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Ecology and evolution in control and cure of metastatic cancers.

Increasing numbers of effective therapies are available for metastatic cancers. For example, there are currently 52 drugs approved for use in metastatic prostate cancer. However, of the 35,000 men diagnosed this year, none will be cured. The reason for treatment failure is evolution. With access to the information stored in the human genome, cancer cells can deploy strategies to counter all current therapies. A new treatment approach focuses on the evolutionary dynamics that allow resistant cells to proliferate sufficiently to repopulate the tumor. Resistance usually comes with phenotypic costs from operation of the associated molecular machinery which can be exploited to reduce cellular proliferation in the substrate-poor environments of clinical cancers. Evolution-based cancer treatment is designed to delay or prevent proliferation of resistant cells. Developed through mathematical models, this approach is now in clinical trials. A new initiative focuses on the eco-evolutionary dynamics of Anthropocene extinctions to develop strategies for curing metastatic cancers with available drugs. Mathematical models and computer simulations have demonstrated this to be a feasible approach. Initial pre-clinical studies and pilot clinical trials are underway. (Received August 27, 2019)