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# A cross-hospital cost and quality assessment system by extracting frequent physician order set from a nationwide Health Insurance Research Database

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## ABSTRACT

**Purpose:** Clinical pathways fall under the process perspective of health care quality. For care providers, clinical pathways can be compared to improve health care quality. The objective of this study was to design a convenient physician order set comparison system based on claim records from the National Health Insurance Research Database (NHIRD) of Taiwan.

**Methods:** Data were retrieved from the NHIRD for the period of 2003–2007 for frequent physician order sets found in hospital surgical hernia repair inpatient claim records. The derived frequent physician order sets were divided into five frequency thresholds: 80%, 85%, 90%, 95% and 100%. A consistency index was defined and calculated to understand each care providers' adherence to clinical pathways. In addition, the average count of physician orders, average amount of cost, Charlson comorbidity index, and recurrence rate were calculated; these variables were considered in frequent physician order sets comparison.

**Results:** Records for 3262 patients from 257 hospitals were retrieved. The frequent physician order sets of various frequency thresholds, Charlson comorbidities, and recurrence rates were extracted and computed for comparison among hospitals. A recurrence rate threshold of 2% was established to separate low and high quality of herniorrhaphy at each hospital.

**Abbreviations:** AST, aspartate aminotransferase; BUN, blood urea nitrogen; CBC, complete blood count; CRTN, creatinine; DRG, Diagnosis Related Group; EKG, electrocardiography; ETL, extract transform load; GOT, glutamate oxaloacetate transaminase; Hb, hemoglobin; Hct, hematocrit; ICD9, The International Classification of Diseases, 9th revision; ID, identification; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; MCV, mean corpuscular volume; NHIRD, National Health Insurance Research Database; RBC, red blood cell; WBC, white blood cell.

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Univariable analysis showed that low recurrence rate was associated with high consistency index ( $70.99 \pm 23.88$  vs.  $52.60 \pm 20.30$ ;  $P < .001$ ), few surgeons at each hospital ( $3.50 \pm 4.41$  vs.  $7.09 \pm 6.57$ ;  $P < .001$ ), and non-medical center facility type ( $P = .042$ ). A multivariable Cox regression analysis indicated an association of low recurrence rates with consistency index only (one percentage increased:  $OR = 0.973$ ;  $CI: 0.957–0.990$ ;  $P = .002$ ).

**Conclusions:** The proposed system leveraged the claim records to generate frequent physician order sets at hospitals, thus solving the difficulty in obtaining clinical pathway data. This allows medical professionals and management to conveniently and effectively compare and query similarities and differences in clinical pathways among hospitals.

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## 1. Introduction

### 1.1. Health service quality and clinical pathways

Health service quality is critical for both health care providers and receivers. In the 1980s, Donabedian proposed a conceptual model for studying and evaluating health care service quality [1]. This model classified the quality of care into three perspectives: structure, process, and outcome. The structure perspective focused on “the material, facilities, equipment, human resources, and organization of the health care providers”. The process perspective focused on “what is actually done in giving and receiving care”, including the activities involved in making a diagnosis and recommending or implementing treatment. The outcome perspective focused on the “effects of care based on the patients’ health conditions”. There are many issues associated with the three health service delivery perspectives noted above. There are many concerns associated with implementing these three health service delivery perspectives, such as providing allocation of resources, providing evidence-based care, and reducing variability in outcomes [2]. Clinical pathways provide one approach to addressing these; they comprise “structured, multidisciplinary care plans (identify patient group; set pathway parameters; agree goals; map multidisciplinary care; track variances; feedback and review; upgrade pathway) that detail essential steps in the care of patients with a specific clinical problem [3,4]. They fall under the process perspective and are important components of health service quality.

### 1.2. Purpose of clinical pathways

One of the main issues in clinical practice is the variability in care delivery among health care providers. That is, patients with similar clinical conditions may receive different care, particularly regarding surgical procedures. This situation can result in differences in elements such as hospital stays, laboratory tests, the use of medication and blood products, outpatient treatment, complications, readmissions, total cost, outcomes, and patient satisfaction. All of these issues are of concern to patients, health professionals, and health care management [5]. The application of clinical pathways is one way to address the quality-of-care challenge, as they provide guidance for common diagnostic and therapeutic procedures in clinical practice [6]. The application of clinical pathways

can reduce re-admission [7] and medical cost [8] for hernia surgery, pulmonary complications and hospital stays for head and neck reconstruction [9] or minimize hospital costs and hospital stays for both hepatectomy [10] and kidney surgery [11]. Thus, clinical pathways have been developed and applied in many hospitals.

Clinical pathways have taken many forms. A typical clinical pathway contains a set of physician order activities to be executed during a defined time period for a specific clinical care objective (e.g., exam, anesthesia, drug prescription). The pathway can be used to coordinate the clinical care team, standardize practices, and reduce the variance in health care delivery. The benefits of clinical pathways include achieving expected outcomes, promoting effectiveness and efficiency of clinical care, and optimizing resource utilization. Taken together, these benefits lead to a higher quality of care [12].

### 1.3. The problems

Best practice clinical pathways come from two sources: creation of clinical pathways and adherence to clinical pathways. The creation of clinical pathways is usually based on existing evidence and medical rules discussed in a professional committee. This process can ensure that the clinical pathways are as objective as possible. However, a group of professionals under the same health care institution may still overlook or exclude an important factor or activity. Day-to-day usage of the clinical pathways may also identify areas of improvement. In addition, hospitals could possibly find ways to improve their own clinical pathways by reviewing those of other hospitals.

Though comparing clinical pathways in use at other institutions could be helpful, it can be difficult to obtain this information. Even when details of the clinical pathways of another hospital are obtained, the resulting outcome of these clinical pathways can be difficult to determine. Moreover, it is never known whether the other hospital precisely follows the clinical pathways. Thus, it is difficult to make a comparison with another hospital. In summary, we need a practical and convenient method for overcoming the above issues and realizing an effective comparison of clinical pathways.

### 1.4. Objectives

Among the diverse components of the clinical pathway, sets of physician orders are a main component, which can be extracted and validated by reimbursement database. The

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