

Implementation of a Clinical Information System in Nurse-Managed Care

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Le Penn Nursing Network Information System Project est le fruit d'une collaboration entre un concepteur de logiciels dans le domaine de la santé, des praticiennes et des chercheurs universitaires. Constitué de pratiques gérées par des infirmières, le Penn Nursing Network appartient à l'École de sciences infirmières de l'Université de la Pennsylvanie et est administré par elle. Ce réseau a pris la direction du projet et travaille à mettre au point un système d'information adapté à la gestion des soins infirmiers, créant du même coup une base de données régionale destinée aux centres de soins infirmiers de la région de Philadelphie. Parmi les volets importants de ce projet, on trouve l'identification des données clés permettant de représenter les problèmes traités, ainsi que les interventions effectuées et les résultats découlant des soins infirmiers administrés. Le système Omaha s'est avéré utile, permettant de recueillir les données nécessaires; il faudra cependant en obtenir davantage. De plus, on s'est concentré sur la mise au point d'un logiciel qui complèterait le rythme de travail de la praticienne tout en permettant la saisie efficace des données. Le but principal de ce projet consistait à mettre au point une base de données de type longitudinal reflétant la pratique clinique et pouvant servir à des fins de recherche et d'évaluation de la qualité.

The Penn Nursing Network Information System Project is a collaborative effort of practitioners, academic researchers, and a health-care software developer. The Penn Nursing Network, a group of nurse-managed practices owned and operated by the University of Pennsylvania School of Nursing, has taken a leadership role in the project. PNN is developing an information system specific to the needs of nurse-managed care and creating a data warehouse for nursing centres in the Philadelphia region. Important components of this project include the identification of key data elements to represent the problems treated, interventions performed, and outcomes sensitive to the nursing care provided. The Omaha System provided a useful framework for capturing the necessary data elements. However, additional data were needed. In addition, attention was paid to the development of a software program that would complement the workflow of the practitioner while capturing data efficiently. The main goal of the project is development of a longitudinal database reflective of clinical practice, to be used for both research and evaluation.

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The Penn Nursing Network (PNN) is a group of nurse-managed practices owned and operated by the University of Pennsylvania School of Nursing. Its goal is to provide models of health care while integrating the tripartite mission of practice, research, and education. Its main objective is the development of a longitudinal database reflective of clinical practice, to be used for research and evaluation. An important feature of the database is standardized language for the problems that nurses treat (nursing diagnoses), nursing interventions, and outcome measures specific to each practice.

PNN entered into an agreement with Epsilon Systems Inc. to customize the clinical software program *CareFacts*TM for use in PNN practices. *CareFacts*TM includes the Omaha System (OS), a classification system that uses standardized language for nursing diagnoses, interventions, and outcomes.

The purpose of this paper is to discuss the collaboration of the University of Pennsylvania School of Nursing and Epsilon Systems Inc. in developing and implementing a clinical software system for nurse-managed care.

The PNN nurse-managed, community-based programs provide family-focused care for all ages in multiple settings. This article will discuss two programs, the Collaborative Assessment and Rehabilitation for Elders (CARE) program and the Myers Health Annex. The CARE program, a day hospital, provides intensive nursing and rehabilitation care to frail elders. Patients with multiple health problems are cared for by an interdisciplinary team of nurses, nurse practitioners, physical therapists, occupational therapists, social workers, geropsychiatric nurse specialists, and physicians. The Health Annex is a family- and community-centred primary-care facility. Family nurse practitioners, midwives, psychiatric clinical nurse specialists, and outreach workers provide physical- and mental-health services to clients of all ages.

A major goal of the PNN from the outset was development of a longitudinal database to guide effectiveness research. Several criteria were identified in the search for a computerized clinical-record system. The system had to include the elements of the Nursing Minimum Data Set (NMDS) (Werley & Lang, 1988). The collection of data elements had to complement the workflow of the practitioner. The system had to be easily customizable so that features such as pull-down menus could be altered and research tools could be added as needed. The database had to be object-oriented with a flexible report-writing capability so that data could be generated to meet the needs of both evaluation and research. Finally, it had to be capable of linking billing and clinical data.

Each PNN practice has unique data needs as well as data needs that are common to all practices. A database committee was formed to examine the needs of each and determine which nomenclature would be chosen to represent nursing clinical practice. The four nomenclatures recognized by the American Nurses Association were reviewed — the OS, the North American Nursing Diagnosis Association (NANDA), the Nursing Intervention Classification (NIC), and the Home Health Care Classification (HHCC) (Lang, 1995). The OS was chosen largely because it was easy to use, especially across disciplines. It was decided that the OS would serve as the backbone of documentation and be expanded to meet the needs of each practice while preserving the integrity of the nomenclature. In addition, it was recognized that other classification systems, such as the International Classification of Disease's Ninth Edition Clinical Modification (ICD-9-CM), *Diagnostic and Statistical Manual of Mental Disorders* (DSM), and Current Procedural Terminology (CPT), would be needed.

Omaha System

The OS, a standardized system of recording health-care data that are particularly useful in community-based settings, was developed by the Visiting Nurse Association of Omaha. Its classification scheme has three clinical components: (a) Problem Classification Scheme (nursing diagnoses), (b) Intervention Scheme, and (c) Problem Rating Scale for Outcomes (Martin & Scheet, 1992).

The OS was developed between 1975 and 1992 in a series of four complex, interrelated projects supported by the Division of Nursing, Department of Health and Human Services, and the National Institutes of Health. Its clinical components were developed inductively from approximately 1,000 patient records during the course of the first three projects. More than 500 nurses at four sites participated in developing the system by generating client records and critiquing its usefulness. The OS has several unique features. First, it was developed inductively from the records of home-care patients and has a community-health focus. Second, it includes a standardized framework for nursing diagnoses/problems, interventions, and outcome ratings. Finally, it has been tested and revised over a 15-year period with an emphasis on usability for the practising nurse. Revisions have been made as a result of extensive field testing and critiquing by community-health nurses (Martin & Scheet, 1992).

The OS's Problem Classification Scheme consists of 44 problem/diagnostic categories classified into four domains of community prac-

tice: environmental, psychological, physiological, and health-related behaviours. Each problem is assigned specific clusters of signs and symptoms. For example, the problem of pain is classified in the physiological domain and includes signs and symptoms such as "expresses discomfort." A problem is further referenced as health promotion, potential, or deficit/impairment/actual. In the 1984 OS testing, interrater agreement was established at 98%. In addition, client records were found to support 98% of the identified problems and 100% of the modifiers were used correctly (Martin & Scheet, 1992).

The OS has a standardized framework for recording nursing interventions. The intervention scheme is an organized framework of nursing activities and actions that address specific patient problems. Interventions are divided into four broad categories containing 63 targets of nursing action. The categories are: Health Teaching, Guidance, and Counselling; Treatments and Procedures; Case Management; and Surveillance. Interrater agreement of the intervention scheme ranged from 42.2% to 96.9%, with two thirds of the ratings above 80% (Martin & Scheet, 1992).

The Problem Rating Scale for Outcomes, a five-point Likert scale, rates the Omaha problem in the areas of knowledge, behaviour, and status. Reliability testing revealed that the following interrater agreement, using the criterion of either an exact match or a match with a difference of one point, was established for each scale: (a) knowledge, 87.5%, (b) behaviour, 92.2%, and (c) status, 96.1% (Martin & Scheet, 1992).

Epsilon Systems Inc.

After many programs had been examined, the *CareFacts*TM program by Epsilon Systems Inc. was chosen. Epsilon Systems Inc. is an innovative software company whose focus is the development of community-based clinical information systems. *CareFacts*TM is designed for use by multiple disciplines in multiple settings. It uses a client-server relational database that is client-centred to enhance continuity of care. *CareFacts*TM has an open architecture with a robust interface engine. Data are captured at the point of care with an emphasis on complementing the practitioner's workflow. The program includes several standardized data sets, such as Outcome and Assessment Information Set (OASIS) (Shaughnessy & Crisler, 1995), ICD-9-CM, and the OS. In addition, a feature called Measures and Goals allows users to add additional assessment or research tools and specify the location for data collection throughout the program.

Implementation

The strengths of the OS are many. It provides consistency in language across disciplines. It is easy for practitioners to use. The intervention scheme is easily adapted across several disciplines. The four domains of the Problem Classification Scheme encourage practitioners to view the client beyond the physiological realm, with the inclusion of the environmental, psychosocial, and health-related behaviour domains. The problem-rating scale helps practitioners to evaluate progress.

In using the OS at PNN an overlap was discovered between ICD-9-CM codes and the physiological domain. For most physiological problems, nurse practitioners were more comfortable using the medical diagnosis. For example, in treating the hypertensive client they preferred the ICD-9-CM label "hypertension" over the OS label "circulation." In addition, some OS problems and related signs and symptoms lack specificity. For instance, the OS problem of emotional stability lists one sign and symptom as "sadness/hopelessness/worthlessness." For geriatric psychiatric clinical specialists, sadness, hopelessness, and worthlessness are very different problems requiring different interventions. Similarly, the practitioners requested that the intervention category "health teaching, guidance, and counselling" be broken down and that counselling be made a separate category.

CARE

Implementation of the clinical information system necessitated a close examination of the workflow of the providers. The CARE program carries out extensive assessments and detailed care plans for each patient. It was found that there was duplication of assessment by multiple disciplines. For example, there were six different assessments of cognitive ability. The OS's 44 problems proved useful in guiding responsibility for areas of documentation. For instance, social work was responsible for the initial assessment of environmental problems; other disciplines could assess these areas, but, since a general overview was completed by social work, the assessment would be limited to a small number of specific items. Nursing was responsible for the majority of psychosocial and physiological problems, with the exception of neuromusculo-skeletal status, which was the primary responsibility of physical therapy and occupational therapy. The division of areas of assessment responsibility has streamlined the documentation process for each discipline and eliminated duplicative questions for clients.

Research-based screening tools were added to *CareFacts*TM to enhance the assessment. For instance, the Geriatric Depression Scale (GDS) (Yesvage & Brink, 1983) was linked to the OS "emotional stability." The GDS allows for more in-depth assessment of this area, to determine whether the client is functioning adequately and whether emotional malfunctioning should be identified as an actual, potential, or health-promotion problem. The GDS is used on admission and again at discharge or at designated intervals. Other tools, such as a nutrition screening tool, have been linked to appropriate OS problems to enhance assessment and provide problem-specific outcome measures. The use of research-based standardized tools administered at varied points provides additional outcome measures sensitive to specific problems and interventions.

Myers Health Annex

The Myers Health Annex provides primary health care to low-income minority families. Although some data needs were common to the CARE program and the Myers Health Annex, the OS could not be implemented easily at the primary-care site. For most clients, the time of the family nurse practitioner is mainly spent gathering data through a history and physical and diagnosing the health problem. The lack of a standardized language to document a client's history is problematic. A standard physical-assessment process will be added for primary-care use (Bates, 1995). Documentation will be organized according to the Subjective-Objective-Assessment-Plan (SOAP) format (American Medical Association, 1997). Practitioners will have the choice of identifying client diagnoses from the OS problem list, ICD-9-CM, or DSM-IV. Interventions that can be selected include the areas of treatments/procedures, medications, diagnostic tests, health teaching, counselling, case management, and monitoring. The user interface provides the practitioner with a familiar language but is coded for analysis in the appropriate classification (for interventions, either OS or CPT-IV codes are used) (Billing & Stoeckle, 1989; Martin & Scheet, 1992). The Omaha System Problem Rating Scale for Outcomes is used to rate each OS problem identified. Problems can be rated at each visit or, if visits are frequent, at the discretion of the practitioner.

To further assist the practitioner with health promotion, US Preventive Health Guidelines (US Preventative Services Task Force, 1996) will be incorporated into templates for wellness care based on age. In addition, templates will be developed for specific visits such as family planning, gynecologic care, and prenatal care. Also, national

protocols for assessment and management of asthma, diabetes, and hypertension will be incorporated into templates for the practitioner to select. Furthermore, documentation screens for the lay outreach provider encounter will be supplied. The program is currently undergoing beta testing at two nursing centres. Practitioner feedback is used to incorporate changes in the program so that the natural flow of the care process is complemented in both capture and retrieval of data.

Regional Consortium Data Warehouse

The PNN information-system project is one component of a major regional nursing-information project funded by the Independence Foundation. A major dimension of the project is the development of a warehouse of key data elements for use in research and evaluation of regional nursing centres, and a consortium of some 18 Philadelphia nursing centres is participating in it. Common data elements were identified and defined using a format similar to that developed for the Data Elements Emergency Department Systems (DEEDS) (National Center for Injury Prevention and Control, 1997). An attempt was made to incorporate any standards available in data identification, definitions, and transmission. The consortium is currently addressing the area of data-sharing by developing protocols for membership in the warehouse as well as access and transmission of data. It is hoped that regional benchmarks can be developed on key elements.

Most nursing centres serve a small population. The warehouse will enable nursing centres in the area to pool data to obtain a larger number of clients, so that evaluation can take into account the large number of confounding variables affecting client outcomes. The majority of nursing centres are located in under-served inner-city neighbourhoods with multiple health and social problems. This database will provide detailed data to facilitate examination of the influence of these demographic, health, and social variables, as well as the influence of nursing interventions on the outcomes.

The PNN information project is an example of a collaborative effort of health-care software developers, practitioners, and academic researchers. Several areas were considered. First and foremost was identification of the appropriate data elements to represent the problems treated, interventions performed, and outcomes sensitive to the nursing care provided. The OS offered a useful framework to capture the necessary data elements of care. However, additional data were needed at each site to meet the needs of the practitioners and evaluators. Second, attention was paid to the practitioner's workflow, to com-

plement information needs while capturing data efficiently. Finally, the PNN project has provided leadership to the community of regional nursing centres in developing a data warehouse to help them evaluate the effectiveness of the nursing-centre model of care delivery.

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