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Title: Dispatching medical samples: a case study

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Abstract :

Amyotrophic Lateral Sclerosis (ALS) is a rare fatal motor neuron disease that causes degeneration of the upper and lower motor neurons. No diagnosis and prognosis biomarkers are identified to help patients' management and research in this field is highly active. Different ALS centers are in charge of patients' care in France with visits every 3 months for clinical and biological explorations. Many research projects are based on biological fluids samples exploration and involve different centers hospitals as ALS is considered as a rare disease. Consequently, the need to centralize samples in the specialized laboratories in charge of specific biological analyses is crucial. The question is how to organize the flow to optimize the use of these precious samples.

Several biological fluids (blood, cerebrospinal fluid, etc.) are collected from each patient in each cohort in several tubes of varying quantities. Each product must reach the other centers, which express needs for each product. Three constraints complicate this (sort of graph flow) problem: (1) dividing a sample into several portions is a tedious aliquoting operation, (2) a shipment requires a freeze/thaw operation and (3) a patient sample cannot arrive in two different tubes at the same site. We minimize the maximum number of aliquoting operations and limit the number of freezing operations.

We model this problem, show that it is NP-complete, propose an MILP model, a lower bound and a heuristic algorithm.