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(57) Abstract :
ABSTRACT [0011] In public health programs, medical test rationing is a critical challenge due to limited resources and the need to accurately identify individuals at risk. This study presents a novel decision-tree-based Bayesian approach to optimize health prevention budgets by determining whether a particular medical test is necessary for each individual based on their profile. The goal is to minimize unnecessary tests while ensuring that high-risk individuals are not left undiagnosed. The proposed method involves a four-step process: classification of subjects using a decision tree, Bayesian inference to estimate unknown risk probabilities and subject distributions, performance evaluation to derive risk measures, and an integer programming model to allocate tests under chance constraints. The model is applied to real-world case studies involving hypertension (HTA) and diabetes screening in France, demonstrating substantial reductions in unnecessary tests up to 90% while maintaining low rates of false negatives among at-risk populations. This approach offers public health authorities a practical tool for balancing cost-efficiency with medical coverage. By combining interpretable machine learning with probabilistic modelling and optimization, it enables more personalized and data-driven test allocation strategies. The framework is robust to different data sizes and decision tree variations, making it suitable for real-life health prevention programs across diverse populations.

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