LONGITUDINAL PANEL ANALYSIS OF NURSING REGISTRANT DATA

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This paper examines the methodological advantages and limitations of applying techniques of longitudinal panel analysis to nursing registrant databases. Given that the costs for primary data collection are increasing, it is essential to take full advantage of existing data sets through secondary data analysis techniques. Nursing registrant databases (collected regularly by licensing authorities, government agencies and other organizations in many jurisdictions) provide an excellent opportunity for investigating mobility trends and patterns in nursing employment over time. This paper describes one such data set and identifies the strengths and weaknesses of applying longitudinal panel analysis techniques to the data.

All registered nurses working within the profession in the province of Ontario are required to renew their registration with the College of Nurses of Ontario (CNO) on an annual basis. Each year registrants must complete a short survey focusing on the nature of their employment at the time of registration. Variables collected from the survey form include employment status (full-time, part-time or casual), place of employment (a detailed classification of the type of unit or organization nurses are employed by), primary responsibility (or practise specialty within the profession), and position type (according to status and degrees of authority within organizations), along with other information. The CNO has collected such data for many years, but has only recently (since 1984) been recording them in machine-readable form for data processing.

A large population database containing all available nursing registrant survey data (from 1984 to present) was constructed. Data for individual registrants were linked across the years by matching the CNO registration numbers, which were unique for each individual. By processing and analyzing registrant data as a longitudinal panel (covering a number of years), it is possible to track the employment histories of individual registrants over time, and highlight their subtle yet significant transitions in employment. This permits a detailed investigation of patterns of stability and mobility, since it is possible to directly

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compare the classification of individual registrants on a given variable from year to year. Various analyses can be applied to the longitudinal panel data for detecting significant trends.

Longitudinal panel analysis is distinct from more traditional analyses of simple cross-sectional surveys, which do not track individuals over time. Most previous research on the employment of nursing professionals has taken the form of cross-sectional surveys or one-shot case studies. While this may provide profile "snapshots" at distinct times (Uncles, 1988, p.3), much of the change or employment mobility can only be assessed by actually tracking the experiences of individuals over a period of time using a longitudinal panel design.

Even when cross-sectional surveys are retrospective (e.g., covering employment histories), the survey data are inferior to those generated via longitudinal panels. Accurate recall may pose serious problems when long periods of time are being covered by a single cross-sectional survey or when very detailed information about multiple past employment experiences is being requested. Uncles (1988, p.3) summarized that: "Inaccuracy is a problem [with cross-sectional surveys] because people's recollections are relied upon when it is known that their memories are fallible."

A longitudinal panel design avoids problems of recall by requesting only current or very recent information at distinct points in time which may later be merged together for a full-scale panel analysis. The data collected are generally fresh in the minds of registrants as they are completing survey forms, and records are therefore believed to be more accurate (Uncles, 1988, p.4). It has also been suggested that with panel designs there are fewer problems associated with recall loss, recall distortion, and telescoping or over-reporting for a specified recall period (Uncles, 1988, p.4).

Another distinct advantage of working with longitudinal panel data relates to the possibility of establishing causal ordering among study variables. In his book on longitudinal data analysis, Coleman (1981, p.65) stated that: "With panel data some information about the sequence of states is available, and under certain conditions, this information can aid in establishing the causal order." He added that: "This information about causal ordering is in many cases the principal purpose of obtaining panel data rather than depending on cross-sectional data." Uncles (1988, p.5) concurred, noting that with longitudinal panel designs "... spurious statistical effects can be isolated from real behavioural effects."

Longitudinal panel analysis offers a very different research strategy and direction. For the nursing registrant data discussed here, it permits a more systematic and thorough investigation of the employment mobility and stability of Ontario registered nurses. This analysis goes well beyond the detection of aggregate profile differences over time, identifying the changers and their

impact on the nursing profession province-wide, as well as the stable professionals who are contributing to the status quo. Longitudinal panel analysis helps to identify a number of subtle, yet important shifts over time which are not readily apparent from a simple analysis of aggregate profile changes.

As with any data analysis, there are distinct limitations associated with longitudinal panels such as the nursing registrant data described here. One of the most serious limitations relates to changes in the definition of variables over time. For some of the survey variables, new categories were added and old categories deleted to improve the accuracy of the data collected and capture important changes in nursing practice. Campbell, Mutran, and Parker (1986, p.485) observed that managing a complex longitudinal data set requires many difficult decisions, including coding comparability over time.

In the current context, for instance, the category "nursing in several areas" was added to the "primary responsibility" variable to reflect the fact that an increasing proportion of registered nurses were working in more than one specialty. Such modifications have an impact on the distribution of registrants across remaining categories and complicate the analysis of mobility patterns on single variables over time. The variables of marital status and nurses' union membership status were dropped from the CNO registrant survey form in 1989 after there were objections to personal data of this nature being collected. Hence, it is no longer possible to examine the relationship between these factors and critical employment variables over time.

Another limitation of longitudinal panel data analysis is that there are missing data for some critical variables. In some cases the survey form specifically excludes certain segments of the nursing population, such as those working outside of the province of Ontario, or those working outside of the field of nursing. As well, the annual registrant survey does not capture data from first-time registrants — those who have recently entered the nursing field and are registering with the College of Nurses of Ontario for the first time. Survey data on first-time registrants are not collected until their second year of registration.

The non-reporting of data invariably causes problems with surveys where completion is voluntary. Liang and Zeger (1986, p.20) noted that missing data were common in some longitudinal studies, but stressed that they must be completely random (that is, missing status must not be dependent upon a previous outcome) in order to ensure that estimated statistical parameters be consistent. In future, the problem posed by missing data is expected to be lessened. The CNO has introduced new regulations which will make survey form completion mandatory for all registrant surveys beginning in 1990.

As a longitudinal panel, CNO registrant data are further limited since they only capture one classification for each employment variable per year. Multiple

changes in classification in a single year are not captured on the survey form and the true magnitude of employment mobility is underestimated. For instance, short-term switching behaviour, such as moving from a general hospital to a nursing home and back to a general hospital all in the same year, cannot be detected.

Further, since broad categories are used on the survey form other instances of actual mobility may be missed or masked as stability over time. For instance, a nursing registrant may report being employed in a general hospital on 1989 and 1990 survey forms (which would be classified as stability or no change over time), but may have moved to a new general hospital in the interim. In this case, employment mobility would not be evident from the analysis of the longitudinal panel.

It is important to recognize that CNO registrant data were originally collected for administrative, rather than research purposes. Analyses were performed annually. Only recently have data from consecutive years (1984 to present) been linked together via registration identification numbers to construct a longitudinal panel for the Ontario nursing population. While the survey was not originally designed for longitudinal panel analysis, it is certainly possible to restructure registrant data into a longitudinal panel form to derive new insights into the employment mobility of nursing professionals. Despite the aforementioned limitations and problems, it is a rich data source for the analysis of mobility patterns among registered nurses over time.

Data Illustration

A simple example is provided here to demonstrate the advantages of examining nursing registrant data in longitudinal form rather than relying upon cross-sectional survey analysis. While the illustration described here focuses on only one-year change, the techniques of longitudinal panel analysis can easily be extended to examine any time frame of interest. For example, Hiscott (1991) produced two analyses for the period 1984 to 1989, based on registrant data and using all available variables.

Table 1 provides frequency distributions for employment status of registered nurses for the 1989 and 1990 registration years. These figures include registered nurses working both inside and outside of the province of Ontario, who reported their employment status on both 1989 and 1990 survey forms. The figures shown for each year represent results from treating each of the two annual surveys as a simple cross-sectional survey. Since there are negligible differences in the percentages over the two years, one would be tempted to conclude that there was virtually no mobility among registered nurses.

Table 1

Employment Status of Ontario Registered Nurses for 1989 and 1990

	1989		1990	
	Number	Percent	Number	Percent
Full-Time	45,053	58.6	45,020	58.5
Part-Time	24,817	32.2	25,026	32.5
Casual	7,100	9.2	6,914	9.0
Totals	76,960	100.0	76,960	100.0

The aggregate profile for employment status presented in Table 1 provides a partial picture at best; it does not truly reflect the extent or magnitude of employment mobility along this dimension over time. Table 2 shows employment status data for the same two years treated in longitudinal form — that is, viewed as a longitudinal panel rather than as two independent cross-sectional surveys. Only by examining this turnover table is it possible to ascertain the magnitude of mobility along this employment dimension, to determine the proportion of stable and mobile registrants, and identify patterns of mobility.

Table 2

Mobility Between 1989 and 1990 for Employment Status of Ontario Registered Nurses*

	Employment Status 1990			
Employment Status 1989	Full-Time	Part-Time	Casual	
Full-Time	53.5	3.8	1.2	45,043
Part-Time	3.8	26.4	2.1	24,817
Casual	1.2	2.3	5.7	7,100
Column Total	45,020	25,026	6,914	

* Cell entries are grand percents totalling 100% for the table

The shaded cells of the turnover table (Table 2) represent stability; a total of 85.6% of registrants did not change employment classification between 1989

and 1990. However, the remaining 14.4% of registered nurses (approximately one in seven) were mobile, with a total of 7.3% increasing their status (i.e., moving from part-time to full-time (3.8%), and from casual to full-time (1.2%) or part-time (2.3%)), and 7.1% decreasing their employment status between 1989 and 1990. Equivalent proportions of registered nurses increased and decreased their employment status, as shown by the basic symmetry in the turnover table. The number of registered nurses moving between pairs of categories tend to be comparable (e.g., the number changing from full- to part-time status is very similar to the number moving in the reverse direction, from part- to full-time status). This pattern of symmetry is not necessarily found in other mobility or turnover tables.

Discussion

While little change was evident from Table 1, approximately one in seven registered nurses reported changing their employment status between 1989 and 1990 as seen in Table 2. By treating nursing registrant data as a longitudinal panel rather than as independent cross-sectional surveys, it is possible to determine the actual magnitude of mobility along different employment dimensions. When similar techniques of longitudinal panel analysis were applied to other employment variables, there were relatively high levels of mobility — even over a one-year period. Approximately one in eight (12.4%) of registered nurses reported a change in their place of employment, and a full quarter (25.9%) indicated a change in primary responsibility. The magnitude of mobility increases considerably when longer time frames are examined. Hiscott (1991) found, for example, that over the period 1984 to 1989 31.3% of reporting nurses indicated a change in their employment status. By applying the techniques of longitudinal panel analysis to nursing registrant data, it is possible to achieve a better understanding of employment mobility.

While the illustration provided here is a simple one, a variety of more sophisticated multivariate techniques are appropriate for the analysis of longitudinal panels. For instance, Campbell, Mutran, and Parker (1986) compare three different multivariate statistical methods as applied to longitudinal panel data: multivariate analysis of variance or MANOVA, linear structural relations or LISREL, and a third class of similar models including hazard models, event history analysis, and survival analysis. They conclude that each of these statistical techniques is appropriate for different research problems involving longitudinal panel data, and that no single technique is optimal for all situations.

One can add to this group of statistical methods a class of log-linear models which are appropriate for the analysis of mobility or turnover tables and hence well suited for the analysis of longitudinal panel data. Log-linear modelling is a powerful statistical technique for the analysis and interpretation of relation-

ships or associations between categorical (nominal-level) variables. A particular class of log-linear models (independence, quasi-independence, symmetry and quasi-symmetry) are especially appropriate for the analysis of turnover or mobility tables (Hagenaars, 1990; Hout, 1983). In each case, these models are applied to symmetrical turnover tables which express registrant status at two points in time. Variables must be recoded to ensure the same coding scheme is used for both years providing standardized square (symmetrical) turnover tables. These models were useful for examining the nature of relationships in complex mobility tables for a longer time frame — 1984 to 1989 (Hiscott, 1991).

Whether one wishes to examine data in a simple fashion (i.e., looking at percentage distributions in turnover tables), or through applying more complex multivariate statistical models, the benefits of working with longitudinal panel data are clear. Far more accurate information can be gleaned about the nature and magnitude of employment mobility through treating these nursing registrant data as a longitudinal panel, as opposed to analyzing a series of independent or cross-sectional surveys. Nursing registrant data (whether collected by a licensing body, government agency or other organization), when organized in a longitudinal panel form, can provide important information on the employment mobility of nursing professionals.

Implications

Given that primary data collection through survey research is very costly, it is prudent to make full use of existing survey data sets when possible. The form of secondary data analysis applied in this paper makes fuller use of registrant data that were originally collected by CNO for administrative purposes. When organized in the form of a longitudinal panel, these data help answer some very specific research questions about the employment mobility of nursing professionals.

The methods described here could be applied to registrant data from other jurisdictions (e.g., data collected by other provincial licensing authorities), as well as other professions. To illustrate the latter point, CNO data for registered nurse and registered nursing assistant groups were set up in longitudinal panel form as separate data sets for the analysis of employment mobility patterns of each. Independent analysis of the data for each professional group was essential since important differences in the basic employment profiles had a significant impact on employment mobility patterns.

By applying these techniques to registrant data from other jurisdictions it would be possible to address national trends, and provincial or regional differences in patterns of employment mobility of nursing professionals. Do registered nurses in Ontario, for example, experience more or less employment mobility than nurses in British Columbia or Atlantic Canada? Does the form of employment mobility differ from province to province? Comparisons between

provinces or regions could yield important information on differences in employment mobility trends among nursing professionals. However, in order to conduct such regional comparisons, data collection would have to be highly standardized. For instance, it would be helpful if all provincial licensing authorities used a common survey questionnaire for the collection of registrant information. Such standardization would help to ensure that any comparisons between provinces or regions would be accurate and reliable.

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RÉSUMÉ

Analyse d'une étude longitudinale sur les personnes inscrites en sciences infirmières

Cet article concerne les techniques d'analyse d'études longitudinales sur les personnes inscrites en sciences infirmières. Ces informations sont recueillies chaque année par l'Ordre des infirmières et infirmiers de l'Ontario. Le traitement des données recueillies sous une forme longitudinale au cours de plusieurs années permet d'examiner en détail les différents schémas de mobilité d'emploi des professionnels en sciences infirmières de l'Ontario. Cette technique permet de suivre pendant quelque temps l'historique d'emploi des personnes inscrites en sciences infirmières, et d'identifier celles qui changent de statut dans le cadre de leur emploi pendant une certaine période. Un exemple simple est fourni pour démontrer les forces de ce type d'analyse, et les avantages méthodologiques par rapport aux recherches transversales simples sont décrits. Les limitations quant au travail sur des données recueillies longitudinalement sont également évoquées.