

## Determining an Effective Treatment Plan for Breast Cancer: A Multi-Criteria Decision Model and Algorithm

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Breast cancer is the second leading cause of cancer deaths in U.S. women. For 2017, the American Cancer Society estimates that 255,180 women will be diagnosed with invasive breast cancer and 40,610 will die. Selection of an effective, patient-specific treatment plan has challenged physicians because the decision process involves many critical factors such as disease stage, disease risk factors, biomarker-related risks, and patient-related risks. In this study, a comprehensive set of criteria for selecting treatments was determined by literature review and oncologist interviews, and two analytical hierarchy process (AHP) models were used to weight criteria for both primary and secondary treatment therapies. Using the weighted criteria, we propose a treatment-ranking algorithm that evaluates every scenario and provides optimal patient-tailored treatment alternatives. We validate the multi-criteria ranking algorithm by comparing its treatment rankings with rankings from five oncologists, and show that, in most cases, the algorithm's output matches or is significantly correlated with the expert ranking. Thus the algorithm, on an easy-to-use Microsoft Excel platform, could be an accessible decision-support tool to aid oncologists and educate patients in choosing breast cancer treatment. Our multi-criteria ranking approach can also be adapted to solve complex decision-making problems in other service industries.