Modern Molecular Imaging owes much of its success in oncology, cardiology, neurology, and other areas of medicine to nuclear physics and physics instrumentation. Many cutting-edge technologies such as silicon photomultiplier tubes, new scintillators, and front-end processing of signals are quickly moved from the laboratory environment to the clinical Nuclear Medicine area in Radiology Departments around the country and around the world. We will examine some of these as we follow a Positron Emission Tomography (PET) scan from isotope production, through radiochemistry, and into the imaging suite. We will end with some new developments that are just now making their way into the clinic.