Appendix

Diagnostic diversity – an indicator of institutional and regional healthcare quality

Martin Brutsche, Frank Rassouli, Harald Gallion, Sanjay Kalra, Veronique L Roger, Florent Baty

Discussion

Relationship between DDI and medical management

The relationship between DDI and medical management was investigated by focusing specifically on hospitalization cases due to pneumonia (ICD-10-GM codes: J12*, J13, J15*, J18*). The aim was to check whether ICD-10 clusters with similar treatments could be identified in relationship with the institution DDI and caseload. A contingency table summing up for each institution the number of hospitalization cases with regards to every specific pneumonia codes was generated and analyzed using correspondence analysis (CA). Clusters of ICD-10-GM codes in relationship with the institution's DDI and caseload were investigated. Figure 1, left panel, shows the biplot representation (axes 1 and 2) of the CA of the institutions vs. ICD-10 pneumonia codes contingency table. The first axis which summarizes 19% of the overall variability, displays a gradient according to the size of the institutions (smaller institutions on the left side, larger on the right side). The association between the institution's caseload / DDI and CA is represented by 2 blue vectors pointing in the direction of maximal correlation on the CA space (upper right quadrant). In Figure 2, right panels, the institution are grouped according to the quartiles of their caseload and DDI (upper and lower panel, respectively). The CA based on the caseload quartiles shows some distinct clusters of pneumonia ICD-10 codes in relationship with the institution's caseload. As an example, smaller institutions lying on the upper left quadrant of the CA biplot are associated with the bacterial pneumonia codes J153, J154 and J158, standing for bacterial pneumonia due to streptococcus, pther streptococci and other bacteria. On the other hand, larger institutions (right quadrants of the CA biplot) are associated with the bacterial pneumonia codes J156, J151 and J157, coding for pneumonia due to Gram-negative bacteria, pseudomonas and mycoplasma pneumoniae. This analysis shows that for the same condition (pneumonia), the frequency of usage of specific ICD-10 sub-codes differs depending on the size of the institution. Furthermore, the two identified clusters of bacterial pneumonia are typically treated differently, which may indicate that the medical management in some specific conditions like pneumonia might be different depending on the type/size of the institution. Notice that, due to the strong association between the institution's caseload and DDI, a similar interpretation could be reached based on the analysis of the DDI-based CA (lower right panel).
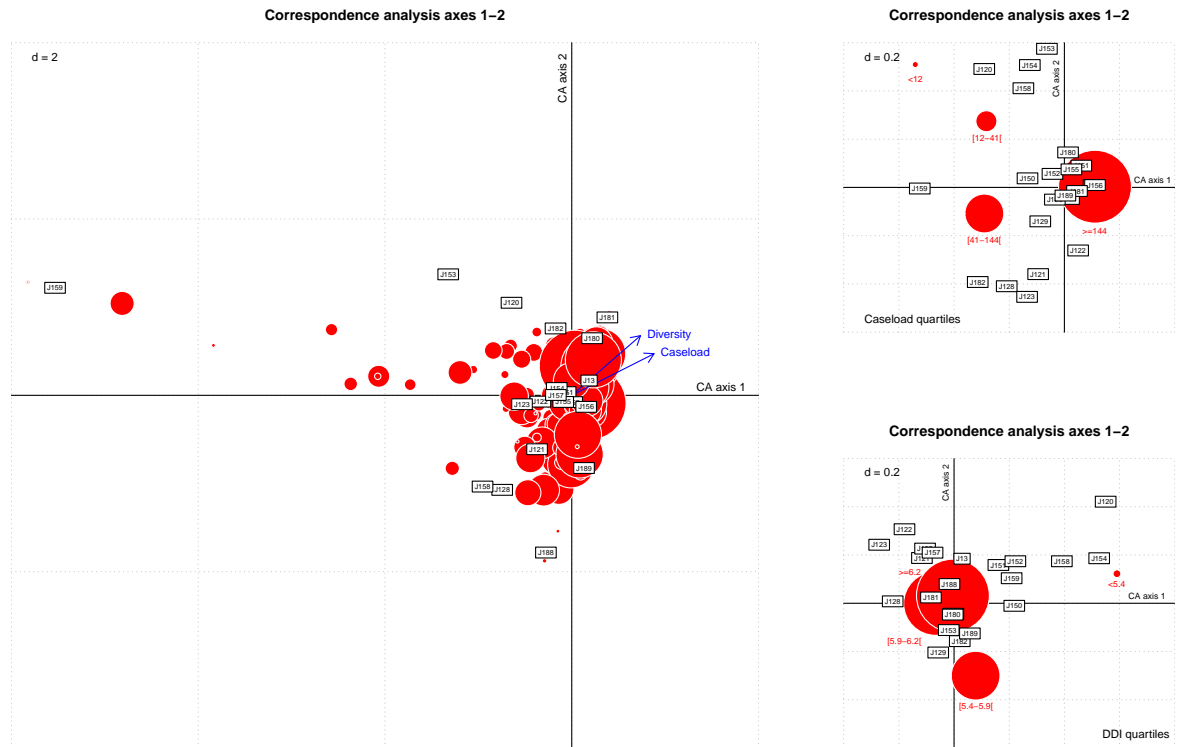
Figure 1: **Relationship between DDI and treatment options in pneumonia.** The left panel displays the correspondence analysis biplot of the pneumonia cases according to the institution (red circles with a radius proportional to the institution's caseload) and the specific ICD-10-GM code (boxed labels) used. The blue vectors show the association between caseload and DDI and the correspondence analysis using a vector fitting procedure which identifies the directions of maximal correlation with external variables on the correspondence analysis space. Two sub-analyses are proposed after grouping the institutions according to the quartiles of their caseload (upper right panel) and the quartiles of the DDI (lower right panel).