The Hidden Cost of Healthcare
Transforming medical equipment management with data and analytics

Why it matters

$60 bn annual medical equipment spending (U.S.)
30% of total costs of health systems

“The doctor with the loudest voice gets new equipment”

No data-driven decision like in other industries (e.g. transportation)

Current practice

First to offer a data solution for asset management in healthcare

HANDLE Global

Question

Can we use historical maintenance data to provide decision support for better asset replacement strategy?

Descriptive Analytics

Maintenance cost over lifecycle (clustering)

Time series clustering on maintenance cost aggregated by product/category

Distance metric: Dynamic time wrapping & Euclidean

Method: Agglomerative/hierarchical clustering

Cluster across life cycle

Assets per cluster

Lemon analysis

Lemon = asset with significantly higher life-time maintenance cost as its peers
1. Demeaning of asset maintenance cost to achieve global comparability
2. Select global cutoff for lemons - how much more expensive is a lemon?

Example Mindray Passport2 (monitor)

Outcome

Majority of assets show stable maintenance cost over time

Products can be ranked by relative number of “lemons”

Predictive Analytics

Predictive setup

Predicting expected annual maintenance cost to detect early costly assets.

Comparison of high maintenance assets at t & t - 1

A Global-Local-Baseline (GLB) approach

For each category, we select the best predictor between a local linear regression, a global gradient boosting and the previous year’s cost

R² improvement

28% R² improvement with GLB

Feature importance

Feature importance makes our model more interpretable, but also will guide future data collection and equipment handling.

Shap plot

Asset age is a weak predictor for maintenance cost.

Maintenance cost is predictable with MAE $90 per asset per year

Prescriptive Analytics

What to optimize for?

HANDLE score: Asset quality
Expected maintenance cost: Cost and reliability
Physician preference: Physician satisfaction
Past vendor support: Risk of higher replacement effort
Strategic goals: E.G. Standardization
High-revenue equipment: Risk of revenue-loss
Patient-facing equipment: Patient experience

Improvement

15% increased capital-effectiveness

Trade-off analysis

Pareto frontier to illustrate trade-offs between multiple objectives

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Only ~17% of high maintenance assets in year t - 1 are again high maintenance year t. Disaggregated cost is unstable

Last year’s cost is a bad predictor

Example of GLB

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Example of GLB

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