

## **Title** How to improve severity determination in the French DRGs ?

**Introduction:** The French DRG-classification for acute-care hospitals is two-pronged: first the algorithm identifies the major cause of the stay and then a severity level based on additional diagnoses (AD) is attributed in order to account for the marginal economic burden from the patient's other morbidities and/or acute complications during the stay. Currently, a stay's severity level is equal to the maximum level within its additional diagnoses. This model has been used for the past 10 years. Iterative revisions have led to marginal changes across time. Providers have mentioned the limits of the current model, particularly in its ability to adequately describe complex, multiple pathologies stays. Our goal was to develop a new model for the determination of the severity level.

**Methods:** Patient stays in 2017 and 2018 from the national database of patient hospitalizations in acute care were used in the analysis (around 16.000.000 stay), combined with stays from the corresponding patient hospitalization costs database (around 1.100.000 stays). A bespoke statistical methodology inspired by gradient descent was elaborated to optimize the R2 of the distribution of length of stay (LOS) and costs severity classes. The optimization targeted three areas of improvement:

- the number of severity levels for a patient's stay
- combining the effects of multiple additional diagnosis into higher severity
- conditioning the severity level of additional diagnoses to the main diagnosis

Physicians reviewed and suggested changes to the statistical model to ensure medical coherence. Lastly, providers representatives were presented with the results to keep them informed and allow them to make an informed decision.

**Results:** Increasing the number of severity level from 4 to 5 increased the R2 by 1 point (from 41.7 to 42.7%), while multiplying the number of groups.

Combining the effects of multiple additional diagnosis increased the R2 by nearly 5 points (from 41.7 to 46.3 %). This increased to 6.6% with 5 levels of severity (48.3%). From a model complexity perspective, performance is increased with a low number of combination rules. Meanwhile, from a medical standpoint, physicians deemed the results coherent, leading to readable and understandable examples of classification. Finally, conditioning the severity level of additional diagnoses to the main diagnosis seems to trade a low economic performance gain with a high model complexity increase.

**Conclusions:** New orientations for the determination of stay's severity were investigated. First and foremost, combining the effects of all additional diagnosis beyond the main yields a very significant performance gain: the economic burden of a stay depends on the number and weight of additional conditions considered. The current iteration of the model has good economic performance and medical coherence. Our work will continue by engaging further discussions with stakeholders to refine the next iteration model.