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A directed acyclic graph of overall survival for patient with pancreatic ductal adenocarcinoma

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Keywords

Directed acyclic graph, causal inference, cancer

Abstract

Purpose

Accurate model representation is critical for conveying assumptions and guiding data analysis, especially when using observational data. This qualitative study employed a knowledge-driven approach to develop a causal model represented by a directed acyclic graph (DAG).

Methods

A literature review was conducted on treatment selection and prognostic factors for patients with non-metastatic pancreatic ductal adenocarcinoma (PDAC). Factors identified from literature and observations of multidisciplinary tumor boards were verified with providers through semi-structured interviews, where additional factors were also identified. Finally, all factors and their relationships to each other were synthesized in a DAG.

Results

Forty-two factors relevant to non-metastatic PDAC treatments on overall survival were identified and broadly categorized into genomic concepts, tumor biology, and patient characteristics. The majority of patient characteristics factors determined a patient's chemotherapy tolerance, which affected available treatment options. We suspected that providers integrate various clinical concepts (e.g., inflammatory markers, complete blood count) into an unmeasured "patient overall health status," which governed a patient's chemotherapy tolerance and influenced providers' treatment recommendations. Together, tumor stage, treatment options, and non-modifiable tumor biology were the main determinant of overall survival.

Conclusion

This is a preliminary though comprehensive model representing concepts that causally affect non-metastatic PDAC patient's outcome. A knowledge-derived DAG can help researchers identify variables required in an observational dataset and how missing variables may be mitigated. Furthermore, a DAG helps researchers correctly classify variables (e.g., confounders, mediators, colliders) and apply appropriate statistical method. Future researchers can use this DAG as foundation of their modelling of the disease and contribute additional factors or causal relationships to this DAG.