New math model could lead to more personalized cancer therapies

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Researchers have found a new way to use math to better treat cancer and prevent its relapse.

Using the first mathematical model of its kind, researchers at the University of Waterloo found a way to study the interactions between the immune system and different types of cancer cells.

Using their new model, the researchers found that administering different cancer therapies in a particular sequence could better target cancer stem cells in tumors, potentially leading to more personalized treatments for cancer patients.

Cancer stem cells are known to drive tumor growth, which means that eradicating them can lead to long-term treatment success with a reduced likelihood of disease relapse.

"Cancer and response to treatments can vary from patient to patient," said Michelle Przedborski, a postdoctoral fellow in Waterloo's Department of Applied Mathematics. "Many cancer researchers and clinicians are currently working together to identify and develop more targeted treatment strategies and to determine how to optimize their effectiveness for individual patients.

"The model we have developed in this work might help with creating and optimizing these patient-specific treatment strategies."

In conducting their study, researchers calibrated the model with experimental data from studies on tumor growth and immunotherapy treatments. They then used the calibrated model to simulate the effects of chemotherapy in combination with different types of immunotherapies to predict the most effective combination of treatments.

"The numerical simulations predicted that giving cancer stem-cells specific immunotherapy before chemotherapy is most effective at reducing tumor size," said Przedborksi, who is supervised by Mohammed Kohandel, a professor in Waterloo's Faculty of Mathematics. "While cancer stem cells comprise only a small percentage of the tumor cells, they drive tumor growth, are often resistant to treatments, and can eventually contribute to relapse if left unchecked.

"Our results suggest that, if used together, immunotherapy and chemotherapy have the potential to reduce tumor size much more significantly and efficiently than either treatment on its own."

The study, "Mathematical modeling of cancer stem cell-targeted immunotherapy," appears in the journal *Mathematical Biosciences*.

More information: Daniel Sigal et al. Mathematical modelling of cancer stem cell-targeted immunotherapy, *Mathematical Biosciences* (2019). DOI: 10.1016/j.mbs.2019.108269

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