# Computational Model of Chimeric Antigen Receptor (CAR) T-Cell Therapy in Triple-Negative Breast Cancer with Binary Distribution of Antigen Receptors.

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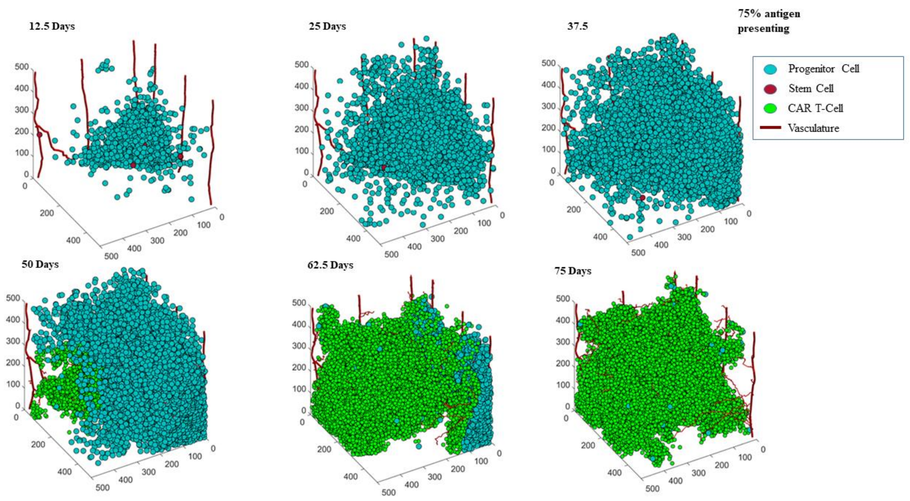
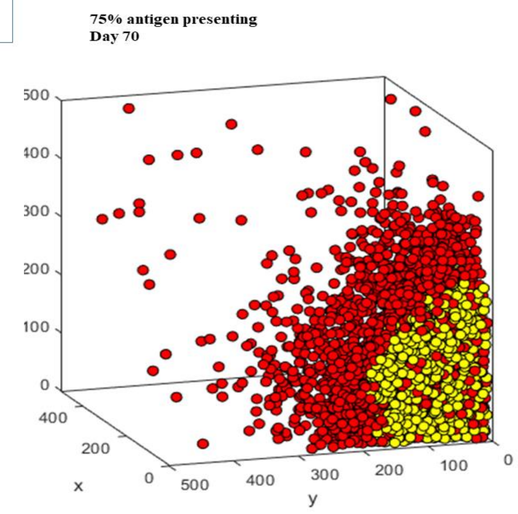
## Introduction

Among the various types of breast cancer, Triple-Negative Breast Cancer (TNBC) has proven to be one of the most potent with poor prognosis and limited treatment options. We built upon a previous 3D agent-based model of TNBC to incorporate Chimeric Antigen Receptor (CAR) T-cell therapy. CAR T-Cell therapy is a promising method of treating cancers which modifies the patients' T-Cells to directly kill cancer cells that present certain antigens. We varied the percentage of tumor cells with antigen present to see the overall effectiveness of CAR T-cell therapy on tumor growth. We used a binary antigen presentation, where each tumor cell either does or does not have the antigen necessary for their detection and elimination by a CAR T-cell.

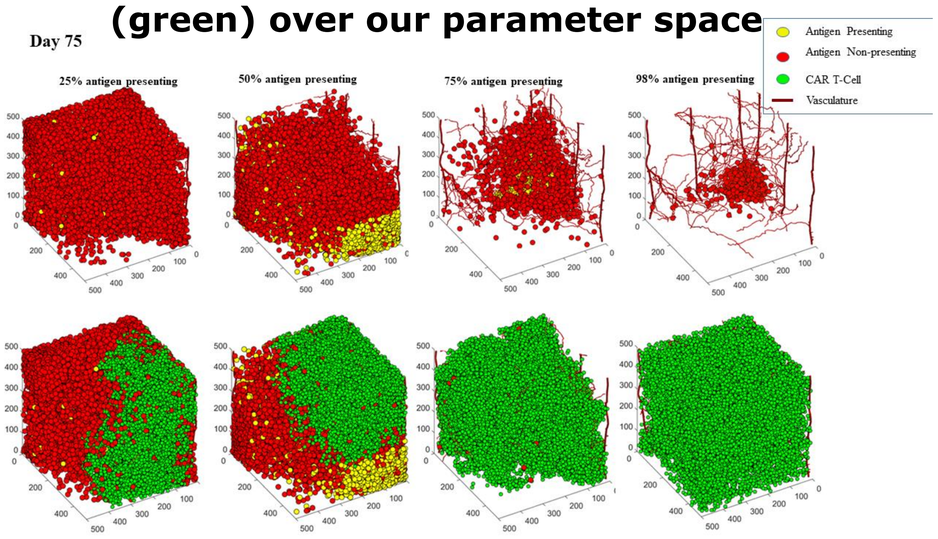
## Growth of tumor (blue) and CAR T-cells (green) over time




## Antigen non-presenting (red) cells shielding antigen-presenting (yellow) cells from CAR T-cells




## Antigen-presenting (yellow), antigen non-presenting (red), and CAR T-cells (green) over our parameter space



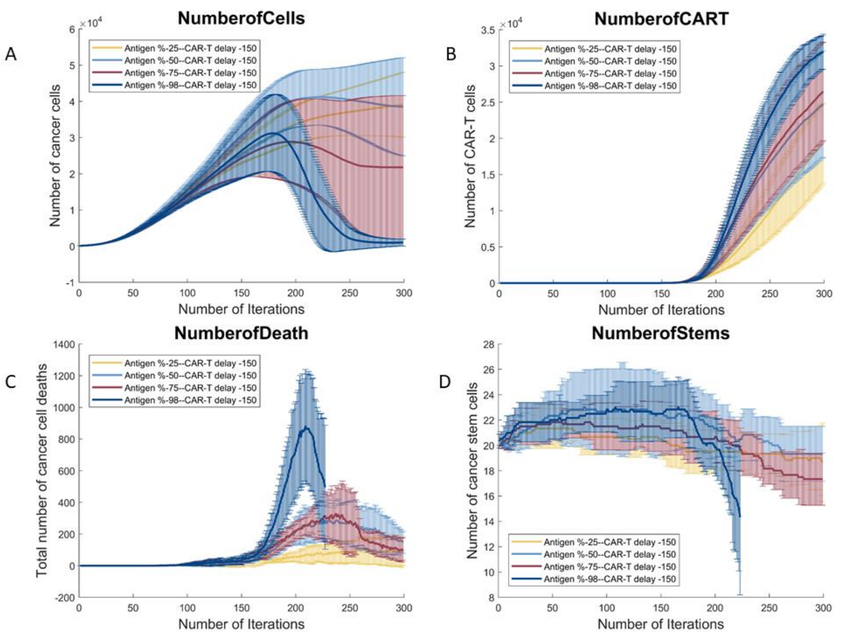

## Methods

- Our simulations take place in two separate grids: a cellular grid containing TNBC and CAR T-cells (20 micron$^3$) and a vascular grid containing endothelial cells (2 micron$^3$).
- Our model includes vasculature, stem and progenitor cells, CAR T-cells, and hypoxic cells.
- Tumor cells can migrate, proliferate, become hypoxia, undergo apoptosis, and senesce.
- If a tumor cell is hypoxic, its migration rate is tripled and its proliferation rate is halved. If a cell is hypoxic for too long, it dies.
- CAR T-cells therapy is introduced at 150 iterations (37.5 days). Each iteration, CAR T-cells can migrate, kill tumor cells, proliferate, and undergo apoptosis.

## Results

- CAR T-cell treatment statistically reduces the size of the tumor
- The more antigen-presenting tumor cells the greater the rate of tumor reduction
- There is a positive trend between percentage of antigen-presenting tumor cells and the growth of CAR T-cells
- Cancer cell deaths decreases with an increasing percentage of antigen-presenting tumor cells
- Non antigen-presenting tumor cells can form a shield that protects antigen-presenting tumor cells from CAR T-cells
- Stem cells are only eliminated at 98% presenting tumor cells

## Tumor metrics over time




## References

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