# STRUCTURE-PROCESS-OUTCOME: A CAUSAL MODEL FOR QUALITY IN NURSING HOMES

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## Abstract

*In this paper, we explore the correlation structure between some indicators of quality in nursing homes. These indicators include Structure (Staff and Facility), Process (Social Care, Medical Care, and Resident Involvement), and Outcome indicators (Medical Outcome, Social Outcome, and Organizational Performance). Using path analysis, a causal model is also hypothesized and empirically tested based on these indicators and on data collected for 104 nursing homes in Wisconsin. This causal model constitutes a basis for formulating quality improvement strategies.*

## Introduction

The purpose of this study was to investigate cause and effect relationships among quality dimensions and organizational characteristics in nursing homes.

We needed some common frame of reference to study the causal relationship among the quality indicators of nursing homes. So, we decided to use WHO's definition of health, by which health is a "state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity" (Alma-Ata, 1978).

We also decided to use Donabedian's (1966, 1969) framework for evaluating the quality of patient care: structure, process, and outcome. This trilogy has been generally accepted as an approach to assess quality of care, as well as an instrument to classify quality assurance programs (Constanzo and Vertinsky, 1975; Lohr and Brook, 1984; Lohr and Ware; 1987).

Structure corresponds to the physical characteristics of the health care settings (e.g., types of full-time staff, specialities available), or the characteristics of the providers (e.g., medical speciality certification). Process variables are those that describe what is done by practitioners to the patient. Lastly, outcome variables reflect what happened to the patient, in terms of palliation, treatment, cure or rehabilitation. Physical function, psychological function, and social function are considered effects of care, as well as client attitudes and their behavior relevant to care. Due to numerous problems in measuring process and outcome in isolation, process-outcome evaluation has been advocated by various authors (Bellinger, 1976; Chen et al., 1975; Drummond et al., 1987; Miyamoto and Eraker, 1985, 1988; Torrance et al., 1982).

This paper presents the findings obtained in the second phase of a project to assess the quality of care delivered in nursing homes based on a population of 104 nursing homes in Wisconsin. In the first part of the project we used factor analysis to group variables into different factors such as structure factors, process factors, and outcome factors. Here we explore into more depth the cause and effect relationships between these quality factors.

As explained in a previous paper (Sainfort and Ferreira, 1989), we based our study on the

Quality Assessment Index (QAI) developed by Gustafson et al. (1981) and intended to measure the quality of care in nursing homes. The validity and the reliability of this instrument are reported elsewhere (Gustafson et al., 1990). Figure 1 presents the aggregation of 19 variables into 8 factors, as obtained through factor analysis.

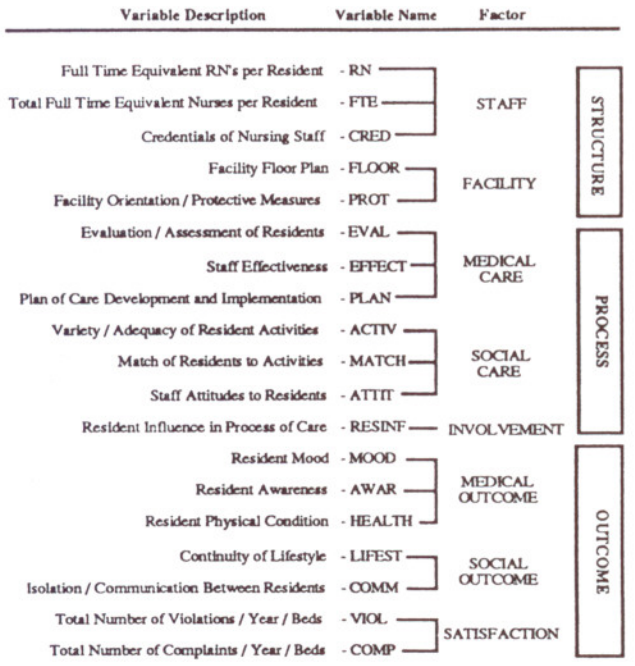


Figure 1 - Quality Variables as Obtained by Factor Analysis

## Methodology and Results

### Methodology

We began our investigation of the underlying causal structure by analyzing the correlation coefficients among variables.

However, correlation alone does not prove causation. So, we used path analysis to investigate the cause-effect relationships between quality variables.

First, based on Donabedian's model, we hypothesized a structure-process-outcome quality model.

However, the model at this level is not directly operational to help administrators to design specific quality improvement interventions. So, the second step is to hypothesize a similar model at the factor level. Figure 2 shows such a model. The factors obtained from factor analysis and used here are S1 (staff), S2 (facility), P1 (social care), P2 (medical care), P3 (resident involvement), O1 (medical outcome), O2 (social outcome), and O3 (satisfaction).

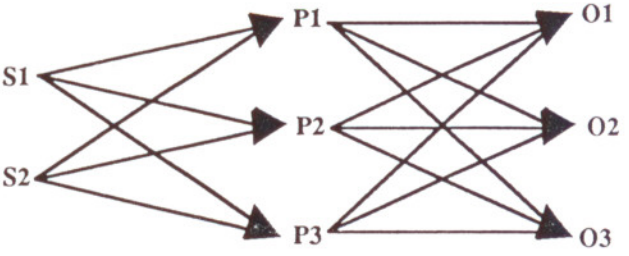


Figure 2 - Hypothetical Causal Model

In order to test this hypothesized causal model, we used path analysis. The purpose of path analysis is to provide explanations of cause-and-effect relations among variables, based on the observed correlations. It is a specific statistical technique based on row and standardized multiple regression (Heise, 1975), and weighted regression with proportion or percentage differences (Davis, 1975; Taylor, 1983).

To help the reader less knowledgeable about this technique, we will present an example that we believe will be enough to understand the rest of this paper. Let us pose the following path analysis based on a hypothesized causal relation between two variables $X_1$, $X_2$, and the variable Y, and allowing an error $\varepsilon$, in the relationship:

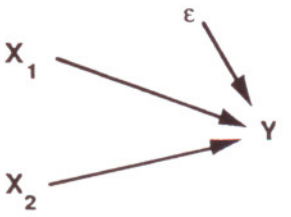


Figure 3 - Hypothesized Causal Relation

In terms of a linear model, we may write

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$$

This model can be written in a standardized form

$$Y = p_{Y_1} X_1 + p_{Y_2} X_2 + p_{Y_\varepsilon} \varepsilon$$

where the regression coefficients for the standardized predictors $p_{Y_1}$ and $p_{Y_2}$ are called path coefficients. The error $\varepsilon$ is assumed to be uncorrelated with $X_1$ and $X_2$.

The path coefficients express the importance of the direct and indirect influences. Johnson and Wichern (1988) give the following example:

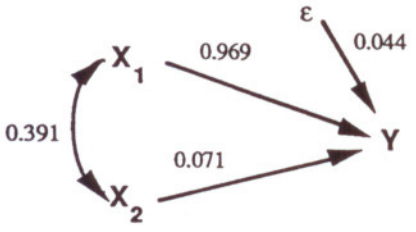


Figure 4 - Path Diagram

In this case, $X_1$ affects Y directly ($\hat{p}_{Y_1}$ = 0.969) and also affects Y indirectly through $X_2$, via the correlation coefficient between $X_1$ and $X_2$ (the indirect effect is measured by 0.391 × 0.071 = 0.028).

In the correlation and path diagrams, we used arrows with the following meaning:

| | |
|---|---|
| X ◄——► Y | X and Y might show statistical correlation, but we do not assume anything about the direction of the relationship |
| X ——► Y | positive relationship: the greater the X, the greater the Y |
| X – –► Y | negative relationship: the greater the X, the less the Y |

Figure 5 - Notations

Results

Figures 6, 7, and 8 present the significant ($\alpha$=0.01) correlation coefficients within each Donabedian's assessment category.

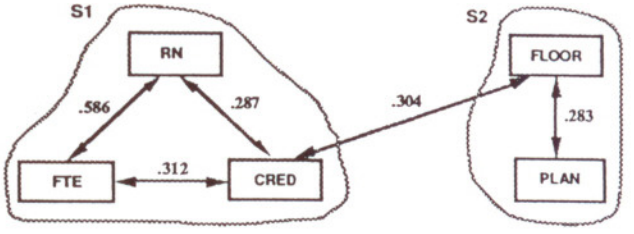


Figure 6 - Correlation Coefficients for Structure Variables

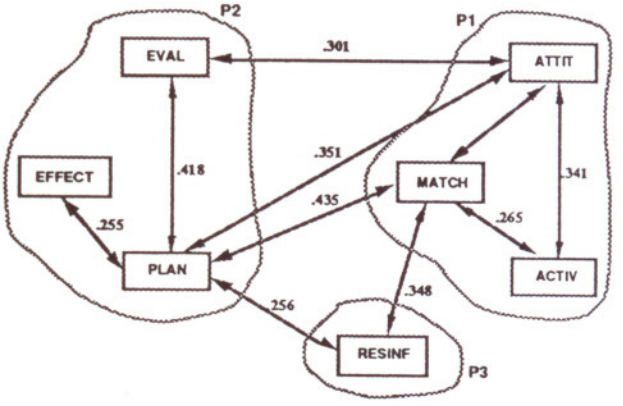


Figure 7 - Correlation Coefficients for Process Variables

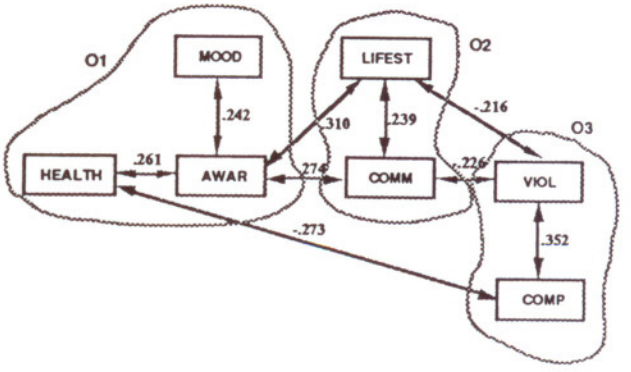


Figure 8 - Correlation Coefficients for Outcome Variables

The result of the path analysis performed to test the causal model hypothesized in Figure 2 is presented in Figure 9. In this model, we divided the third outcome factor O3 (satisfaction) into its two components - complaints & violations - in order to gain additional information on what contributes to these outcomes.

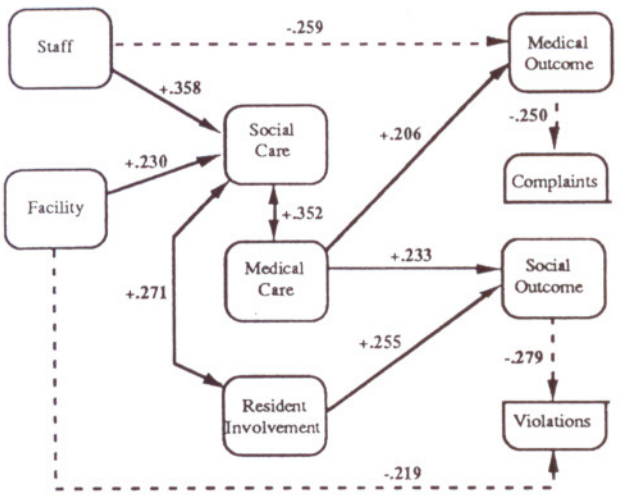


Figure 9 - Path Analysis for Structure-Process-Outcome

As we can see, social care provided in the nursing home is primarily determined by the composition and effectiveness of the staff, the characteristics of the facility, and the involvement of residents in the process of care. Contrary to the original classification, it looks like the social care as defined by three variables (variety and adequacy of activities, match of resident to activities, staff attitudes to residents) may be considered as an outcome rather than a process variable. In practice, the line between the end-result of a process and an outcome is often difficult to draw. Anyway, it is more important to recognize what elements tend to contribute to good social care. In addition, social care process and medical care process are strongly correlated.

Looking at the outcomes and how structure and process contribute to them, the only unexpected result is that staff contributes negatively to the medical outcome. A possible explanation of this counter-intuitive causal relationship may be that the nursing homes with a mix of residents who have severe conditions and therefore poor medical outcomes are also the nursing homes with high credentials staff. It would be necessary to account for case mix to further study this relationship. It should be noted, however, that staff positively affects medical outcome indirectly through the social and medical care processes. Medical care is an important predictor of both medical outcome and social outcome. Social care is also such a predictor, but only indirectly through medical care.

Social outcome is explained directly by medical care and resident involvement and indirectly by social care and its own determinants, that is: staff, facility and resident involvement.

Finally, in terms of the organizational outcomes at the end of the spectrum - complaints & violations - complaints are directly caused by poor medical outcomes whereas number of violations are caused directly by poor social outcome and poor facility characteristics. These results confirm what one could have intuitively predicted.

## Conclusions

The causal model developed in this paper allows to highlight the intensity as well as the direction of relationship between different variables related to the structure, process, and outcome of care delivered in nursing homes.

The next step in using such a model is to identify which variables are controllable by nursing home administrators and to design actions to improve such variables in the desired direction in order to improve selected outcomes. For example, resident involvement is a variable that has significant positive effects on social care and social outcome. Such an element is relatively easily controllable and furthermore does not require significant spending. It would be advisable to provide guidelines to nursing homes to ensure proper resident involvement in the process of care. Other variables can be improved in the same way, although they might necessitate additional spending.

The strength of the relationships may help nursing homes in prioritizing the different potential interventions and may allow better decision making, according to the final

objectives of each nursing home. For example, depending on the mix of patients, some nursing homes will emphasize health rehabilitation more than providing a high quality social environment, although all nursing homes would consider both objectives important and intertwined.

We believe that this study opens an important research avenue and that further research needs to be carried out to refine such models by incorporating other important elements such as resident mix. Finally, specific guidelines to help administrators should be devised and implemented on the basis of such causal models.

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## Biographical Sketch

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