

# A Grouping Method based on the N-Dimension Euclidean Divergence Using Cerebral Infarction Cases in China and Japan

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## 1. Introduction

Since the 1980s, due to the remarkable progress of medical technology and the diversity of healthcare needs, it becomes difficult to cover the medical expense with fee-for-service scheme (FFS) due to the budget constraint in many countries. A new payment method, Diagnosis-Related Group/ Prospective Payment System (DRG/PPS), was introduced and adopted in the USA, Germany and other developed countries.

The Diagnosis Procedure Combination/Per-Diem Payment System (DPC/PDPS), a Japanese-style DRG/PPS scheme, has introduced in Japan since early 2000s with concerns over healthcare charge, length of stay (LOS), and the healthcare needs. Similar to the DRG/PPS, DPC is also a prospective payment system to classify the inpatient cases with coding. The unique part of this payment system is that per-diem and FFS payment schemes are integrated. Providers are paid a flat-rate prospective fee per day of inpatient hospital stay for certain DPC services and paid FFS for non-DPC services as well.

To evaluate the medical services and resources provided in hospitals more accurately, Comorbidity Complication Procedure Matrix (CCPM) was investigated in Japan as a comprehensive evaluation method with the consideration of severities. The trial version of CCPM was introduced for the patients with cerebral infarction, pneumonia, and diabetes mellitus from 2016.

DRG/PPS has been imported into China from the early 2000s. However, DRGs have not been widely used in China, and it has not yet been adopted nationally. It will be necessary to improve the usability of DRGs in China for promoting it to strengthen healthcare systems in future.

The purpose of this study is to develop a grouping method of DRGs based on N-dimension divergence, and to evaluate this method using the cases of cerebral infarctions in Japan and China to verify the applicability in different settings.

## 2. Methods

### 2.1 Data source and sample inclusion/exclusion criteria

The medical records of inpatients with cerebral infarction (ICD-10: I63) as the principal discharge diagnosis were extracted both in Japan and China. Personal information was anonymous and incapable of being connected. The Chinese data were the DRG data with 929 inpatients between January 1st 2015 and December 31st 2015 in a rehabilitation institute of China. The Japanese data were the DPC data with 918 inpatients between July 1st 2010 and February 29th 2012 discharged from 5 general hospitals in Japan. Inclusion criteria of this study were patients with cerebral infarction as the main diagnosis, and patients covered by a medical insurance. Exclusion criterion was the patients with the surgery. All of the analyses were performed using SPSS ver. 22.

### 2.2 Data collection and definitions

The extracted medical records of the inpatients with cerebral infarction contained various information such as (1) Basic information such as type of medical insurance, gender, age, admission date, discharge date, length of stay (LOS) and major diagnosis with ICDs, (2) Detailed information related to cerebral

Infarction such as complications and comorbidities (CC) with ICDs. (3) Medical charge information for drugs, type of bed, imaging, rehabilitation, laboratory analysis, sanitary materials, diagnostics and nursing care, which were used for this analysis.

### 2.3 processes of grouping method

The processes of grouping method of DRGs based on 2-dimension divergence using Chinese and Japanese data were 1) extract the factors related to the LOS by applying the decision tree method for case grouping, 2) measure the difference of the distribution of LOS and medical charge between groups using 2-dimension divergence, and 3) the groups with the similarity were allocated into the same cluster to get the clustering result of case mix grouping. The Japanese clusters had been compared to the existing CCPM to verify the applicability of this method.

### 2.4 Ethical considerations

This research is supported by International University of Health and Welfare and China Rehabilitation Research Center with the approvals of the ethics committees in two institutions (Approval number: 15-Io-14 and 17-Ig-43 respectively).

## 3. Results

The method was applied to both the Chinese data and Japanese data. The common factors between two countries, i.e., rehabilitation, pneumonia and diabetes type II, were extracted for the grouping. All samples were divided into eight groups using the common factors, and this method was performed for the eight groups, calculating the similarities of each group using divergence of LOS and medical charge distribution. The Chinese samples were divided into 6 clusters whereas Japanese had 4 clusters. The Japanese clusters were similar to the existing CCPM.

## 4. Discussion

The grouping methods using decision-tree method as well as the Euclidean divergence matrix could be applied for the improvement of DRG/DPC. The results of the clustering in this study were similar with the existing clustering using CCPM. The results of the clustering using Chinese data indicated that this method would be applicable for the Chinese DRGs. This research with the limitation of using sample data of cerebral infarction only suggests that it will be necessary to expand the data and target diseases for the further analysis.

## 5. Conclusions

A grouping method based on the N-dimension Euclidean divergence using the cerebral infarction cases was discussed in this study. This method was focused on the distribution of LOS and medical charge with other variables such as treatment related to severity and CC. It assigned the groups with similarity of distribution of medical resources such as LOS and medical charge into the same cluster, which with the similar medical resources. And the grouping method has been proved to be suitable and verified by analyzing and comparing the research subjects in China and Japan. But with the study limitation of one-disease cases, it is necessary to conduct further study to discuss the applicability of this method to other diseases.

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