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EDITORIAL

Cell Population Dynamics in Cancer Progression

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This special issue includes three aspects of cancer progression:

- Moritz Gerstung and Niko Beerenwinkel show how the accumulation of mutations in cancer cells drives the progression of cancer throughout successive stages. They highlight the role of selective advantage for cells at evolutionary time scales.
- Michel Malo, Amandine Cartier-Michaud, Elisabeth Fabre-Guillevin, Guillaume Hutzler, Franck Delaplace, Georgia Barlovatz-Meimon, and Annick Lesne address the multiscale dynamics of the physiological state of the cells in their surroundings. They study the early metastatic process, a rare but key event involving a complex interplay between intracellular, extracellular, and cell population levels.
- Stefan Hoehme and Dirk Drasdo use numerical tools to represent the kinetics and the morphology of cell division and tumor growth. They search to control the growth and form of the tumor either by nutrients or by mechanical constraints.

Data describe the genetic profiles of cancer cells, their physiological properties, morphology, and qualities of adhesion or motility. Models help give sense to experiments: Markov and waiting time models, dynamical systems and bifurcation theory, cellular automata, both on-and off-lattice agent-based simulations, and Langevin equations. Understanding the progression of cancer leads us to combine mathematical theorems and numerics, qualitative proofs-of-principle and

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quantitative predictions. Modeling helps us delineate the respective role of mutations, cell state bifurcations, nutrient supply, random growth of the tumor, mechanical and surrounding constraints in the progression of cancer, and formulate scenarios, which integrate various time scales and levels of organization.

Modeling also opens new opportunities for experiments on the long road to understanding the progression of cancer.