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Classes and scores: How will casemix funding evolve

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Main approach to payment

- Similar approaches and principles have been applied in applying casemix approaches in payment
- Group patients to classes using a consistent algorithm.
  - Classes are intended to capture "clinical meaning" and "resource homogeneity"
  - Number of classes within a DRG system reflect different judgements about the balance of these two objectives.
- Core of payment models is a single payment level all "inlier" episodes within the DRG. The idea is that the DRG classes can capture the main factors driving various in costs.
- In almost all systems, additional adjustments are made to reflect:
  - Exception cases (long stay or high-cost outliers; short stay or low-cost outliers)
  - "Unbundling" of selected components of care, such as:
    - Intensive care
    - High-cost prostheses
  - Components paid for through different payment streams (e.g. medical care).

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Main approach to payment

The development of classes with the DRG based on clinical guidance plus statistical analysis including through:

- Analysis of variance
- Regression trees (of which CART was an early variant)
- Use of complexity scores for splitting Adjacent DRGs

Analysis of costs (or charges), generally a more regular basis.

Identification of outliers

Statistical analysis of effects of other adjusted

Calibration

Can be interpreted as a **prediction of costs** reflecting the adjustments judged to be "legitimate" impacts on cost variation and excluding factors considered to be subject to "unjustified" variation in managerial or clinical decision making

Other approaches to prediction

- The aim of the analytical approaches has typically been to develop a set of classes that predict costs – a continuous variable.
- In machine learning this is best described as:
  - A supervised learning task (we have an "outcome" that we are trying to predict) and we have data that allows use to determine whether our models produce more or less accurate predictions.
  - More specifically we are interested in "regression models" – we want models that predict a continuous variable (cost) rather than a "classification models" (we are not predicting whether a observation belongs to a particular class).
- In the last three decades a range of other supervised machine learning techniques have come into common use or have been developed.
- Additionally, a better understanding of how to avoid some of the pitfalls of earlier approaches have emerged, for example, avoiding over-fitting.
- Many of the approaches don't involve assigning the unit for which prediction is made to a single class/group (such as DRG).
- In many situations ensembles of models (for example taking the average of several models) produces a better predictions.

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Paper purpose

Theoretical discussion:

- Could a payment systems be based on prediction of cost for individual episodes rather for groups/classes such as DRGs?

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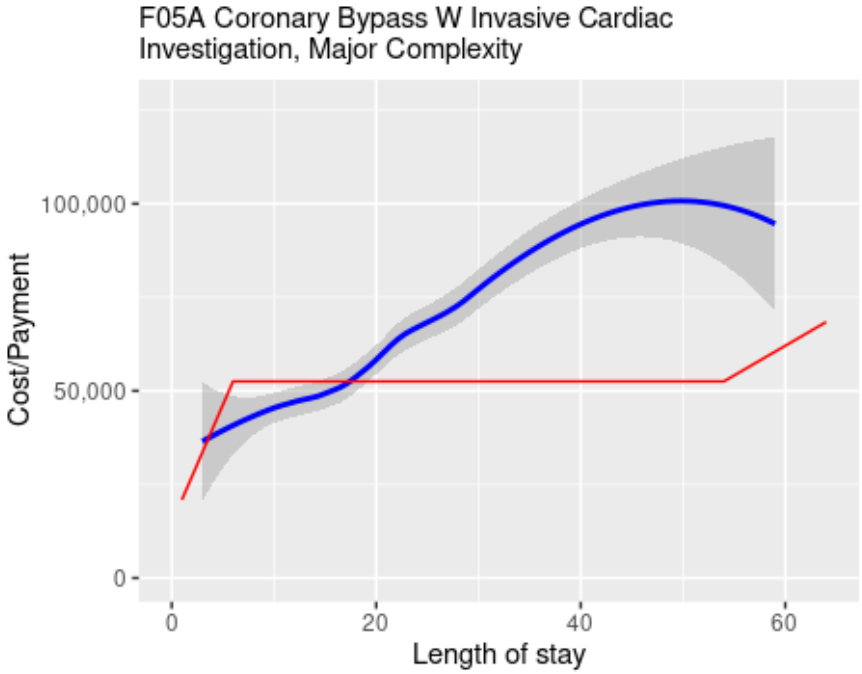
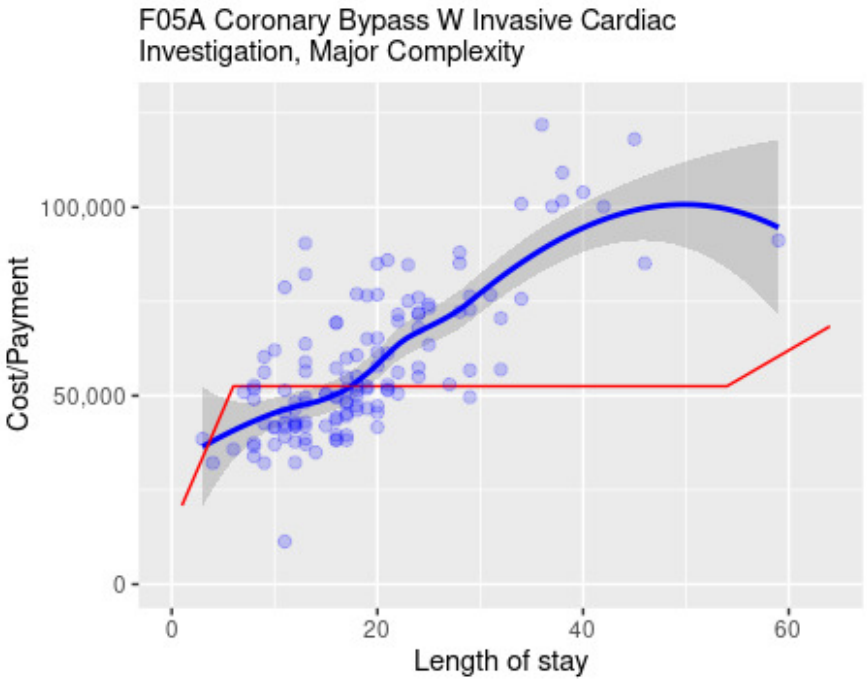
Simplified example



Blue line represents the trend in costs (generally increasing with length of stay)

Red line represents the payment

Majority of episodes fall into the inlier length of stay range and receive a single inlier payment.



The points represent costs of individual episodes

There is considerable variation in cost not all driven by length of stay

Cost prediction model

Basic idea is to develop models that predict costs for individual episodes that take account of more of the variation we often see within inlier DRGs.

The models could be constructed using a range of machine learning techniques, but for illustration purposes, we will stay with a simple regression model with no interactions. The model includes the following predictors:

- Separation mode
- Length of stay in ICU
- Long Stay Outlier days
- Short Stay Outlier days
- Age group (5 categories)
- Episode complexity score raw

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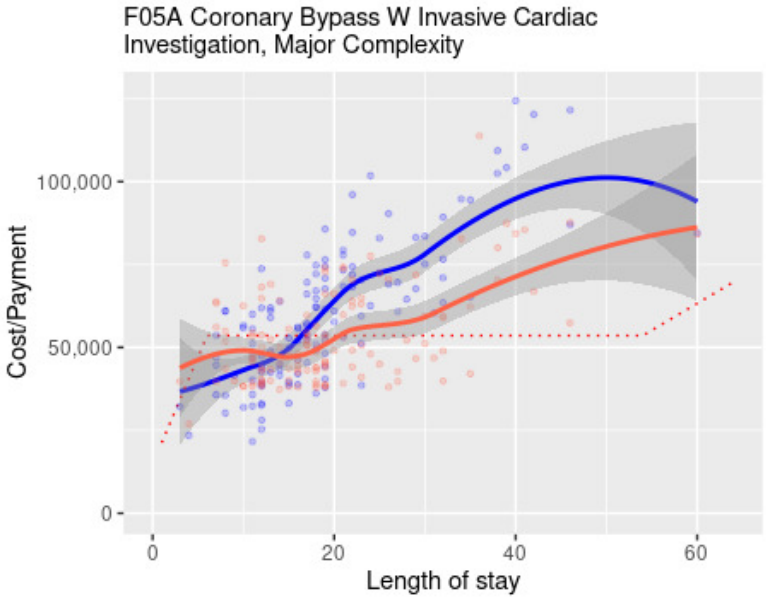
Example



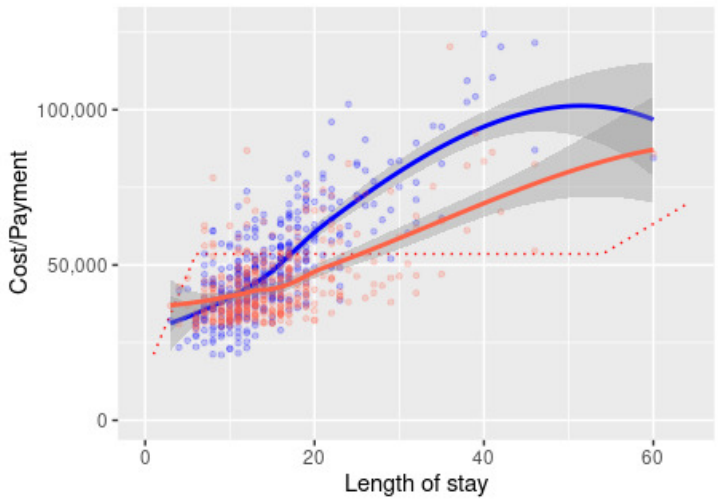
The blue points represent costs of individual episodes and the blue line shows a smoothed relationship between cost and LOS

The red points represent payment using the simple episode level prediction mode together with a smoothed relationship between payment and LOS

The red dotted line shows the tradition payment approach

Extension to Adjacent DRGs

Adjacent DRG F05



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Preliminary results of simulation

Used a specific AR-DRG version and NWAU model

Simulated data for 29 AR-DRGs and 10 hospitals.

Simulated costs using inferred parameters for gamma distribution (rate, shape) at DRG level based on sample of data.

32,365 episodes

Limited to simulating public patients

Only applied the Same Day, Short Stay Outlier and Long Stay Outlier adjustments.

Mean cost: $7,860

Evaluation metric:

Improvement in root mean square error (RMSE) between

(a) Original payment policy

(b) Payment approach based on prediction from simple regression model.

RMSE for (a): $5,498

RMSE for (b): $4,471 (20% improvement)

RMSE for (b) Adjacent DRG model: $4,617

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Some initial reflections

Advantages:

- More accurate prediction of cost by including additional predictors considered to be legitimate influences on cost
- Capacity to better address interaction of predictors and non-linear effects (these weren't examined in the simulation)
- Depending on modelling approach capacity to "borrow strength" in modelling general influences on costs

Disadvantages

- More complex payment model (possibly)
- May be more difficult to understand
- Potentially requires is own software.
- Decision making on what should be considered legitimate predictors may be more complex (but this faces similar issues to existing debates on cost weight adjustors)
- Cost of change

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Other issues

- What decision rules need to be implemented around models (e.g. which predictors should be considered valid)?
- What impact would these models have on incentives for improving efficiency?
- What role might DRG classes have in this system? Could the approach permit a greater focus on “clinical meaning” of groups?

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