

# Nursing dependency, diagnosis-related groups, and length of hospital stay

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*Most efforts to modify the diagnosis-related group (DRG) case classification system focus on variables related to medical management. In this study, we investigated the separate but related natures of medicine and nursing by examining 1,288 adult medical and surgical patients in an urban teaching hospital. The complexity of medical treatment was*

*measured by use of the DRG relative cost weight. The nursing indicator was derived from a set of nursing diagnoses. We found that the DRG cost weight is a poor predictor of nursing dependency and that the nursing dependency index added significantly to the DRG weight in explaining length of stay.*

## Introduction

The development of the concept of the diagnosis-related group (DRG) facilitated the melding of seemingly unrelated hospital activities: medical care and financial management. "The nursing perspective was conspicuously absent from DRG construction, both because the available data contained no dependency or psychology-of-illness measures and because hospital accounting methods do not reflect patient-specific variations in the use of nursing time" (Smits, Fetter, and McMahon, 1984).

The degree of patients' dependence on nursing care is of considerable importance in their clinical management and the management of nursing department resources in acute care hospitals. This nursing dependence must be ascertained to ensure effective patient management and to more efficiently utilize nurses, the costs for whom make up 20-30 percent of total hospital expense. The contributions nurses make in patient care management are not well understood because nursing is often blurred together with medicine and the outcome of nursing activity attributed to physicians. Fagin (1982) has summarized reports of nurses' independent and cost-effective contributions to care in hospitals, in extended care, and in the community.

The nursing perspective on DRG's is important for two reasons. First, in the construction of DRG's, length of hospital stay played a less significant role than is commonly believed. Meaningfulness to physicians was a more important criterion in the development of the DRG system than was explanation of variability in length of hospital stay. For example, despite similar lengths of hospital stay, patients having a dilatation and curettage are classified in a different DRG than patients having a cystoscopy because different physician specialists treat these two patient groups. In addition, the number of and statistical behavior in the groups formed and the use of existing data in the Uniform Hospital Discharge Data Set limit the utility of the DRG's in explaining length of stay. Indeed, the DRG system was tested and adopted for use primarily because variability in

costs of care for Medicare patients was explained in a manner understandable to physicians and not because it is the model that best predicts length of stay (Shin, 1977). Per diem costs are only one component (albeit about 50 percent) of hospital case costs; nursing care costs comprise one-half of room and board expenditures. DRG case-mix-based explanatory models do not explain room and board costs as well as they explain total or ancillary service costs that are based principally on physician orders (Shin, 1977).

A second reason for identifying the nursing perspective is to establish a constructive relationship among physicians, nurses, and the patients they both treat. The DRG payment scheme masks the contributions nurses make to effective patient care by attributing all patient costs, and therefore management, to physician-generated activity—the establishment of the principal diagnosis and subsequent treatment. For certain hospital patients (the dying, for example), the principal treatment is nursing, often given in great measure (Halloran, 1980). Considerable attention has been given to possible abuse of Medicare patients' rights to continued hospitalization, but few have yet questioned the premise that physicians are in the best position to manage all aspects of hospital care (Inglehart, 1986; *New York Times*, 1986; *Federal Register*, 1986).

Numerous modifications to the DRG system are proposed to improve the measurement of hospital case mix by taking severity and intensity of patient illness into account. Case-mix measurement is intended to characterize episodes of hospitalization in a manner that permits prediction of the resources needed for care during the stay. Because length of stay is a commonly used measure of hospital resource utilization, the ability to predict length of stay by using DRG's is frequently used as an evaluation criterion in critiques of the DRG case-mix measure.

A number of researchers reported length-of-stay variability within DRG's and sought to explain this variability by faulting the DRG system (Berki, Ashcraft, and Newbrander, 1984; Gonella, Hornbrook, and Louis, 1984; Horn, Sharkey, and Bertram, 1983; Knaus et al., 1981). In several of these commentaries, the authors presented patient classification systems that explain variability in length

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of stay (Gonella, Hornbrook, and Louis, 1984; Horn, Sharkey, and Bertram, 1983; Knaus et al., 1981).

On examination of the content of these measures of severity or intensity of illness, considerable overlap can be seen among well-established methods that estimate nursing time (Abdellah et al., 1960; Giovanetti, 1978), the proposed scales, and the DRG patient classification scheme itself. Although a zero-order correlation between 21 different DRG relative cost weights and mean nursing care hours produced a value of 0.737, reducing nursing care hours to means within DRG's tended to smooth variability among the 1,600 patients studied and inflated the correlation coefficient (McKibbin et al., 1985). However, studies have shown DRG's to be a relatively poor predictor of nursing time; not surprisingly, total nursing time seems to be highly correlated with length of hospital stay (Caterinicchio and Davies, 1983; Halloran, 1980; Sovie et al., 1984). A patient classification system that is shown to be independent of the DRG and of value to clinicians in case management is needed (Jencks et al., 1984). Like DRG's, the scheme must be meaningful to clinicians, who should be able to relate the classification to their patient care practices.

As nursing is by any measure a significant factor in the hospital care of patients, it seems reasonable to measure nursing dependence and relate the measure to medical case mix and hospital length of stay. In this article, the relationship between nursing and medicine is explored through an examination of the association between a nursing dependency index and an index of medical complexity, the Medicare DRG cost weight. These two indexes, one derived from nurses and one derived from physicians, are then related to length of hospital stay.

The magnitude of the need for nursing care is presumed to be greater for patients who have more complex medical conditions (Lave, 1985). The more complex a medical condition, the higher the DRG relative cost weight. Conversely, the need for nursing care is presumed to be less for those individuals who have less complex medical conditions, and it is also reflected in lower DRG relative cost weights. We would expect, then, a high degree of correspondence between these operational measures of nursing and medicine.

In this study, nursing dependency was operationalized using nursing diagnosis (Figure 1). The number of separate nursing diagnoses present during hospitalization quantifies nursing dependency: The greater the number of different diagnoses, the higher the nursing dependence. Because the number of nursing diagnoses present has been associated with the time spent by nurses with patients (Halloran, 1985), nursing dependency is an indicator of nursing resource use.

The research questions addressed were:

- Does the DRG relative cost weight predict nursing dependency?
- What is the explanatory power of nursing dependency and the DRG relative cost weight for length of stay (LOS)?

## Method

### Sample

This study was part of the development of a nursing information system in which patients' nursing care needs are described using standard terms for identifying phenomena that nurses manage clinically. The sample consisted of all patients, except those in intensive care units, who were treated consecutively on four conveniently chosen adult hospital wards (three surgical and one medical) in a teaching health science center from March through July 1983 ( $n = 1,288$ ). The findings presented should not be generalized to other hospital patients. To be included in the study, a patient's total length of stay had to occur within the data collection period. The sample mean age was 54 years, with a standard deviation of 19.6 years and a range from 16 to 97 years. The average length of stay was 7.8 days, with a standard deviation of 8.5 and a range from 1 to 89 days. The skewness and kurtosis of LOS (3.76 and 21.01, respectively) indicated nonnormality and positive skewness. Included were 608 men and 680 women.

The distribution of medical diagnoses for these patients was classified into 23 major diagnostic categories (MDC's), developed at Yale University (Yale University School of Public Health, 1981). Each MDC represents a broad clinical category that is differentiated from all others by body system and disease etiology. The medical diagnoses and treatment modes of sample patients included 281 of the 470 mutually exclusive DRG's and represented 21 of 23 MDC's (Table 1).

Measures of central tendency of the dependency index and the DRG weights revealed means of 14.5 and 1.09, respectively. The standard deviation of the nursing index was 10.5, with a range of all values from 0 to 52. The DRG weights had a standard deviation of 0.69 and a range of values from 0 (because of 16 cases classified in DRG 470, not otherwise classifiable) to 6.63. The skewness of the nursing dependency index distribution was 0.94, which was larger than its standard deviation by a factor of 10, showing positive skewness. Kurtosis was 0.37, which was shown by its standard deviation to be trivial. The skewness of the relative cost weights was 2.18 and the kurtosis was 8.41, indicating pronounced nonnormality with positive skewness.

### Instrument

The nursing dependency data collection tool (Figure 1) consisted of 127 items and was developed using nursing diagnosis as a theoretically sound, process-oriented classification system meaningful to nurses for describing patient dependency and need for nursing action. The 127 items on the data collection instrument were derived from the North American Nursing Diagnosis Association terms or a term from the literature hypothesized to be associated with demand for nursing care. Eleven functional health

**Table 1**  
**Distribution of sample patients, by major diagnostic category**

| Major diagnostic category  | Total cases | Diagnosis-related groups represented |
|--|-------------|--------------------------------------|
| Total  | 1,288       | 281                                  |
| 1. Diseases and disorders of the nervous system                                  | 75          | 20                                   |
| 2. Diseases and disorders of the eye   | 142         | 10                                   |
| 3. Diseases and disorders of the ear, nose, throat                               | 19          | 13                                   |
| 4. Diseases and disorders of the respiratory system                              | 106         | 20                                   |
| 5. Diseases and disorders of the circulatory system                              | 250         | 30                                   |
| 6. Diseases and disorders of the digestive system                                | 145         | 38                                   |
| 7. Diseases and disorders of the hepatobiliary system and pancreas               | 57          | 14                                   |
| 8. Diseases of the musculoskeletal system and connective tissue                  | 106         | 15                                   |
| 9. Diseases of the skin, subcutaneous tissue, and breast                         | 68          | 23                                   |
| 10. Endocrine, nutritional and metabolic diseases                                | 79          | 15                                   |
| 11. Diseases and disorders of the kidney and urinary tract                       | 86          | 24                                   |
| 12. Diseases and disorders of the male reproductive system                       | 18          | 14                                   |
| 13. Diseases and disorders of the female reproductive system                     | 13          | 7                                    |
| 14. Pregnancy, childbirth  | 0           | 0                                    |
| 15. Newborns   | 0           | 0                                    |
| 16. Diseases and disorders of the blood and blood-forming organs                 | 16          | 5                                    |
| 17. Myeloproliferative disorders and other neoplasms                             | 20          | 8                                    |
| 18. Infections and parasitic diseases  | 4           | 2                                    |
| 19. Mental disorders   | 7           | 4                                    |
| 20. Substance use disorders and substance-induced organic disorders              | 6           | 3                                    |
| 21. Injury, poisoning, and toxic effect of drugs                                 | 30          | 10                                   |
| 22. Burns  | 5           | 2                                    |
| 23. Selected factors influencing health status and contacts with health services | 36          | 4                                    |

patterns (e.g., elimination, activity-exercise, sleep-rest) provide the organizing framework for the instrument (Gordon, 1982). Nursing dependency, measured using nursing diagnosis, is an indicator of the intensity and complexity of the nursing care to be provided.

### Validity

The nursing diagnosis terms can be traced to well-accepted works on nursing (Abdellah et al., 1960; Henderson and Nite, 1978; Nightingale, 1860, reprinted 1976). Prior to 1983, the clinical validity of nursing diagnosis had been tested in eight studies (Gordon, 1985). In these studies, researchers compared the universe of situations described in nursing problem lists and supported by clinical data with patient descriptions using nursing diagnosis. In a study by Jones and Jakob (cited in Gordon, 1985), congruence between the nursing diagnosis taxonomy and supporting clinical data ranged from 76 percent in a sample of 2,700 diagnostic labels to 95 percent in a second sample of 270 nursing diagnoses. In a more recent study of validity in psychiatric, pediatric, and maternity populations, the nursing diagnosis terminology was found to include most phenomena requiring nursing care (Kiley et al., in preparation). Criterion-related concurrent validity between 37 nursing diagnoses and nursing workload ( $R^2(37; 2,522) = .532, p < .001$ ) was demonstrated by Halloran (1985).

The development of nursing diagnoses is similar to that of medical patient classifications. The Task Force of the North American Nursing Diagnosis Association

(1984), Gordon (1982), and Kritek (1985) agree that nursing diagnoses are not yet an inclusive classification scheme, so work on further development and validation must continue in a variety of clinical and research settings.

### Reliability

Several studies of reliability have been reported. Hoskins et al. (1984) used five raters to assess 11 interviews as to the presence of nursing diagnosis and found a mean of 91.5-percent agreement. Only the measure of whether a nursing diagnosis was present or absent was employed because more complex scaled measures tend to be less reliable (Mitchell, 1979). Abraham (1984) obtained a reliability coefficient of 0.8 for internal consistency of subjects using nursing diagnosis. Using a sample from a midwestern community hospital, Halloran (1985) explored 2,560 cases in which nurses assessed patients each day of hospitalization regarding the presence of 37 nursing diagnoses. An aspect of reliability, efficiency of the estimation of the population mean, is demonstrated between his sample and the present sample. A total of 16 nursing diagnoses (16 of 37 in the Halloran sample and 16 of 56 nursing diagnoses in this sample) were common to both samples and had incidence in similar proportions ( $r = 0.91, p < .01$ ). After transforming the frequencies of these 16 nursing diagnoses to logarithms based on the integer 10 because of their skewed distributions, it was found that eight of the means from the present sample were within the 99-percent confidence intervals from the Halloran sample.

**Figure 1**  
**Data collection form**

**UNIVERSITY HOSPITALS OF CLEVELAND**  
**NURSE/PATIENT SUMMARY**

DATE TODAY \_\_\_\_\_

Nursing Staff Assigned:

|              | RN Code No | Other Code No. |
|--------------|------------|----------------|
| Today        |            |                |
| Last Night   |            |                |
| Last Evening |            |                |

Check the items below if present or must be considered:

|                                     |                              |                                     |                                |                                 |     |
|-------------------------------------|------------------------------|-------------------------------------|--------------------------------|---------------------------------|-----|
| <b>HEALTH PERCEPTION-MANAGEMENT</b> | Positioning .....            | 41                                  | Disturbance in self esteem ... | 82                              |     |
| Injury, potential for .....         | 1                            | ROM .....                           | 42                             | Fear .....                      | 83  |
| Noncompliance .....                 | 2                            | Gait .....                          | 43                             | Personal identity confusion ..  | 84  |
| <b>NUTRITIONAL-METABOLIC</b>        | Fluid/electrolyte imbalance: | Traction .....                      | 44                             | Powerlessness .....             | 85  |
| Excess volume .....                 | 3                            | Ambulation .....                    | 45                             | <b>ROLE RELATIONSHIPS</b>       |     |
| Volume deficit .....                | 4                            | Paresis .....                       | 46                             | Anger .....                     | 86  |
| Electrolyte .....                   | 5                            | Self care deficit:                  |                                | Family process alteration ..... | 87  |
| Nutrition:                          |                              | Feeding .....                       | 47                             | Grieving .....                  | 88  |
| Excess .....                        | 6                            | Bathing/hygiene .....               | 48                             | Parenting, alteration in .....  | 89  |
| Potential for excess .....          | 7                            | Toileting .....                     | 49                             | Social isolation .....          | 90  |
| Depletion .....                     | 8                            | Dressing/grooming .....             | 50                             | Suspiciousness .....            | 91  |
| Impaired skin integrity:            |                              | Temperature:                        |                                | Verbal Communic. Impaired. .    | 92  |
| Surgical wound .....                | 9                            | Hyperthermia .....                  | 51                             | Language barrier .....          | 93  |
| Decubitus .....                     | 10                           | Hypothermia .....                   | 52                             | Does not speak .....            | 94  |
| Trauma .....                        | 11                           | <b>COGNITION-PERCEPTION</b>         |                                | Aphasic .....                   | 95  |
| Burn .....                          | 12                           | Comfort, alteration in:             |                                | Cannot speak .....              | 96  |
| Rash or irritation .....            | 13                           | Pain .....                          | 53                             | Violence .....                  | 97  |
| Oral mucous memb. imprd. .          | 14                           | Discomfort .....                    | 54                             | <b>SEXUALITY-REPRODUCTION</b>   |     |
| <b>ELIMINATION</b>                  |                              | Itching .....                       | 55                             | Sexual dysfunction:             |     |
| Bladder function:                   |                              | Consciousness, level of:            |                                | Physiological .....             | 98  |
| Retention .....                     | 15                           | Lethargic .....                     | 56                             | Psychological .....             | 99  |
| Frequency .....                     | 16                           | Stuporous .....                     | 57                             | <b>COPING-STRESS TOLERANCE</b>  |     |
| Incontinence .....                  | 17                           | Semicomatose .....                  | 58                             | Coping, Family, Potn'l growth   | 100 |
| GI motility/function:               |                              | Comatose .....                      | 59                             | Coping, Ineffective: Patient .. | 101 |
| Constipation .....                  | 18                           | Delusions .....                     | 60                             | Family, Disabling ...           | 102 |
| Impaction .....                     | 19                           | Hallucinations .....                | 61                             | Family, Compromised             | 103 |
| Nausea .....                        | 20                           | Hearing deficit (uncorctd.):        |                                | <b>VALUE-BELIEF</b>             |     |
| Vomiting .....                      | 21                           | Hard of hearing .....               | 62                             | Spiritual distress .....        | 104 |
| Diarrhea .....                      | 22                           | Deaf .....                          | 63                             | <b>ADDITIONAL:</b>              |     |
| Incontinence .....                  | 23                           | Knowledge deficit .....             | 64                             | ADL assistive devices .....     | 105 |
| Distention .....                    | 24                           | Memory deficit (shrt. term)...      | 65                             | Bleeding:                       |     |
| <b>ACTIVITY-EXERCISE</b>            |                              | Psychosis .....                     | 66                             | Internal .....                  | 106 |
| Activity intolerance .....          | 25                           | Seizures:                           |                                | External .....                  | 107 |
| Airway impaired .....               | 26                           | History of .....                    | 67                             | Oozing from wound .....         | 108 |
| Secretions .....                    | 27                           | Occurred this hospital .....        | 68                             | Hemorrhage .....                | 109 |
| Tracheostomy .....                  | 28                           | Sight (uncorrected):                |                                | Contagion .....                 | 110 |
| Breathing pattern disturb. .        | 29                           | Reads with difficulty .....         | 69                             | Susceptible to infection .....  | 111 |
| Gas exchange impaired .....         | 30                           | Blurred vision .....                | 70                             | Cultural considerations .....   | 112 |
| Blood pressure:                     |                              | Sees shadows only .....             | 71                             | Socioeconomic considerations    | 113 |
| Hypertension .....                  | 31                           | Blind .....                         | 72                             | Disability, prolonged .....     | 114 |
| Hypotension .....                   | 32                           | Smell deprivation .....             | 73                             | Disease, prolonged .....        | 115 |
| Tissue perfusion (altrn.) .         | 33                           | Touch deprivation .....             | 74                             | Hormonal influences .....       | 116 |
| Shock .....                         | 34                           | Thought processes (altrn.)...       | 75                             | Instability (physio/psycho) ..  | 117 |
| Cardiac status:                     |                              | <b>SLEEP-REST</b>                   |                                | Medical treatment includes:     |     |
| Arrhythmia .....                    | 35                           | Sleep disturbance .....             | 76                             | Elect. monitors 118 Dial.       | 119 |
| Decreased cardiac output. .         | 36                           | <b>SELF PERCEPTION-SELF CONCEPT</b> |                                | Hyperal. .... 120 Resp.         | 121 |
| Diversional activity defct. .       | 37                           | Anxiety:                            |                                | Pregnancy .....                 | 122 |
| Health maintenance (altrn.) .       | 38                           | Acute .....                         | 77                             | Reaction to med., blood, etc. . | 123 |
| Home maintenance mgmt .....         | 39                           | Chronic .....                       | 78                             | Substance abuse .....           | 124 |
| Mobility impaired                   |                              | Situational .....                   | 79                             | Suicidal .....                  | 125 |
| Turning .....                       | 40                           | Depression .....                    | 80                             | Terminal illness .....          | 126 |
|                                     |                              | Disturbance in body image ..        | 81                             | Triple last 24 hours .....      | 127 |

## Procedure

A manual of definitions for each of the 127 items on the instrument was developed, and all registered nurses on the four study wards were oriented to the data collection in staff conferences. The data obtained each day consisted of a record of the nurses assigned to care for the patient each shift and a description of the patient in terms of items on the instrument. Nurse assignment data are essential for determination of the cost of nursing care. However, these data were not included in the present analysis.

Compliance by nurses with data collection was more than 90 percent. Uniform data from a nurse's daily assessment of a patient allow patterns of nursing dependency during hospitalization to be examined. Nursing diagnoses describe the response of the patient to his or her health problem and define nursing judgment. The assignment of nurses to patients summarizes the nursing action (in hours and/or dollar values) and is representative of the relative consumption of nursing resources.

## Nursing dependency index

The nursing dependency index is the total number of equally weighted individual nursing conditions that nurses assessed as present during the patient's hospital stay. A vector of 127 elements (0,1) represents the presence or absence of particular nursing diagnoses at some point during the patient's hospital episode. Nursing dependency, as well as the pattern of nursing conditions, is illustrated for two patients in Tables 2 and 3. The patient described in Table 2 was assigned to DRG 278, which indicates that the patient had cellulitis, was 18-69 years of age, and had no complications. The relative weight for DRG 278 is .8096. The number of different nursing conditions present during the stay was 10. A patient demonstrating higher nursing dependency (22 separate nursing diagnoses) is described in Table 3. DRG 294 indicates that the medical diagnosis was diabetes and

that the patient was 16 years of age or over. The DRG relative cost weight of .8087 is very similar to the cost weight for Case 1, yet Case 2 had twice the number of nursing diagnoses, indicating much greater nursing dependency.

## DRG relative cost weight

The DRG relative cost weight, a numerical factor, is intended to reflect the resource consumption (costs of treating cases across all hospitals) associated with each DRG. Multiple diagnoses were taken into account in the data base used to construct mutually exclusive and exhaustive weights and average standardized cost amounts for each DRG. The actual Federal payment rate for each patient is determined by multiplying the DRG weight by the standardized cost. The relative cost weights are in the public domain (*Federal Register*, 1983). All cases in the sample were grouped into DRG's using grouper program software (Yale University School of Public Health, 1981). The appropriate weight was subsequently assigned to each case.

## Results

### Nursing dependency and DRG weights

In Figure 2, we demonstrate the spread of the set of untransformed points in a scatter diagram of the pair of observations for each case. New axes were drawn through a point  $O'$  using  $(\bar{X}, \bar{Y})$  as the origin. Forty-eight percent of the points lie in the third quadrant, with the remaining 52 percent fairly evenly distributed in quadrants I, II, and IV.

A regression of nursing dependency on relative cost weight was done using the linear model

$$Y = \beta_0 + \beta x + e.$$

To allow the mathematical assumption of normality to be met for the dependent variable, both the dependent and independent variables were

**Table 2**  
**Case 1: Nursing conditions, by day during hospital stay**

| Nursing condition                          | Total | Day |   |   |   |   |   |   |
|--|-------|-----|---|---|---|---|---|---|
|  |       | 1   | 2 | 3 | 4 | 5 | 6 | 7 |
| Total                                      | 17    | 5   | 3 | 2 | 2 | 2 | 2 | 1 |
| 9. Skin integrity impaired: surgical wound | 4     | 1   | 1 | — | — | 1 | — | 1 |
| 11. Skin integrity impaired: trauma        | 1     | —   | — | — | — | — | 1 | — |
| 37. Diversional activity deficit           | 1     | —   | — | — | 1 | — | — | — |
| 48. Self care deficit: bathing/hygiene     | 1     | 1   | — | — | — | — | — | — |
| 50. Self care deficit: dressing/grooming   | 1     | 1   | — | — | — | — | — | — |
| 53. Comfort, alteration in: pain           | 2     | —   | — | 1 | — | — | 1 | — |
| 54. Comfort, alteration in: discomfort     | 3     | 1   | 1 | — | 1 | — | — | — |
| 55. Comfort, alteration in: itching        | 1     | —   | — | 1 | — | — | — | — |
| 79. Anxiety: situational                   | 2     | 1   | 1 | — | — | — | — | — |
| 100. Coping: family potential for growth   | 1     | —   | — | — | — | 1 | — | — |

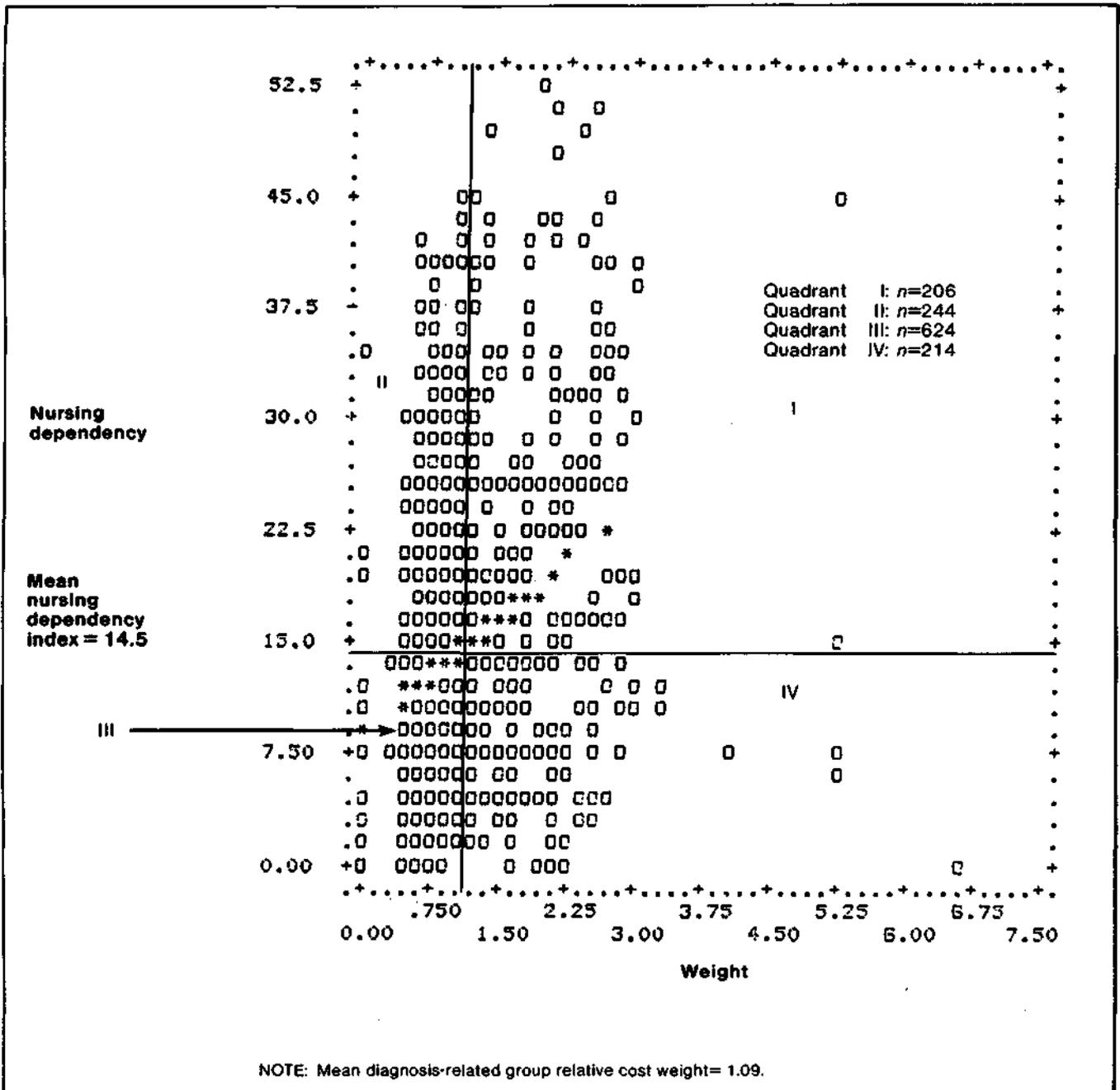
NOTES: Nursing dependency index: 10.

Diagnosis-related group 278: Cellulitis, 18-69 years of age, no complications.

Diagnosis-related group relative weight: .8096.

Figure 2

Scatter diagram of pairs of nursing dependency index and diagnosis-related group relative cost weight observations for 1,288 cases



**Table 3**  
**Case 2: Nursing conditions, by day during hospital stay**

| Nursing condition                             | Total | Day |   |   |   |   |    |   |   |
|---|-------|-----|---|---|---|---|----|---|---|
|   |       | 1   | 2 | 3 | 4 | 5 | 6  | 7 | 8 |
| Total   | 46    | 5   | 8 | 8 | 5 | 5 | 11 | 2 | 2 |
| 3. Fluid: excess volume                       | 1     | —   | 1 | — | — | — | —  | — | — |
| 4. Fluid: volume deficit                      | 2     | —   | — | 1 | 1 | — | —  | — | — |
| 5. Electrolyte imbalance                      | 2     | —   | — | — | — | — | —  | 1 | 1 |
| 6. Nutrition: excess                          | 1     | —   | — | — | — | 1 | —  | — | — |
| 7. Nutrition: potential excess                | 4     | 1   | 1 | 1 | — | — | 1  | — | — |
| 15. Bladder: retention                        | 8     | 1   | 1 | 1 | 1 | 1 | 1  | 1 | 1 |
| 18. Gastrointestinal: constipation            | 2     | —   | — | 1 | — | — | 1  | — | — |
| 37. Diversional activity deficit              | 1     | —   | — | — | 1 | — | —  | — | — |
| 38. Health maintenance alteration             | 1     | —   | — | — | 1 | — | —  | — | — |
| 39. Home maintenance management impaired      | 2     | —   | 1 | 1 | — | — | —  | — | — |
| 51. Hyperthermia                              | 1     | —   | — | — | 1 | — | —  | — | — |
| 53. Comfort, alteration in: pain              | 2     | —   | — | — | — | 1 | 1  | — | — |
| 54. Comfort, alteration in: discomfort        | 1     | —   | — | — | — | — | 1  | — | — |
| 64. Knowledge deficit                         | 2     | 1   | 1 | — | — | — | —  | — | — |
| 87. Family process alteration                 | 1     | —   | — | — | — | — | 1  | — | — |
| 89. Parenting, alteration in                  | 1     | —   | — | — | — | — | 1  | — | — |
| 100. Coping: family potential for growth      | 2     | —   | 1 | 1 | — | — | —  | — | — |
| 103. Coping: ineffective, family compromised  | 2     | —   | — | — | — | 1 | 1  | — | — |
| 115. Disease, prolonged                       | 5     | 1   | 1 | 1 | — | 1 | 1  | — | — |
| 116. Hormonal influences                      | 1     | —   | — | — | — | — | 1  | — | — |
| 117. Instability: physiological/psychological | 3     | 1   | 1 | 1 | — | — | —  | — | — |

NOTES: Nursing dependency index: 22.  
Diagnosis-related group 294: diabetes, 16 years of age or over.  
Diagnosis-related group relative weight: .8087.

**Table 4**  
**Stepwise regression results**

| Variable entered                                | R <sup>2</sup> | Change in R <sup>2</sup> | B     | Beta weights |
|---|----------------|--------------------------|-------|--------------|
| 1. Nursing dependency                           | .450           | .450                     | 0.543 | 0.583        |
| 2. Diagnosis-related group relative cost weight | .508           | .058                     | 0.424 | 0.257        |
| Constant  | —              | —                        | 0.198 | —            |

NOTE: F(2;1,285) = 664.94, *p* < .000.

transformed to logarithms based on the integer 10. The regression results indicated a *b* coefficient of 0.60, an intercept of 1.03, and a standardized *b* coefficient (beta weight) of 0.34. Thus, the regression equation was

$$y = 1.03 + 0.60x.$$

The percent of variation in nursing dependency explained by the DRG cost weight was 11.6 (F(1; 1,286) = 169.36, *p* < .001). The explanation of the variance in nursing dependency by the DRG weight is low, suggesting that the two measures are independent. From these data, it appears that medical complexity is a poor predictor of nursing dependency.

### Length of stay

A stepwise linear regression was used to examine the explanatory power of nursing dependency and the relative cost weight for LOS. To satisfy the

requirement of assumed normality for the distribution of the dependent variable, LOS was transformed to logarithms to the base 10. The linear model was

$$Y = \beta_0 + \beta_1x_1 + \beta_2x_2 + e.$$

This regression resulted in *b* coefficients for the two independent variables of 0.543 and 0.424, respectively, and an intercept of 0.198. The standardized *b* coefficients (beta weights) were 0.583 and 0.257, respectively. The regression equation was

$$y = 0.198 + 0.543 x_1 + 0.424 x_2,$$

where *x*<sub>1</sub> = nursing dependency and *x*<sub>2</sub> = DRG relative cost weight.

The DRG weight explained 5.8 percent of the variation in LOS, and nursing dependency explained 45.0 percent of the variation (Table 4). As might be expected from an explanation of 50.8 percent of variation, there was a significant linear relationship between the independent variables, nursing dependency and DRG weight, and LOS (F(2;1,285) = 664.94, *p* < .001).

Many patients with different medical conditions have the same length of stay, and many with the same medical condition experience different lengths of stay. The reason for hospital admission is traditionally expressed in medical diagnostic terms and the admission process is attributed to physician behavior, yet patient need for medical and nursing services seems to better explain variability in hospital use. Medical care was necessary for these 1,288 hospital inpatients, but the analyses suggest that their hospital

entrance and stay reflected their dependence on nursing care as well.

When the sample was divided into surgical cases ( $n = 599$ ) and medical cases ( $n = 641$ ), it was found that the correlation between the surgical DRG weights and LOS was .629 ( $p < .001$ ), and the correlation between the medical DRG weights and LOS was .153 ( $p < .001$ ). The correlations of nursing dependency with LOS in surgical and medical cases were .668 and .688, respectively. This finding is congruent with results of Frank and Lave (1985), in which the amount of variation in LOS, cost, and charges within DRG's was shown to be significantly greater in medical than surgical cases. The closer relationship between the relative cost weight of surgical intervention and LOS allows hospitals in which a disproportionate amount of surgery is performed to better forecast payment and actual utilization of medical and nursing resources. Similarly, hospitals with a lower proportion of surgical cases (less than 50 percent) will have difficulty in predicting both LOS and the use of nurses unless a nursing dependency factor is calculated.

## Discussion

Hospitals are complex social institutions whose customers (patients) are vulnerable and dependent on health professionals for services related to basic human values involving life, the quality of life, and death. In a more narrow interpretation of their services, hospitals have recently been described as multiproduct firms whose "products" are defined as the number of cases of one or another medical illness. Illnesses, in turn, have been grouped into medical diagnostic and treatment categories (DRG's) associated with the costs of providing services. It has been assumed that physicians direct all clinical activities that take place in the hospital by reason of their responsibility for admission, discharge, and prescriptive activities related to the medical diagnoses of the patients. In the data and analysis presented here, evidence is provided that at least one other process in addition to medical treatment explains variability in length of patient stay in the hospital. These findings suggest that a broader description of hospital services is needed and, further, that payment schemes reflect both medical and nursing care.

Wennberg, McPherson, and Caper (1984) observed differences in admission rates for various illnesses and attributed variability to physician behavior. However, the decision to admit or not admit is partly attributable to the patients' dependence on others for services that they would ordinarily perform for themselves. The importance of nursing dependency is expressed in Henderson and Nite (1978):

The unique function of the nurse is primarily helping people (sick or well) in the performance of those activities contributing to health or its recovery (or to a peaceful death) that they would perform unaided if they had the necessary strength, will, or

knowledge. It is likewise the function of nurses to help people gain independence as rapidly as possible.

The dependence of patients on nurses constitutes a rationale for hospital admission. Its effect was not measured by Wennberg, McPherson, and Caper (1984), yet it is an alternative explanation of variability in admission rates to hospitals for patients with particular medical conditions. Further research on the relationship between nursing and medical care in the hospital is essential to a proper understanding of quality care, which Abdellah (1985) defined as the care that the patient needs—no more and no less. Such research is hampered by a failure to standardize nursing terminology that can be used across settings to express the demand for nursing care.<sup>1</sup>

As a result of these analyses, the study hospital is using a patient classification system derived from nursing diagnosis, describing all patients on a daily basis to capture information about nursing dependency. The data are used to help clinicians choose the best place for patients to receive nursing care. The options include both movement during the hospital episode (transfers from one unit to another, particularly to and from intensive care units) and movement after discharge (self care, family care, visiting nurse, rehabilitation hospital, assisted living, or extended care facility). To increase the speed of collection and processing, data are entered into hand-held portable terminals with light pens by the nurse assigned to the patient. Data are transferred to the mainframe over voice-transmission telephone lines during the day shift. A summarized report by patient is returned to the ward within 2 hours to assist nurses and physicians in the optimum management and placement of patients.

The description of patient medical diagnostic condition and nursing dependency provides clinicians, health service researchers, and economists with a comprehensive set of patient variables on which the health care system can be more accurately modeled. Our findings suggest that a patient's dependence on nurses explains variability in length of stay unaccounted for in the DRG classification scheme. A nursing dependency model, because of its relationship to professional nursing practices, may be more fundamental to the quantification of illness than are other measures of severity and intensity that have been proposed to complement the DRG system. Nursing diagnoses are abstractions of the process of providing nursing care. Because 1.1 million nurses are engaged in the provision of care to patients in American hospitals (Bureau of Health Professions, 1986), it seems eminently useful to simultaneously capture their input and enlist their involvement with case-mix-based patient management. Other models of the severity and intensity of illness appear farther

<sup>1</sup>A step to remedy the absence of standardized nursing terminology was taken in May 1985, when an invitational conference was convened under the auspices of the University of Wisconsin, Milwaukee, and the Hospital Corporation of America to define a nursing minimum data set.

removed from the clinical decisionmaking efforts collectively employed by physicians and nurses.

Those seeking control of hospital costs would do well to more fully describe the functional and psychosocial circumstances of patients that contribute to health and health-related expenditures.

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