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Enhancing healthcare cost communication through visualization

A decision-tree framework

BACKGROUND

Healthcare databases, especially claim databases, offer large opportunities to study healthcare costs.

However, cost data are complex: they can be distributed across heterogeneous categories (hospitalizations, drugs, procedures…), vary over time, and differ according to patient subgroups (e.g. different disease stages). Summarizing such data in a way that is both accurate and interpretable is therefore challenging.

Effective visualization plays a key role in translating these complex cost structures into insights that are understandable and actionable for decision-makers and clinicians. Yet, there is currently no standardized guidance on how to choose the most appropriate visualization depending on the analytical question and dataset characteristics. This methodological gap can lead to suboptimal communication of results and limit the impact of cost analyses on healthcare decision-making.

OBJECTIVE

The objective of this work is to provide a practical decision-tree framework to guide data scientists, biostatisticians and epidemiologists in selecting the appropriate type of data visualization for healthcare cost analyses depending on the context and objectives.

METHODS

A literature review was carried out to search for health economic studies reporting cost data. We examined reported methodologies and combined them with common uses of the SNDS (French national health data system) to produce a decision-tree framework. The decision tree is structured around binary questions and integrates key criteria: analytic objective (descriptive vs. comparative), hierarchical cost breakdown, number of groups compared, and focus on individual cost distribution (variability, skewness, outliers) versus overall trends. All visualizations were created using a synthetic dataset designed to reflect real-world healthcare cost.

The study period was set from 2017 to 2023; for comparisons between two key time points, we selected 2017 and 2020, as the strong impact of COVID-19 on costs in 2020 provided more visual contrasts.

The term ‘groups’ refers either to distinct patient subpopulations (e.g., non-metastatic vs. metastatic cancer) or to the same population observed at different time points (e.g., costs in 2022 vs. 2024). This dual meaning was adopted to keep the decision tree concise.

CONCLUSION

Our work resulted in a decision-tree guide that helps users clarify their analytical questions before selecting the visualizations of healthcare costs that best align with their data and objectives.

RESULTS

Cost type legend
Hospitalizations · Sick leaves · Drugs · Consultations · Medical devices · Medical procedures · Laboratory tests · Transport

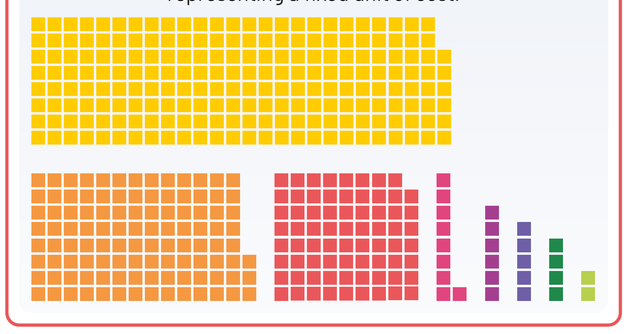
Groups
Group 1 · Group 2 · Group 3 · Group 4

Descriptive

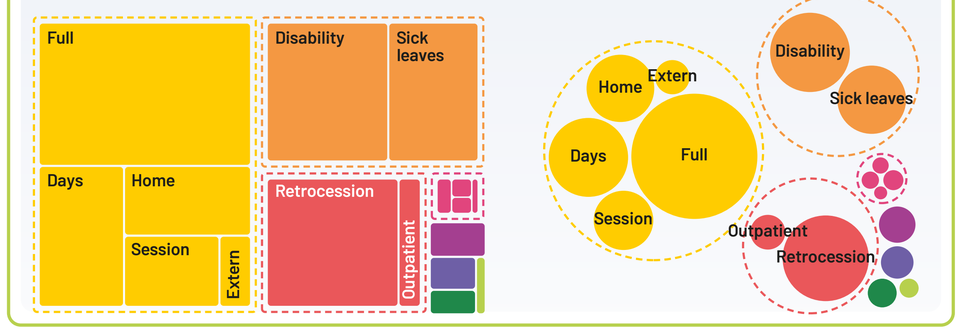
Evaluation of cost subcategories

No ✕ / Yes ✓

WAFFLE CHART
Compare costs by category within a group, with each square representing a fixed unit of cost.



TREEMAP OR CIRCLE PACKING
Visualize the hierarchical structure of costs by category and subcategory within a group.



Comparative

≤ 3 groups

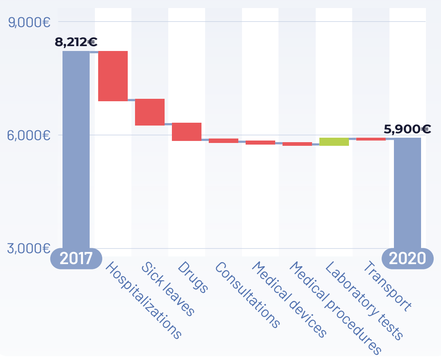
Identify individuals costs (variability, skewness, outliers) vs Global trend ?

No ✕ / Yes ✓

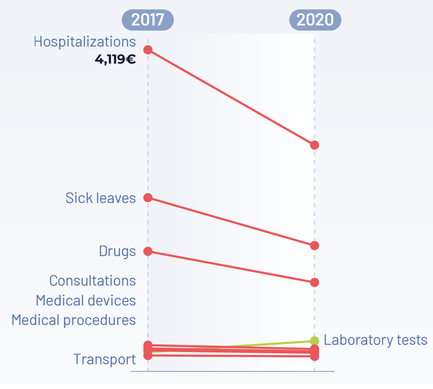
From simple to advanced visualization

2 groups

WATERFALL CHART
Break down the change in total costs between two groups by cost category.

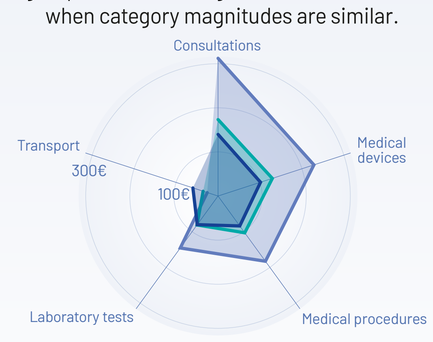


SLOPE CHART
Compare cost categories between two groups.

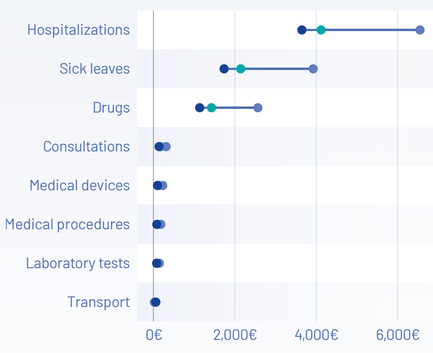


2-3 groups

RADAR CHART
Compare the cost structures accross different groups and cost categories. Recommended when category magnitudes are similar.

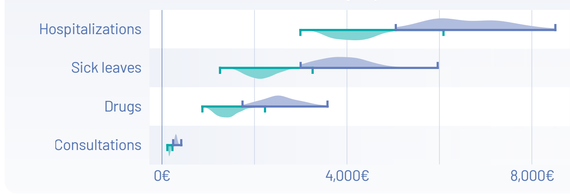


DUMBELL PLOT
Compare mean costs between different groups for each cost category.

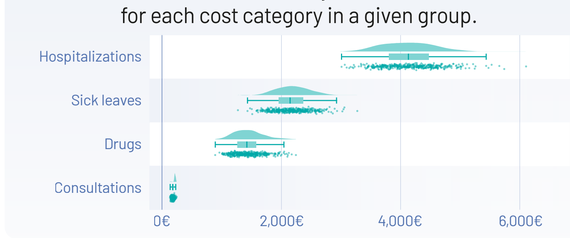


BOXPLOT
Show cost distribution within different groups, for each cost category.

VIOLIN PLOT
Show cost distribution and density within different groups, for each cost category.



RAINCLOUD PLOT
Combine cost distribution, density, and indivual observations, for each cost category in a given group.

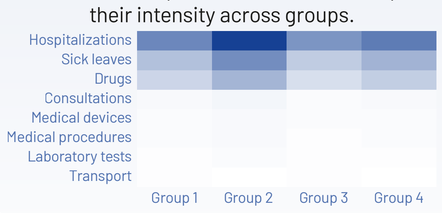


> 3 groups

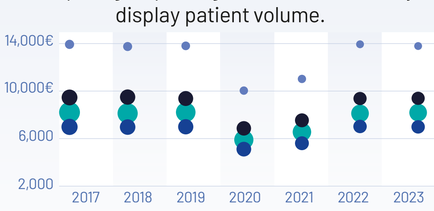
Identify individuals costs (variability, skewness, outliers) vs Global trend ?

No ✕ / Yes ✓

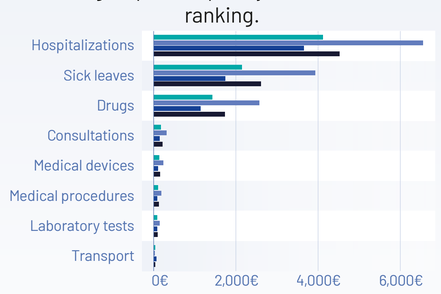
HEATMAP
Show the overall picture of costs and compare their intensity across groups.



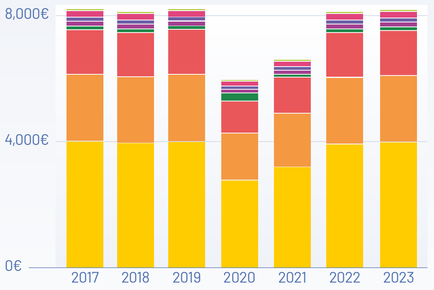
BUBBLE CHART
Compare group categories and additionally display patient volume.



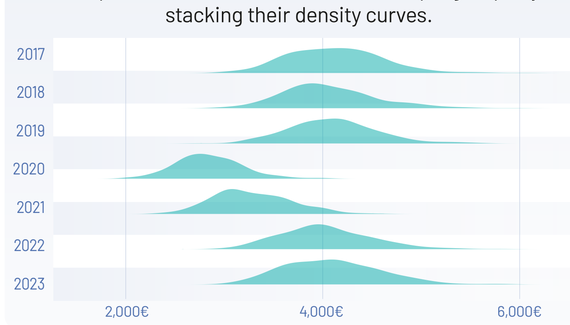
GROUPED BAR CHART
Compare precise cost values side by side across groups and quickly determine their ranking.



STACKED BAR CHART
Compare group categories and additionally show the evolution of the total cost.



RIDGELINE
Compare cost distributions across multiple groups by stacking their density curves.



Références

[1] Thaker NG, Ali TN, Porter ME, Feeley TW, Kaplan RS, Frank SJ. Communicating Value in Health Care Using Radar Charts: A Case Study of Prostate Cancer. J Oncol Pract. sept 2016;12(9):813-20.

[2] Tufts J, Guan N, Zemedikun DT, Subramanian A, Gokhale K, Myles P, et al. The cost of primary care consultations associated with long COVID in non-hospitalised adults: a retrospective cohort study using UK primary care data. BMC Prim Care. 20 nov 2023;24(1):245.