Environmental and endogenous stressors can cause DNA damage to promote cancer onset, cancer progression and ageing. The overarching theme of my research program has been the study of cellular, tissue and organismal responses to stress, with an emphasis on alkylating agents and stressors that increase reactive oxygen species (ROS) levels. In addition, my research team participates in the development of technologies to study and mitigate cellular stress responses. Our long term goal is to use information from our studies to define new mechanisms of signal transduction and to develop a knowledge base and tools to treat human disease.

Highlights of research in the Begley Laboratory include (1) the demonstration that epitranscriptomic marks found in the form of RNA modifications play key stress response roles, by regulating the translation of DNA damage and ROS response proteins, (2) the development of algorithms and database systems to identify nucleic acid sequences translationally regulated during stress responses, (3) the identification of a new tumor growth suppressor for colorectal cancer, and (4) the development of a mouse model that has increased ROS levels, for use in the testing of potential environmental hazards.

We have also collaboratively developed technology and used it to (1) characterize global changes in RNA modification in response to stress, (2) measure activation of the DNA damage response in patients undergoing diagnostic computerized tomography (CT) scans, and (3) have started work to develop single molecule approaches for the analysis of modified RNA nucleosides.

Major philosophies of our approach to research are to (1) perform exciting science that uses new technologies and concepts to expand our understanding of basic biology and disease conditions, (2) develop new approaches and technologies that can be used by other scientists, and (3) collaborate with other experts to perform state of the art team based science.