A glimpse at evolvability: a theoretical analysis of its role in the adaptive dynamics of cell populations.

Juan Jiménez-Sánchez[1], Carmen Ortega-Sabater[1], Philip Maini[2], Víctor M. Pérez-García[1], Tommaso Lorenzi[3]

[1] Mathematical Oncology Laboratory (MOLAB), Universidad de Castilla-La Mancha (UCLM), Ciudad Real, Spain
[2] Mathematical Institute, University of Oxford, Oxford, UK
[3] Dipartimento di Scienze Mathematiche (DISMA), Politecnico di Torino, Turin, Italy

Evolvability is defined as the capacity of a population to generate heritable variation to facilitate its adaptation to new environments or selection pressures [1, 2]. Although many previous works have studied its causes or its influence on evolutionary dynamics, few have studied the relationship between evolvability and cancer, and even fewer have considered evolvability as a phenotypic trait subject to change and evolution [3]. In this work we explore the evolutionary dynamics of a population of tumour cells subject to changes in their proliferative potential and evolvability by means of a discrete individual-based model and the corresponding continuum PDE model derived from the former, building on previous works studying the adaptive dynamics of phenotypically structured populations [4], as well as populations subject to stochastic fluctuations in fitness [5]. We have discovered robust adaptive trajectories that rely on cells with high evolvability to rapidly explore the phenotypic landscape and reach the proliferative potential with the best fitness. The strength of selection and the cost associated with evolvability can alter such trajectories in such a way that, if both are sufficiently restrictive, tumour populations with high evolvability may become extinct in the discrete model, revealing disagreements between both discrete and continuum models.

References

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