The new generation of cancer immunotherapies includes ways to engineer patients’ own immune cells to kill their cancer and patient-specific neoantigen vaccines. This image alludes to the hope of personalized therapy tailored to each patient.
Cancer immunotherapy—the science of mobilizing the immune system to kill cancer—has been pursued for more than a century. Yet only recently has this powerful strategy finally taken center stage in mainstream oncology. The past few years have seen unprecedented clinical responses, rapid drug development, and first-in-kind approvals from the U.S. Food and Drug Administration. Reports of terminal cancer patients defying the odds and achieving complete remissions are accumulating. These success stories are the culmination of decades of painstaking research by pioneering scientists and physicians. Newly approved immunotherapies include drugs that can manipulate components of the immune system and methods to genetically engineer patients’ own T lymphocytes to recognize and attack their tumors.

Researchers are racing to expand the use of immunotherapy to benefit more cancer patients. But it remains unclear why only a subset of individuals respond to treatment and how to better achieve sustained remissions. Hundreds of clinical trials are under way to see whether improved responses can be attained by combination therapy approaches. Unraveling the cellular and molecular basis of treatment resistance should facilitate rational design of new mechanism-based studies. Advances in genome sequencing are identifying predictive biomarkers and facilitating the design of personalized vaccines that target patient-specific tumor neoantigens. These lines of research, along with growing evidence that the gut microbiome plays a defining role in immunotherapy response, are charting innovative paths toward truly personalized medicine.
The Cancer Immunotherapy Revolution
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