Illuminating breast cancer survivorship with explainable AI: Insights from Malaysian breast cancer survivorship cohort

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ABSTRACT

Breast cancer survivorship involves complex, long-term outcomes influenced by clinical, psychosocial, and economic factors. Conventional models often lack transparency, limiting their use in personalized care. Explainable artificial intelligence (XAI) offers interpretable insights that can enhance decision-making and guide survivorship planning. This study aims to conduct survivorship analysis of breast cancer patients using explainable AI models, with the goal of identifying important predictive features and generating personalized post-diagnosis guidelines for improved patient management. We used data from the Malaysian Breast Cancer Survivorship Cohort, which includes 17 structured domains such as demographic details, baseline clinical factors, psychosocial support (hospital anxiety and depression scale, stress thermometer), work-related status, complementary and alternative medicine use, and cost of treatment. Machine learning models (XGBoost, random forest, support vector machine) were trained to predict survivorship outcomes, including quality of life, return-to-work status, and emotional well-being. Feature importance was derived using SHAP (SHapley Additive exPlanations), enabling both global interpretability and individualized prediction explanations. The XAI models identified key predictors of survivorship outcomes, including emotional distress, availability of psychosocial support, work-related stress, fatigue, complementary and alternative medicine usage, and treatment-associated costs. Using SHAP (SHapley Additive exPlanations), the models offered transparent, patient-specific insights by quantifying the contribution of each feature to individual predictions. These interpretable outputs empower clinicians to design personalized interventions that address psychological well-being, financial strain, and social support, enhancing long-term patient care and recovery. Explainable AI enables transparent and actionable insights into the survivorship trajectories of breast cancer patients. By identifying key modifiable factors, this approach facilitates the development of patient-centered guidelines and supports collaborative, informed clinical decision-making. The methodology is scalable for broader applications in survivorship care and chronic disease management.

Keywords: Breast cancer survivorship, explainable artificial intelligence (XAI), Predictive modeling, shap analysis, personalized healthcare