

Stable Angina Clinical Pathway Correlation Clustering

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Introduction

The aim of the current study was to apply statistical and network science techniques [2] to depict how the clinical pathways of patients with chest pain affect their survival. Our study relies on GYEMSZI's data [1], from the years between 2004 and 2008. We included the data of 506.087 patients who underwent diagnostic procedures related to ischemic heart disease. The patients were assigned to one of the 136 *de facto* primary health care centers based on their residence.

We distinguished three different investigative processes: non-imaging cardiac stress test i.e. stress ECG (E), non-invasive imaging methods (NI) and invasive imaging methods (I). The clinical pathways are built up from the combination of these three processes. The traditional pathway is E-NI-I, but the doctors have the freedom to skip the E/NI steps for patients with higher coronary artery disease risk or inability to perform the noninvasive imaging or non-imaging tests.

Data overview

In the vast majority of cases, non-imaging cardiac stress test (E) was the only procedure performed. The ratio of non-invasive and invasive imaging methods increases together with the age of patients.

Cluster analysis

Network building

The primary care centers were compared with each other using Pearson's correlation according to the distribution of different clinical pathways. We have made a network based on a correlation matrix in which nodes are primary care centers and edge weights are correlation coefficients. We calculated all of the 18769 correlation coefficients with a 95 % confidence level.

Clustering

Using Louvain clustering (a modularity-based clustering) method on this network, 3 different care center groups were identified.

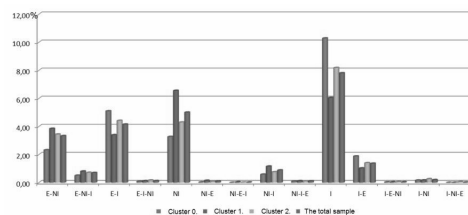


Figure 1: Clinical pathway spectrum of clusters (clinical pathway: x-axis, percentage of occurrence: y-axis)

The 3 clusters have different characteristics (Fig 1.):

- Cluster 0: relative preference for invasive imaging
- Cluster 1: relative preference for non-invasive procedures
- Cluster 2: relative preference for invasive treatment followed by non-invasive imaging

We calculated the revascularization and mortality rates for all of the clusters. Cluster 0 (the "invasive" cluster) has a much higher revascularization rate than Cluster 1 ($p < 0.01$), but the 365-day mortality rates for the two clusters are almost the same ($p < 0.05$), see Fig 1. This indicates that in many cases the revascularization procedure may be unnecessary.

We have observed a correlation between the spatial position of health care centers and the cluster membership (see Fig 2.). Cluster 0 was dominant in Western Hungary, Cluster 1 in Eastern Hungary and Cluster 2 in Central Hungary.

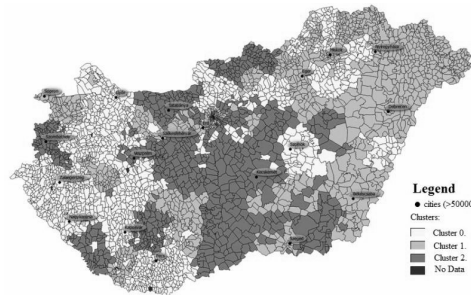


Figure 2: Position of health care centers belonging to the three clusters

Discussion and conclusions

Previous studies analyzed only the health care profiles of individual care centers or even single cases of patients [1]. In our study, the large number of cases allows the clustering and cluster-wise analysis of the profiles in a statistically meaningful way, thus higher level conclusions on the efficiency and organization of the health care system can be drawn. The correlation between the spatial position of health care centers and cluster membership suggests that there is a kind of information spread between neighboring institutions.

There are considerable differences in the utilization of patient evaluation pathways through the country, which is connected with similar differences in the subsequent revascularization procedures. In spite of this difference, 365-day mortality rates do not differ significantly between Cluster 0 and Cluster 1. It would be worthwhile to review revascularization practices for primary health care centers of Cluster 0.

References

- [1] I.Kósa, A.Nemes, É.Belicza, F.Király, I.Vassányi. Regional differences in the utilisation of coronary angiography as initial investigation for the evaluation of patients with suspected coronary artery disease. *Int J Cardiol* 2013; 168: 5012-5. DOI: <http://dx.doi.org/10.1016/j.ijcard.2013.07.148>
- [2] Tariq Ahmad, Nihar Desai et al., Clinical Implications of Cluster Analysis-Based Classification of Acute Decompensated Heart Failure and Correlation with Bedside Hemodynamic Profiles. *PLOS ONE* February 3, 2016