They then return to the same practices and assume much of the primary care management.

With this new pattern of practice in primary care, the doctors and nurses become co-practitioners. The nurse practitioner assesses patients independently in a large proportion of episodes and is expected to reach a correct action decision. One category of decision for the nurse is referral to the associated physician. With other decisions, the nurse practitioner can provide certain types of health maintenance (such as well-baby care), monitor patient status and therapy for common chronic diseases, and help care for individuals or families with psychosocial problems. In the course of these activities the nurse practitioner makes many minor and occasionally major clinical judgements. The associated physician shifts his (or her) role to one of greater attention to difficult clinical problems and to general supervision of the practice.

Introduction of the nurse as a decision-making co-practitioner is a substantive departure from the conventional mode of clinical management for patients in family medicine. The ultimate effects of this innovation can parallel or transcend the significance of new procedures, new drugs and other new therapeutic regimens.

To be accepted, the new concept required suitable tests of its feasibility. Accordingly, with the support and commitment of physicians and nurses of 16 Ontario private practices, two complementary random-

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*This project received support from a grant of the Ontario Medical Foundation and organizational support from the College of Family Physicians of Canada. Nurse activity studies were supported, in part, by National Health Grant (Canada) No. 606-21-48.

ized trials have been conducted in south-central Ontario.

In one trial, designed to assess the effects on patients, the families of two practices were randomly allocated to receive care from the doctor or from the nurse practitioner. We refer to this as "The Burlington Randomized Trial of the Nurse Practitioner". In the second trial, which focuses on the effects upon doctors and nurses, the nurses of 14 practices located in south-central Ontario were randomly assigned to receive nurse practitioner education or to remain in conventional roles. The second project, reported here, has been designated "The Southern Ontario Randomized Trial of the Nurse Practitioner".

General design of the trial

Only the description of the general design is given in this section. More specific methods are presented with corresponding results in later sections.

Eligibility of practices to enter the trial

The criteria of eligibility for entrance of practices in this trial were delineated in advance and included all of the following:

1. Each medical practitioner was a member of the College of Family Physicians of Canada.
2. The general terms of reference of the nurse practitioners' roles were acceptable to the physician and the nurse in each practice.
3. Each practice agreed to accept the randomization results and to cooperate either as an experimental or control group. (Nurses in the control group were assigned priority for admission to the nurse practitioner course one year after conclusion of the trial.)
4. Each practitioner would submit to all measurements instituted by the research group.
5. Each practice's financial records for the time period of interest would be disclosed to the investigators on request.
6. The practices could not be university- or hospital-affiliated.
7. The practice was located within 50 miles of Hamilton, Ontario, excluding metropolitan Toronto.

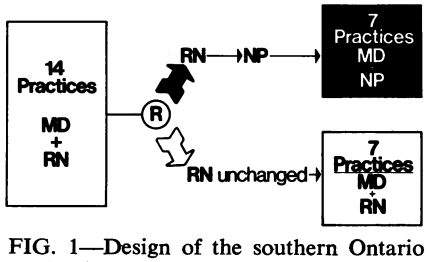

FIG. 1—Design of the southern Ontario randomized trial of the nurse practitioner. R represents randomization process.

The two methods of practice

The contrasting methods to be compared during the 12 months of the trial were as follows: in the conventional practices (the control group), office nurses would provide professional and non-professional assistance to the doctor of each practice in their customary way. Ongoing management of patients would continue to be planned exclusively by the physician based on his (her) clinical judgement. In the nurse practitioner practices (experimental group), the nurses would act as co-practitioners according to ground rules described earlier.

Assignment of practices

Five months before the trial began, the office nurses of 14 eligible practices had applied for the new training to qualify as nurse practitioners. With random number tables, seven nurses were assigned to receive nurse practitioner training and their corresponding practices became the experimental group. The remaining nurses and practices became the control group (Fig. 1).

Research questions

The research questions concerning the new method of primary care were in two categories. The first category concerned financial effects upon practices, physicians and nurses. These results, reported elsewhere, showed that family medicine practices with nurse practitioners were not adversely affected in financial performance.[8]

In this report, we focus on the second category of research questions. These were:

1. How is job satisfaction of physicians and nurses affected?
2. Are physicians' and nurses' views of each others' roles changed?
3. How are clinical and non-clinical activities of physicians and nurses altered?

Timing and implementation of measurements

The nurses in the experimental practices started their educational program in February 1971 and changed their roles in early April 1971. The trial took place from April 1971 to March 1972. Administration of questionnaires, time and motion studies and observation of practices were undertaken by specially trained interviewers and observers of the Health Sciences Field Survey Unit of McMaster University.

Although the results of such a trial would ordinarily require a set of "before" and "after" assessments, certain logistic difficulties prevented the first set of tests from being performed before the trial began. To allow a true set of "before" measurements would have required an unacceptable postponement of the educational program. Instead, the most feasible approximation of "before" measurements, which were called Time 1 values, was done in April and May as soon as possible after the onset of the trial. Time and motion studies extended into early June. The "after" measurements were completed at Time 2, by March 1972. None of the final measurements were made until at least 10 months had elapsed from the beginning of the trial. Each series of measurements was done simultaneously in the conventional practices and in those with nurse practitioners.

Specific methods and results

All 14 practices accepted their random allocations and remained as a part of the study for at least six months. Two practices dropped out before the end of the trial. One experimental practice did so because of professional and financial dissatisfactions. One control practice became university-affiliated. Among the remaining 24 practitioners, compliance to the requirements of the study was nearly perfect. There were minor problems in scheduling some of the measurements.

The individual research questions cited earlier were investigated with the methods and results noted in the sections that follow.

1. How is the job satisfaction of physicians and nurses affected?

Methods: We assessed job satisfaction* of the physicians and nurses using a questionnaire with 67 items that explored: (a) job content, (b) relationships with colleagues, (c) challenge and achievement, (d) available time and energy for the job itself and for other activities, (e) prestige and (f) remuneration. The questionnaire on job satisfaction was adapted from an interview instrument† devised for application to professional occupations.[9] A brief excerpt from the questionnaire used, including instructions and examples of some items included, follows:

Instructions

> After each of the following items circle the 'S' if you are satisfied with that item. Circle the 'D' if you are dissatisfied with the item. Circle the '?' if you are not sure. Circle the 'NA' if the item is not present in your job or not appropriate to it. Please mark each item with your present job in mind.

Selected questions

Job Content	
#16. Committee work required	S ? D NA
#33. Variety of activities required	S ? D NA
Challenge and Achievement	
#47. Feeling of being needed	S ? D NA
#56. Chance to evaluate own work	S ? D NA
Remuneration	
#2. Financial security	S ? D NA
#4. Prospects for future earning	S ? D NA

Since many of the responding practitioners were known to the researchers, an individual not associated with the project or practitioners received and tabulated the instruments. This arrangement was understood by the respondents and allowed them to answer questions without regard to individual relationships.

The maximum possible score (MPS) for all six components of job satisfaction was determined for each individual by adding all the 'S' and 'D' items. The proportion of 'S' items to the total number of 'S' and 'D' items was the score for each individual in the various categories of satisfaction. Maximum possible scores within six categories were then calculated for each individual respondent.

Results: For experimental and control groups the satisfaction scores were expressed as percentages of 'S' items in relation to the aggregate maximum possible scores for the six categories. The scores of physicians are shown in Fig. 2 and of nurses in Fig. 3. With the exception of remuneration, satisfaction scores were high in all components for doctors and nurses of both the experimental and control groups. For remuneration, satisfaction in the experimental group declined in doctors and rose in nurses. Because of the small number of personnel tested, the differences in scores do not attain statistical significance by the usual numerical criteria except in the category of remuneration where the differences are largest and where the probabilities are only borderline.** Nevertheless, we regard the differences as meaningful. They are consistent with the financial concerns expressed by the ex-

*We have adopted the usual terms used in studies of satisfaction with subjects' work: "professional satisfaction" might have been more appropriate in some ways but might also have been misleading or ambiguous.

†Available from the authors on request.

**Using the Mann-Whitney U test (corrected for ties), P=0.19 (one-tailed) for doctors and P=0.047 (one-tailed) for nurses. Using Fisher's exact probability test, P=0.041 (one-tailed) against positive association for doctors and P=0.064 (one-tailed) for nurses. We consider that Fisher's test may underestimate the probabilities because the individual observations may not be strictly "independent" in a statistical sense.

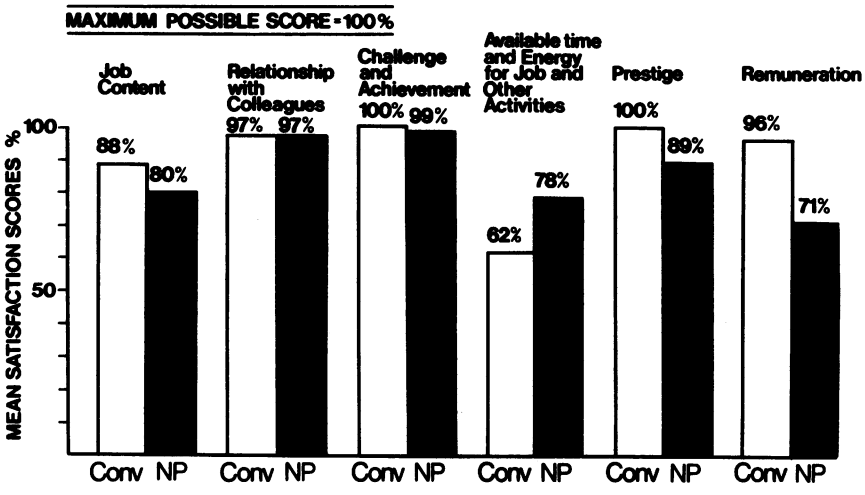

FIG. 2—Satisfaction of physicians with certain aspects of their work at conclusion of trial (March 1972). Conv = conventional control practices; NP = nurse-practitioner experimental practices.

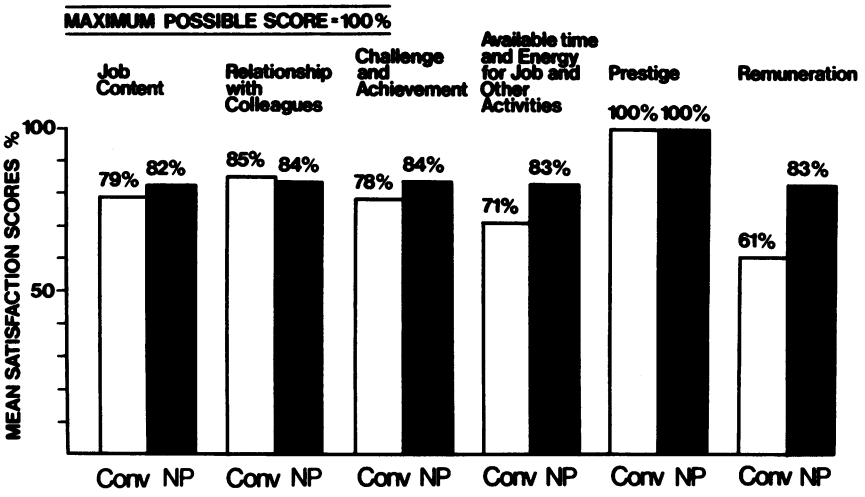

FIG. 3—Satisfaction of nurses with certain aspects of their work at conclusion of trial (March 1972). Conv = conventional control practices; NP = nurse-practitioner experimental practices.

perimenting physicians in another context,[8] and with the financial dissatisfactions that were partly responsible for the drop-out of one of the experimental practices in this trial. These discontents among doctors probably arise from the current legal restrictions that do not allow charges for the services of an unsupervised nurse practitioner. On the other hand, the higher satisfaction of the nurse practitioners could readily be expected because of their accompanying increase in salary.

2. Are physicians' and nurses' views of each others' roles changed?

Methods: We studied mutual perceptions of the practice pairs using standardized questionnaires. Seven selected situational problems of patient diagnosis and management common in family medical practice were described in detail to each doctor and nurse. For each of the seven clinical problems, the respondents were asked about a variety of different roles or activities.[10] The topics or items were grouped in four categories:

1. Performance of procedural tasks (70 items).
2. Assessment of patients (119).
3. Exercise of clinical judgement (126).
4. Performance of health maintenance functions (217).

For each topic, the respondents were asked two questions:

1. Who do you think should perform this role or activity?
2. Who actually does perform the activity in your practice?

When answering, the respondents could choose from four alternatives:

1. Physician only.
2. Nurse only.
3. Interchangeably by M.D. or R.N.
4. Other person.

Scores were calculated separately in each of the four categories of roles or activities for the seven clinical situations. For each category the results were expressed as the percentages assigned to each alternative answer. For example, if there were 40 roles or activities classified in the category "assessment of patients", and a respondent judged 30 of them to be appropriate only to doctors, the score of that respondent would be 75% for opinion about roles appropriate only to doctors in assessment of patients. Similarly, the same respondent could report that the doctor in a given practice in fact performs 36 of the 40 possible roles or activities. The score on actual performance reported would then be 90%. Within a category, e.g. "assessment of patients", the mean of individual respondents' scores was used as the aggregate score for a group such as "control nurses at Time 1" (see Figs. 4 and 5).

Results: In opinions about what work should be done only by nurses, there were no major differences between the experimental and control groups of doctors, either initially or afterward. Similarly, when nurses' views about what activities or roles should be performed only by doctors were elicited, there were no major differences between the groups, initially or afterward. Also, when tabulations were made of items regarded by doctors as proper only for doctors, and by nurses as proper only for nurses, no meaningful contrasts were found.

Some differences did emerge, however, when the physicians identified roles and activities they actually performed themselves, to the exclusion of the nurse. The findings are summarized in Fig. 4, which shows the results at the two time periods for physicians in the conventional control (Conv) practices and nurse-practitioner experimental (NP) practices. The height of each column reflects, for all possible activities, the proportion that was performed exclusively by the physicians. As shown in Fig. 4, the percentages of such "exclusively-physician" activities were lower in the NP group as early as Time 1. Later, at Time 2, an even greater reduction for the NP group had taken place in all categories except Clinical Judgement.

The detailed results of the statistical tests for these data are listed in Table I. Differences were con-

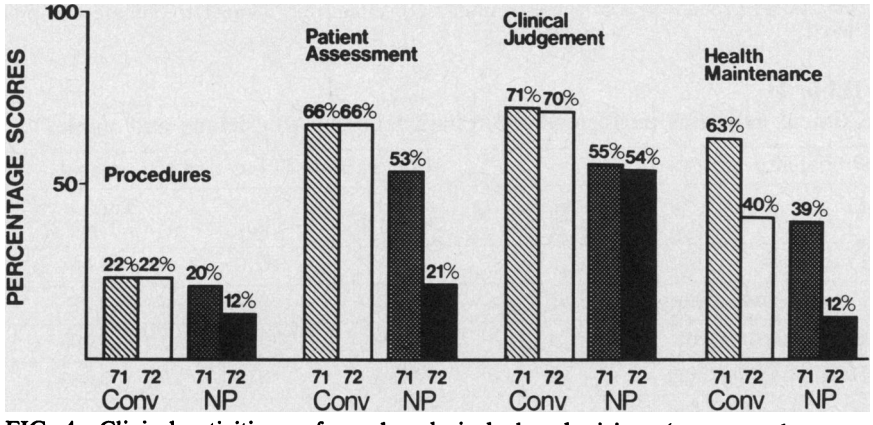

FIG. 4—Clinical activities performed exclusively by physicians (as reported by physicians). Conv = conventional control practices; NP = nurse-practitioner experimental practices; 71 = Time 1; 72 = Time 2.

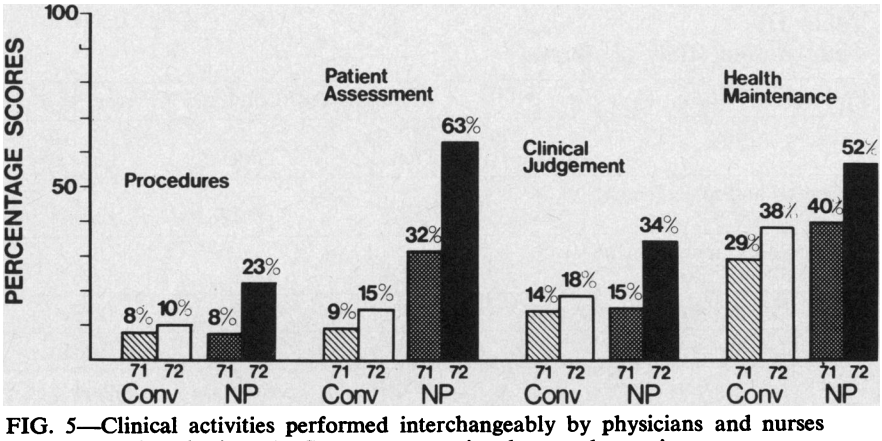

FIG. 5—Clinical activities performed interchangeably by physicians and nurses (as reported by physicians). Conv = conventional control practices; NP = nurse-practitioner experimental practices; 71 = Time 1; 72 = Time 2.

sidered meaningful in a given category if the P values at Time 2 did not exceed 0.05 and were not higher than 0.1 for differences between Time 1 and Time 2.¶ The noteworthy changes for "activities actually performed exclusively by physicians" are in the categories Patient Assessment and Health Maintenance.

Since the physicians and nurses are assessed as co-practitioners in this study, we were particularly interested in the proportion of activities actually performed interchangeably by either health professional. Fig. 5, constructed in a manner analogous to Fig. 4, shows what was reported as interchangeable by physicians at Time 1 (1971) and Time 2 (1972). Higher proportions of activities or roles were being done interchangeably in experimental practices than in control practices at Time 2. Furthermore, the increases between Time 1 and Time 2 in practices with nurse practitioners were considerably more pronounced than those in conventional practices.

Using the same probability criteria specified for the findings in Fig. 4, the increments for categories Patient Assessment and Clinical Judgement were considered important changes (see Table II).

3. How are clinical and non-clinical activities of physicians and nurses altered?

Methods: To ascertain whether there was any change in the mix of clinical and non-clinical activities undertaken by the co-practitioners in a family practice work-week, we did time and motion studies of nurses and physicians in the experimental and control groups. Each series of time and motion studies of both groups of nurses produced observations every two minutes in a representative sample of 288 half-hour periods during an interval of seven weeks. There were 2160 observations in the experimental groups and 2013 in the controls. For the 12 physicians we categorized and timed all activities in a representative sample of 72 half days during an interval of seven weeks. Because of logistical difficulties, the exact time of surveillance was not equal. It was effected for 9202 minutes in the experimental group and only for 7902 minutes in the control group. The inequality in surveillance time did not appear to have any appreciable influence on the results.

Results: Time 1 measurements in this series of assessments were not completed until nearly three months after the trial began. We believe that differences between Time 1 and Time 2 do not reflect shifts in patterns of practice adequately because some of the important changes took place in the first four weeks of the trial. Therefore, only the observations at the

Table I
Clinical activities performed exclusively by physicians*

Probability values:	Comparison of Conv and NP groups†		
	Time 1¶	Time 2‡	Time 1 vs. Time 2‡
Procedures	0.39	0.11	0.23
Patient Assessment	0.042	0.012	0.046
Clinical Judgement	0.016	0.0097	0.16
Health Maintenance	0.042	0.014	0.0065

*Corresponds to Fig. 4 in the text.
†U test (uncorrected) used in column 1 and randomization tests otherwise.
¶Two-tailed probabilities in this column; direction of change not predictable.
‡One-tailed probabilities in these columns; a decline from Time 1 to Time 2 was predicted.

Table II
Clinical activities performed interchangeably by physicians and nurses*

Probability values:	Comparison of Conv and NP groups†		
	Time 1¶	Time 2‡	Time 1 vs. Time 2‡
Procedures	0.31	0.37	0.16
Patient Assessment	0.39	0.0065	0.07
Clinical Judgement	0.18	0.0049	0.095
Health Maintenance	0.39	0.071	0.086

*Corresponds to Fig. 5 in the text.
†U test (uncorrected) in column 1 and randomization tests otherwise.
¶Two-tailed probabilities in this column; direction of change was not predictable.
‡One-tailed probabilities in these columns; an increase from Time 1 to Time 2 was predicted.

Table III
Time-motion study of nurses*

Probability values:	Comparison of Conv and NP groups†		
	Time 1¶	Time 2¶	Time 1 vs. Time 2¶
Diagnosis and management (patient present)	0.026	0.042	0.095
Diagnosis and management (by telephone)	0.39	0.48	0.48
Case study and professional reading	0.35	0.48	0.48
Clerical and housekeeping	0.18	0.042	0.064
Other	0.59	0.35	0.38

*Corresponds to Fig. 6 in the text which only shows Time 2.
†U test (uncorrected) employed for all columns.
¶Two-tailed tests used for all columns; direction of change not considered predictable.

¶Exact probabilities are given in Tables I, II and III, corresponding to the data displayed in certain figures of the text. Three methods were used to calculate the probabilities: (a) Mann-Whitney U Test,[11] (b) Mann-Whitney U Test with correction for ties,[12] and (c) the Randomization Test (after Pitman).[13] The test yielding the most conservative values (i.e. the highest level of probability values) was chosen for each component of the study. However, the probabilities obtained lead to similar conclusions about the comparisons of interest no matter which of the three statistical tests is employed in the analysis. The reader can select other levels of "statistical significance" for any of the possible comparisons.

conclusion of the trial are shown in Figs. 6 and 7.

Considering the results for nurses first (Fig. 6), diagnosis‡ and management with the patient present occupied 33% of the conventional nurses' time in contrast to 56% for the nurse practitioners. For diagnosis and management by telephone, the corresponding values were 10 and 4%. Case study and professional reading during working hours accounted for 0.3% of time in the control group and 5% in the experimental practices. Clerical and housekeeping tasks took nearly twice as much of conventional nurses' time (39%) than of nurse practitioners' time (20%). There was a minor difference for other miscellaneous activities.

To select the categories in which changes were considered important we only took Time 2 differences into account when the P values were less than 0.05. This criterion was met in the category Diagnosis and Management with Patient Present and in Clerical and Housekeeping (Table III).

Although nurse practitioners spent about 50% more time in clinical work and half the time in clerical/housekeeping duties, the shift in time was not at the expense of time of physicians in clinical activities. Nor did the change noted for nurse practitioners result in a higher proportion of non-clinical or clerical tasks done by the corresponding physicians. As shown in Fig. 7, there were no meaningful or statistically significant§ differences between the conventional practices and the practices adopting the new method with respect to activities designated Diagnosis and Management, Professional Non-Clinical and Clerical.

Discussion

It would have been difficult to attain a substantial increase in the level of "job satisfaction" when it was already so high among conventional and experimenting practices. Furthermore, with the small samples available for study, the differences between the groups would have to be substantial before a statistically significant difference would be detectable.

On the other hand, what we consider most important in relation to the research question is that there was no decline in the level of general satisfaction of physicians or nurses in the nurse-practitioner group after one year of experience with the new method except in the area of remuneration. It is noteworthy that despite concern about finances, all the experimenting practices have decided to retain the new approach now that the formal trial is over.

Participation of the experimental group in the nurse-practitioner educational program and in the orientation sessions did not result in differences of opinion between groups about the appropriateness of doctor involvement or nurse involvement in 532 possible activities of family medicine practice. We consider that actual performance of activities is a more reliable indicator of health professionals' perception of roles than their stated views. Compared to control practices a reduction in the proportion of activities carried out exclusively by physicians was reported in the experimental practices. At the same time, more activities were performed interchangeably in the nurse-practitioner group than in the conventional group. Most importantly, the determinations in 1971 and 1972 show the differences became greater with the passage of time with the single exception of activities in the category Clinical Judgement, performed exclusively by physicians.

The assessment of practice activities by objective external observers applying time and motion techniques confirmed what was reported by the practitioners themselves. Compared to conventional office nurses, there were major differences in the patterns of practice of nurses adopting the new role of nurse practitioner. One finding of particular interest to educators of the nurses is that nurse practitioners exhibited a tendency to become self-learners; five months after the conclusion of their formal university course they were observed to spend 5% of working hours in case study and professional reading.

Inferences can only be made

‡"Diagnosis" for nurse practitioners is the act of assessing the problem of a patient and reaching a suitable action decision about the problem. Whenever we monitored nurse practitioners' decisions, in over one third of the cases the action decision selected was "refer to associated physician".

§Using Mann-Whitney's U test, the value of P exceeded 0.35 in all categories.

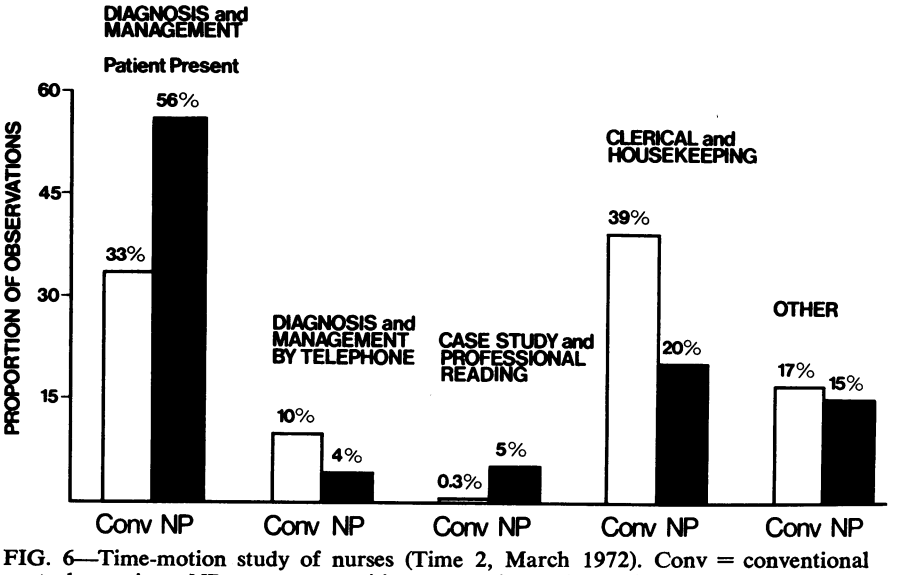

FIG. 6—Time-motion study of nurses (Time 2, March 1972). Conv = conventional control practices; NP = nurse-practitioner experimental practices.

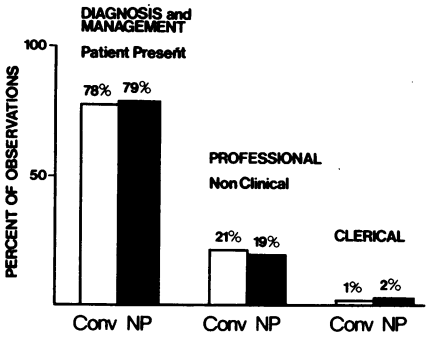

FIG. 7—Time-motion study of physicians (Time 2, March 1972). Conv = conventional control practices; NP = nurse-practitioner experimental practices.

about practices of family physicians in Ontario who are members of the College of Family Physicians. These physicians are characterized further by sufficient interest in this new approach so that it is possible for the nurses associated with them to participate in a demanding post-secondary educational program. It will be many years before nurse practitioners can be trained in our universities and colleges in such numbers that their supply can meet a large demand. It was appropriate therefore, to confine our inquiry to a setting in which the practitioners of nursing and family medicine actively sought to implement the nurse-practitioner role. Within that context, our conclusions are these:

1. Job satisfaction for physicians and nurses does not decline after adoption of the new mode of practice except concerning remuneration among physicians. Physicians and nurse practitioners, having worked as co-practitioners for one year, assessed the concept of provision of primary care by nurse practitioners favourably in all cases.
2. Roles and activities in patient assessment and health maintenance formerly the exclusive domain of physicians are delegated to a greater extent to nurse practitioners than to conventional nurses. Practices with nurse practitioners also exhibit a higher proportion of clinical activities carried out interchangeably by the physician or the nurse.
3. Compared with conventional nurses, nurse practitioners spend about 50% more time in clinical activities and 50% less time in clerical and housekeeping duties.

The authors would like to express appreciation to Dr. Ronald G. McAuley and Miss Norma A. Wylie for their considerable contribution in the earlier formulation and delineation of the problems studied here. Ms. Linda Fischer assisted in certain data gathering and analytical tasks. Miss Eileen Fedor, in collaboration with Audio-Visual Services, McMaster University, prepared the illustrations for the text. Dr. Alvan R. Feinstein was very helpful in reading early drafts of the manuscript and offering constructive criticism. Miss Helen Fulton prepared several drafts of the manuscript. The most essential contribution, however, was made by the members of the College of Family Physicians of Canada and their associated nurses who patiently and cheerfully sustained the investigators' extended surveillance.

Résumé

III. Résultats d'essais effectués dans l'Ontario méridional

Un groupe d'infirmières dont la tâche était jusqu'alors purement administrative ont reçu une formation universitaire spéciale conçue pour les préparer à devenir infirmières cliniciennes et à leur permettre d'assumer une grande partie des soins cliniques fondamentaux. Les médecins de famille qui ont participé à ce projet réservaient alors leur rôle à une surveillance générale et à régler les cas cliniques difficiles. Pour évaluer cette nouvelle forme de pratique médicale, il a été décidé d'entreprendre, dans l'Ontario méridional, deux études complémentaires effectuées d'après la méthode du tirage au sort. L'étude qui est rapportée dans le présent article avait pour objet d'évaluer l'influence du nouveau programme de formation sur les nouveaux rôles du personnel paramédical. Les infirmières de 14 bureaux de généralistes, avec l'accord des médecins et l'engagement personnel de ceux-ci à participer au projet, ont sollicité leur inscription. Sept candidates, choisies au hasard, faisaient partie du groupe expérimental, les autres étant considérées comme groupe-témoin. Au cours de l'année qui a suivi le début de l'enquête, d'importants changements ont été notés dans le rôle professionnel des participantes au groupe expérimental. Les infirmières cliniciennes ont évidemment consacré plus de temps à la clinique que les infirmières classiques. Ce changement ne s'est pas fait aux dépens du temps consacré par les médecins au travail clinique. Les médecins ont délégué aux infirmières cliniciennes une plus grande activité purement professionelle. Sauf en ce qui concerne la rémunération (régie par les contraintes de la loi), les médecins et les infirmières du groupe expérimental étaient très satisfaits de leur nouveau rôle après une année de fonctionnement.

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