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Home cooking or carryout? PET Chemistry at the crossroads.

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Positron emission tomography (PET) offers a different face to each of its perceivers:

- unique metabolic contrast to the clinician
- quantitative imaging of biochemistry to the basic researcher
- a financial opportunity to the entrepreneur or
- one more tunnel of terror to the patient.

Behind the scenes are factors that shape the trajectory of a PET tracer, from its conception, to successful synthesis, to its possible ascendance as a useful imaging agent. Regulatory bodies (e.g. the FDA) strictly govern the manufacture and human use of radiopharmaceuticals. Third-party payers withhold payment until presented with an ironclad case for the efficacy of a new procedure. And finally, clinicians will not move until re-imbursement is assured. This three-link causal chain delayed the acceptance of FDG in cancer staging for almost two decades, a professional generation between the bench top and the bedside.

In the '70's and '80's, PET was limited to a few academic research centers by the complexity of the cyclotron / scanner, as well as tracers having lifetimes measured in minutes. The rise of regional distribution centers for ^{18}FDG extended the reach in the '90's, freeing most PET centers from the heavy steel of the production infrastructure. As a result, two distinct classes of PET centers have crystallized, the clinical imaging center purchasing agents that are commercially available, and the research center concentrating on basic molecular imaging, often in small animal models with short-lived PET tracers (^{11}C, 20 min, ..) and tighter logistics. At the University of Wisconsin, this sea change has occurred over the last 25 years, with two PET/CT scanners now handling the clinical load (oncology patients, FDG), while three others scan research animals (rodents, primates and swine) with several dozen tracers produced on our 11 MeV proton cyclotron (the first CTI RDS 112) or a 6 MeV electrostatic accelerator (NEC 9SD-H2).

The decision to purchase commercial FDG, after more than 20 years of local production, has freed up the production resources to concentrate on markers of proliferation (^{18}FLT), hypoxia (Cu-ATSM), and whole families of neuroligands labeled with ^{18}F or ^{11}C. In the last several years, our production capacity of the longer-lived non-conventional PET isotopes (^{61,64}Cu, ^{86}Y, ^{89}Zr, ^{124}I) has been scaled up, with a growing distribution network to soften the financial load to local users. The versatility, and robustness of our legacy cyclotron, now fitted with a new Labview control system, promises a niche, namely a *sustainable* production resource in the face of shrinking research budgets.