Impact Report 2026



WE DEVELOP

Our radiochemistry experts synthesize and test with precision and care.

WE PROVIDE

The CRF produces the radiopharmaceuticals that start the journey to better answers.

WE ENABLE CARE

Delivering critical information that helps clinicians diagnose earlier and treat with confidence.

Cyclotron & Radiochemistry Facility

Stanford University School of Medicine | Department of Radiology

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Executive Summary

Welcome to the inaugural Cyclotron and Radiochemistry Facility (CRF) Impact Report.

The story we are telling here reflects the story of an entire field coming of age. The field of radiochemistry really began with breakthroughs like FDG that allowed us to see inside the body and find cancer through metabolic processes. That foundation has evolved into highly specific molecular tracers, and now into theranostics, where we can pair diagnosis with targeted treatment in ways that were unimaginable just a decade ago.

The CRF has positioned Stanford to be at the forefront of this transformation. As one of only a handful of academic health centers in the country with more than one cyclotron, we have built not just infrastructure to support increased capacity, but a strategic advantage that puts us at the center of this trajectory. The CRF serves as a vital connection across Stanford Medicine, including the Stanford University School of Medicine, Stanford Health Care, Lucile Packard Children's Hospital, as well as the Stanford Cancer Institute, the Stanford Neuroscience Health Center and the VA Palo Alto Healthcare System. Its capabilities and expertise help establish a seamless pipeline from discovery to patient impact.

The CRF has made significant and tangible contributions since it first opened its doors in 2005. The CRF currently supports nearly $100 million in extramural funding through grants and clinical trials while enabling care for close to 15,000 patients annually. Beyond these numbers, the facility is accelerating the development of first-in-class diagnostic radiopharmaceuticals and targeted radionuclide therapies, shortening the distance between idea conception to clinical application and expanding the set of diseases we can meaningfully address.

But what matters most is what comes next. This report reflects our momentum. It not only documents what we have accomplished, but also presents the foundation for what we are building to help ensure we - as a community - stay at the forefront of early diagnostics, targeted interventions, and precision medicine.



Joseph M. DeSimone, PhD
Sanjiv Sam Gambhir Professor of Translational Medicine
Vice Chair for Strategy, Department of Radiology
Co-Chair, Canary Center

Gunilla B Jacobson, PhD
Technical & Strategic Director, CRF
Department of Radiology





By the Numbers

$84M+
in research grants enabled

14,000+
patients served annually

$3.6M
industry-sponsored trials

22+
clinical trials supported

7
first-in-human studies

14+
departments served

20+
isotopes produced

2
cyclotrons



Celebrating

Twenty Years of Radiopharmaceutical Innovation

Stanford University's Cyclotron & Radiochemistry Facility (CRF) was established in 2005 in the Lucas Center at 1201 Welch Road, with one GE PETtrace 880 cyclotron and a clear mission: bring cGMP radiopharmaceutical production in-house to directly provide Stanford with isotopes and radiolabelled imaging agents essential for advanced PET and SPECT imaging, clinical care, and translational research.

Two decades later, the strategic value of that investment is abundantly clear. Since its opening, the CRF has evolved from a single production unit into one of the most prolific academic radiopharmaceutical facilities in the country. Annual clinical production grew from 2,300 clinical doses per year to over 14,000 today. The facility also enabled Stanford faculty to advance five novel radiopharmaceuticals into first-in-human studies and supported 36 FDA-approved IND or RDRC applications across 40 different radiopharmaceuticals, all manufactured by the dedicated CRF staff. The CRF has become the operational backbone of Stanford's molecular imaging enterprise, delivering FDG and novel research tracers to Stanford Health Care, the VA Palo Alto Health Care System, and preclinical imaging facilities across Stanford University.

Building for the Future

Molecular imaging and theranostics are companion fields in a rapidly growing discipline that enables visualization, characterization, and targeted therapy of biological processes at the cellular and subcellular levels. By 2020, two decades of growth had pushed the CRF beyond its capacity. In 2021, the Department of Radiology committed approximately $20 million to construct a second, state-of-the-art facility at 1701 Page Mill Road.

CRF@Page Mill became operational in 2024 with a new GE PETtrace 890 cyclotron, adding 3,500 sq. ft. of new capacity with solid targetry, dedicated theranostic space, infrastructure for preclinical research, and dedicated space to train the next generation of radiochemists. Today, the CRF operates as a dual-site enterprise across the two cyclotron facilities. Together, they position Stanford to lead in both advanced imaging capabilities for patients and the emerging field of theranostics.

2005 First GE cyclotron installed at 1201 Welch Road

2006 First dose of FDG manufactured for SHC by CRF@Lucas

Novel radiotracers developed to image activated T cells, cellular proliferation, angiogenesis, tumor metabolism, and cell apoptosis

2015 Reach 5000 doses of FDG delivered to SHC annually

20 Years

A Shared Vision, Realized

A great department is defined not only by its achievements, but by its people and their shared vision for the future. The CRF, housed within the Department of Radiology, is a reflection of that collective effort.

When he was department chair, Sam Gambhir imagined a new radiochemistry facility that could propel the field of theranostics forward. Aruna Gambhir carried that vision forward with care and passion. Don Listwin and Hilary Valentine were true catalysts; through their advocacy, encouragement, and steadfast belief in what this could become.

This new cyclotron facility stands as more than an investment in infrastructure. It reflects what is possible when people commit to a shared purpose. Extraordinary science and advances in patient care will forge ahead for years to come.

With deep gratitude to Don, Hilary, and to the department's leaders, colleagues, and friends, this shared vision continues to shape the future at Stanford.



CRF@1701 Ribbon Cutting Ceremony, January 31, 2024. From left to right: David Larson, Yun-Ting Yeh, Don Listwin, Hilary Valentine, Garry Gold, Joseph DeSimone, and Gunilla Jacobson.

2021	2023	2024	**2025**
Department of Radiology commits $20M for second CRF facility	Groundbreaking for 1701 Page Mill Road facility	CRF@Page Mill becomes operational	First dose of FDG manufactured at CRF@Page Mill
Reach 10,000 doses of FDG delivered to SHC annually			



Patient and Clinical Impact

14,000+ Lives Touched Each Year

Patient and Clinical Impact

Behind every radiopharmaceutical the CRF produces is a patient — someone receiving a life-changing diagnosis, participating in a clinical trial for a new therapy, or being monitored during treatment. The CRF's reach spans the full continuum from bench to bedside.

Clinical Collaboration

The CRF collaborates closely with Stanford Health Care and affiliated hospitals. For over 20 years, the CRF has delivered FDG to Stanford Health Care and manufactured new radiopharmaceuticals for over 30 clinical trials under RDRC or IND approvals.

- **Stanford Health Care:** Primary clinical partner for FDG delivery and radiopharmaceutical manufacturing across oncology, neurology, and cardiology.
- **VA Palo Alto Health Care System:** Supported through clinical trials and research collaborations.
- **Lucile Packard Children's Hospital:** Initial discussions underway for future engagement in pediatric applications.

36
IND/RDRC approvals

14,221
Oncology patients

175
Neurology/Alzheimer's patients





Industry Collaborations

Partnerships that
Accelerate Translation

Industry Collaborations

The CRF serves as a critical bridge between academic discovery and industry-sponsored development. Through Sponsored Research Agreements, Service Agreements, and collaborative manufacturing partnerships, the CRF provides end-to-end support for industry partners seeking to advance novel radiopharmaceuticals from preclinical development through clinical trials at Stanford Health Care.

How Industry Engages with the CRF

The CRF provides a streamlined contracting process that supports technology transfer, validation runs, and cGMP manufacturing for clinical trials at Stanford Health Care and affiliated hospitals. Each partnership follows a principle of dedicated focus: one customer, one priority — ensuring quality and reliability at every stage.

- Technology transfer: CRF staff work with industry partners to transfer and optimize radiotracer production methods for Stanford's equipment and regulatory environment.
- Validation and manufacturing: The CRF conducts validation runs and manufactures tracers under cGMP conditions for clinical trials, ensuring compliance with FDA requirements.
- IND support: CRF staff contribute Chemistry, Manufacturing, and Controls (CMC) sections to IND filings, accelerating the regulatory pathway for new tracers.
- Tracer delivery: The CRF provides radiopharmaceutical availability and time-of-delivery optimization to support clinical workflows.

$3.6M+

in active industry contracts

The Multiplier Effect

Each industry collaboration to establish a new tracer at the CRF serves as a stepping stone for up to 6x additional funding for continued clinical trials within Stanford Health Care. The expanded capacity at CRF@Page Mill now allows the CRF to accept industry collaborations that were previously turned down due to space and scheduling constraints.

6x

potential follow-on funding multiplier


084345
FEB 06 FRI
RADIATION
caution radioactive materials
ABSOLUTELY
NO ENTRY
UNLESS
GOWN
VALIDATED



Faculty Voices

The Researchers Who Depend on the CRF

“The CRF is a cornerstone of our program, enabling both cutting-edge research and exceptional clinical care. Its capabilities in developing and producing novel radiopharmaceuticals are truly outstanding, and its operational reliability is unmatched. CRF’s role extends well beyond innovation—it ensures a dependable supply of many of our FDA-approved radiopharmaceuticals, directly enhancing access and continuity of care for our patients. Its extended hours, responsiveness, and flexibility far exceed what commercial radiopharmacies can offer. We are deeply grateful for our partnership with CRF; their expertise, dedication, and collaborative spirit have a profound and lasting impact on our mission to provide preeminent patient care and advance the field of nuclear medicine and molecular imaging. “

— Erin Grady, MD, Nuclear Medicine

“The CRF has been essential to my work developing novel radiopharmaceuticals and securing NIH funding. The CRF helped transform an early concept into a fully developed clinical program.”

— Guido Davidzon, MD, Nuclear Medicine

“The CRF is central to nearly every part of my work from clinical research and patient care to education. Their radiochemistry expertise and reliable radiopharmaceutical production have been essential to advancing patient care.”

— Andrei Iagaru, MD, Nuclear Medicine

“I rely on the CRF for radiochemistry expertise, particularly for synthesizing a non-FDA-approved radiopharmaceutical crucial to my NIH R01 grant. The tight timelines involved in coordinating patient referrals and imaging make the CRF team’s adaptability and dedication invaluable.”

— Carina Mari Aparici, MD, Nuclear Medicine

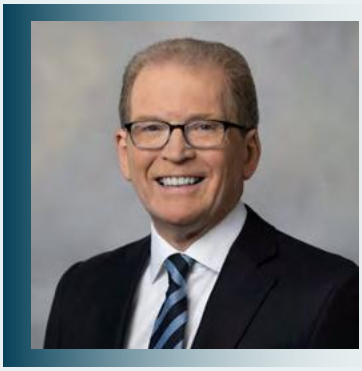
“The CRF’s consistent collaboration has been instrumental to the success of the Stanford Alzheimer’s Disease Research Center, particularly in facilitating access to advanced imaging techniques critical for both research and clinical care as new Alzheimer’s treatment options emerge. In other words, this collaboration has been a significant contributor to the success of the broader Alzheimer’s disease ecosystem within the department of neurology and neurological sciences.”

— Elizabeth Mormino, PhD, Department of Neurology

“The CRF is a foundational pillar of the biomedical enterprise at Stanford, facilitating a seamless connection between basic scientific discovery and clinical care, which ultimately enhances patient outcomes.”

— Guillem Pratx, PhD, Radiation Oncology / Medical Physics

Faculty Voices



"Radiochemistry plays a vital role in modern medicine, but often behind the scenes. This story shines a well-deserved spotlight on the extraordinary work of the Stanford Cyclotron and Radiochemistry Facility team. Thank you for your passion and expertise. You are making a profound difference in patient's lives."

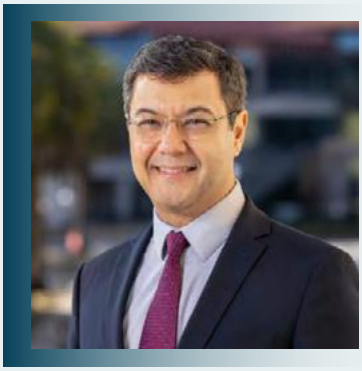
Lloyd Minor, MD
Dean, Stanford School of Medicine

* in response to a StanfordMed Pulse "Wow! You Do What?!" segment about the CRF, produced by the School of Medicine



"The Cyclotron and Radiochemistry Facility represents a cornerstone of Stanford Radiology's research and clinical mission. The CRF's capabilities in producing cutting-edge radiopharmaceuticals are enabling our researchers and clinicians to push the boundaries of precision medicine, from early disease detection to personalized therapeutic approaches. With two state-of-the-art facilities now operational, we are firmly positioned at the forefront of molecular imaging and theranostic innovation."

Umar Mahmood, MD, PhD
Chair, Department of Radiology



"The CRF gives us an unprecedented view into the living brain. We can now detect the earliest molecular signs of diseases like Alzheimer's and Parkinson's. This early visibility is the crucial first step toward developing therapies that can truly alter the course of these conditions."

Antonio Omuro, MD, FAAN
Chair, Department of Neurology and Neurological Sciences



"The CRF is central to how we approach cancer. It empowers us to design molecules that can both find and fight cancer cells with incredible precision. We are closing the gap between a scientific idea and a patient's treatment bringing the promise of personalized medicine to life."

Steven Artandi, MD, PhD
Director, Stanford Cancer Institute
Chief Cancer Officer, Stanford Health Care

Our Facilities

Two World-Class Sites for Radiopharmaceutical Innovation

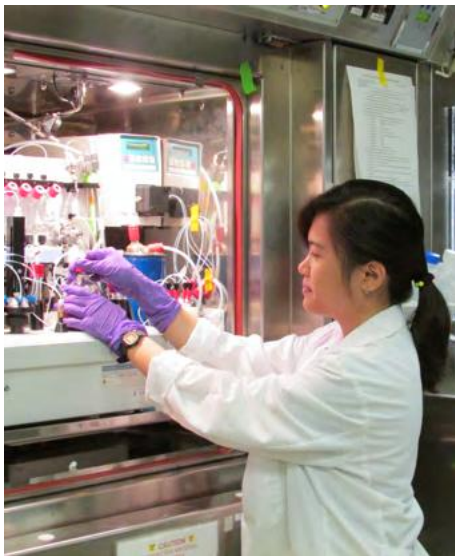
CRF@Lucas — 1201 Welch Road

The Foundation: Preclinical and Clinical Manufacturing



Capabilities

- Cyclotron: GE PETtrace 880 with 6 targets for ^{11}C, ^{18}F, ^{13}N, and ^{15}O production.
- Hot cells & synthesis: 14 hot cells, 2 shielded hoods, 6 fume hoods, and 14 radiosynthesizers (3 FastLab, 11 TRACERLab).
- Clinical production: cGMP automated dispensing for clinical use
- Regulatory track record: 36 IND- or RDRC-approved radiopharmaceuticals manufactured to date.
- Location advantage: Adjacent to Stanford Hospital and the Nuclear Medicine Clinic, enabling rapid tracer delivery for clinical care.





6,000
sq ft combined facility space

CRF@Page Mill — 1701 Page Mill Rd

The Expansion: Research Translation and Theranostics





Capabilities

- Cyclotron: GE PETtrace 890 with 4 targets for ^{11}C and ^{18}F, plus solid targets for ^{68}Ga, ^{89}Zr, ^{64}Cu, and other novel isotopes.
- Hot cells & synthesis: 12 hot cells, 4 shielded hoods, 6 fume hoods, and 8 radiosynthesizers (2 FastLab, 6 TRACERLab).
- Solid target system: Enables production of novel metal isotopes not previously available at Stanford, with space for isotope extraction and flexibility to expand isotope types over time.
- Theranostic capabilities: Dedicated space and equipment for theranostic radiolabeling and dispensing for human translation — enabling Stanford faculty to lead clinical trials at the intersection of diagnosis and therapy.
- Research infrastructure: Infrastructure for cell assays, tissue analytics, in-house radioluminescence microscope, and focus on novel radiopharmaceutical research and immediate clinical translation.

Clinical Locations Served



Because most radiopharmaceuticals must reach patients or research subjects relatively quickly - sometimes within minutes - reliable on-time delivery is essential. The CRF's proximity to Stanford Hospital and its Bay Area partners makes it possible to provide radiopharmaceuticals to eight clinical locations and two preclinical research facilities across the Stanford network and greater Bay Area. All doses are transported according to DOT guidelines by certified CRF staff in dedicated vehicles.

On campus, the CRF delivers tracers to the Lucas Center for Imaging PET/MR suite, Stanford Health Care Nuclear Medicine (300 Pasteur), the Hoover Pavilion Neuroscience Imaging Center, and 875 Blake Wilbur Drive, and Lucile Packard Children's Hospital.

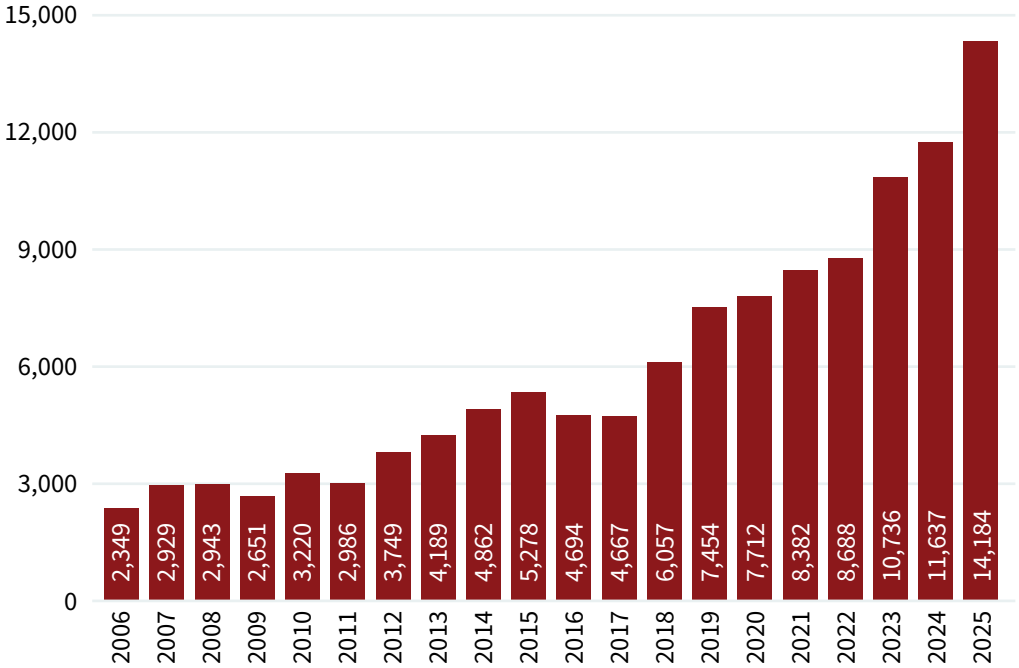
Beyond campus, the facility supplies Stanford Cancer Center South Bay (SBCC), the Emeryville Imaging Center, and the VA Palo Alto Health Care System.



The CRF also provides radiopharmaceuticals for preclinical imaging at the Stanford Center for In Vivo Imaging (SCI3) in the Clark Building at 318 Campus Drive and the small animal imaging facility at 3155 Porter Drive, located across the street from CRF@Page Mill.

Over the past two decades, the CRF has steadily expanded its portfolio of specialized tracers to support neurology and cardiology, adding approximately 600 additional doses per year across these newer applications. Today, the CRF supports research across 14 departments and serves as the sole source of short-lived radiopharmaceuticals for the Stanford Medicine ecosystem.

FDG doses delivered to SHC, 2006–2025



^{18}F-FDG is the tracer the CRF produces in the highest volume, manufactured daily to meet clinical demand in oncology. Since 2006, the CRF has achieved a roughly six-fold increase in FDG doses delivered to Stanford Health Care, reflecting the growing role of PET imaging in cancer diagnosis and treatment monitoring.

140,000+

doses delivered

*cumulative



Emeryville



Hoover/Neuroscience



LPCH



875 Blake Wilbur



SHC (300P)



Lucas Center PET/MR



VAPAHCS



South Bay Cancer Center

From Isotopes to Impact:

How Radiopharmaceuticals are Made

From Isotopes to Impact

Radiopharmaceuticals are molecular probes that allow for diseases to be visualized at the molecular level, and increasingly, to treat it with unprecedented specificity. Each radiopharmaceutical consists of a targeting molecule labeled with a radioactive isotope. The administered dose of the molecular probes are too small to elicit a pharmacological effect - the name “radiotracer” comes from this fact that only a trace amount is used.

These molecules specifically hone in on disease sites and emit signals that PET or SPECT scanners can detect to create images of molecular activity inside the body that would otherwise be invisible on a standard CT or MRI. Diagnostic isotopes (such as ^{18}F, ^{11}C) emit radiation that a PET or SPECT scanner detects from outside the body. The most widely used example is FDG (^{18}F-flurodeoxyglucose), a sugar molecule labeled with fluorine-18 that reveals areas of high metabolic activity, the hallmark of most cancers. For theranostic treatment, the same targeting molecules precisely deliver radioisotopes that emit cell-killing radiation to destroy tumors, while sparing healthy tissue.

The production of radioisotopes represents a challenge in both speed and coordination. Most radioisotopes have short half-lives, meaning that they decay within minutes to hours or days, and must be administered soon after production. The entire manufacturing chain, from isotope creation to patient injection, must be executed with extraordinary speed and precision.

The infrastructure of the two CRF sites enables the facility to produce more than 40 different radiopharmaceuticals, with each radiopharmaceutical for human use produced under FDA-mandated cGMP standards and subject to ten parallel quality control tests completed within a 15-30 minute window before clinical release.





From Cyclotron to Patient: The Four-Stage Workflow

1

ISOTOPE PRODUCTION

Cyclotron accelerates protons into target material to create radioactive isotopes

Minutes to Hours



2

RADIOCHEMISTRY

Isotopes are incorporated into tracer molecules using automated synthesizers in shielded hot cells

1 to 5 Hours



3

QUALITY CONTROL

Every batch undergoes 10 rigorous tests to ensure safety and purity before release

15 to 30 Minutes



4

DELIVERY & IMAGING

Approved doses are dispensed and transported to clinical sites for patient injection and PET/SPECT scanning

Minutes to Hours



CRF Production Capabilities

The CRF spans the range of radiopharmaceuticals, with capabilities to produce and use both diagnostic and therapeutic radiopharmaceuticals. The GE PETtrace 880 cyclotron at Lucas Center produces four short-lived positron-emitting isotopes, while the newer GE PETtrace 890 at Page Mill adds solid targetry for longer-lived metallic isotopes used for immunoPET imaging and theranostic applications. Additional isotopes can be sourced from external suppliers when specialized decay characteristics are required.

Diagnostic Radiopharmaceuticals

Diagnostic radiopharmaceuticals are designed purely to image molecular processes within the body. They range from broadly applied agents used in routine clinical imaging to highly specialized tracers developed for specific research questions and emerging clinical applications. The CRF's on-site production infrastructure enables Stanford to offer both established diagnostics and novel investigational tracers, often within the same day. This dual capability bridges everyday patient care with the translational research that brings next-generation imaging agents into clinical use.

Diagnostic Isotopes: Used for Imaging Only

Isotope	Half-Life	Emission	Source	Key Applications
^{18}F	110 min	Positron (β^+)	CRF Cyclotron	Cancer, cardiac, and neurological PET imaging (FDG and novel tracers)
^{11}C	20 min	Positron (β^+)	CRF Cyclotron	Brain receptor studies, pharmacokinetic research
^{13}N	10 min	Positron (β^+)	CRF Cyclotron	Cardiac blood flow (ammonia PET)
^{15}O	2 min	Positron (β^+)	CRF Cyclotron	Cerebral blood flow and metabolism
^{68}Ga	68 min	Positron (β^+)	CRF Solid Target	PSMA prostate cancer, neuroendocrine tumors (diagnostic partner for ^{177}Lu therapy)
^{89}Zr	3.3 days	Positron (β^+)	CRF Solid Target	ImmunoPET: antibody and cell-tracking imaging
^{64}Cu	12.7 hrs	β^+ / β^-	CRF Solid Target	Dual diagnostic/therapeutic potential



Theranostic Radiopharmaceuticals

Theranostic radiopharmaceuticals can be combined with a diagnostic partner (a so-called companion diagnostic), combining visualization and treatment on a single molecular platform: the diagnostic version locates the disease; the therapeutic version uses the same targeting molecule to deliver targeted radiation for treatment. This approach is already FDA-approved for prostate cancer and neuroendocrine tumors, and represents one of the most innovative precision medicine strategies currently in development.

Beta vs. Alpha: Two Approaches to Targeted Radiation Therapy

Theranostic isotopes deliver radiation through two mechanisms. Beta emitters release electrons that travel several millimeters through tissue, making them effective against larger tumor volumes. Alpha emitters release heavier particles that travel the width of only a few cells but deposit 50 to 100 times more energy along that path, making them highly effective against micrometastases and small clusters of cancer cells.

With the expansion into the new Page Mill facility, the CRF is actively building upon its existing infrastructure to expand into theranostic manufacturing.

Theranostic Isotopes: Used to Treat Disease

β^- Beta Emitters: electrons that travel millimeters, effective against larger tumors				
^{177}Lu	6.7 days	Beta (β^-)	External supplier	FDA-approved: Pluvicto® (prostate), Lutathera® (NETs)
^{161}Tb	6.9 days	Beta (β^-) + Auger	External supplier	Next-generation ^{177}Lu alternative with Auger electrons
α Alpha Emitters: helium nuclei that travel micrometers, effective against micrometastases				
^{211}At	7.2 hrs	Alpha (α)	CRF supplied	CRF glioblastoma alpha therapy program
^{225}Ac	10 days	Alpha (α)	External supplier	PSMA-targeted prostate cancer therapy (clinical trials)
^{212}Pb	10.6 hrs	Alpha (α) via ^{212}Bi	CRF Generator	Emerging alpha platform; ^{212}Pb generator coming to CRF
^{77}Br	57.0 hrs	Auger / ɣ	External (cyclotron)	Theranostic imaging partner for ^{211}At; Beinat lab research

The Strategic Advantage of On-site Production

On-site production capabilities enable the full pipeline of radiopharmaceutical research, enabling researchers to translate novel molecular probes from discovery at the lab bench into first-in-human studies without reliance on external vendors. In addition, isotopes such as carbon-11 (20-minute half-life) and oxygen-15 (2-minute half-life) cannot be shipped from an external supplier. They must be produced and used on campus within the same hour.

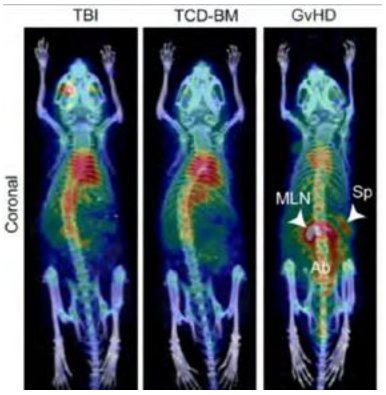
The ability to produce radiopharmaceuticals on-site not only shortens development timelines but also expands the scope of what can be studied clinically. As the molecular imaging and theranostic fields shift toward alpha-emitter therapeutics and next-generation theranostics, the CRF's dual-cyclotron infrastructure and expanding solid target capacity position Stanford to define the future of theranostic medicine and pioneer new radiopharmaceuticals that will reshape cancer care.

Flagship Research

Breakthrough Science
Enabled by the CRF

Flagship Research

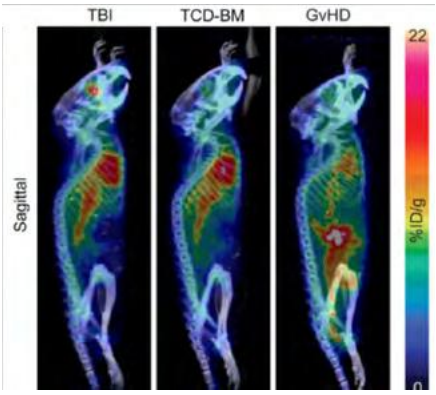
The CRF enables groundbreaking research that spans the full translational pipeline — from novel radiotracer development to first-in-human clinical studies. The following flagship projects illustrate the breadth and depth of research made possible by CRF infrastructure, expertise, and production capabilities.



Imaging Activated T Cells: OX40 ImmunoPET

Principal Investigator: Michelle James, PhD — Radiology and Israt Alam, PhD — Radiology

The Challenge: Immunotherapy has transformed cancer treatment, but patient responses remain highly variable. Current PET tracers lack the specificity to distinguish activated T cells from those merely present. The ability to visualize T cell activation throughout the body provides critical insights into immunotherapy response and helps accelerate the development of new therapies.

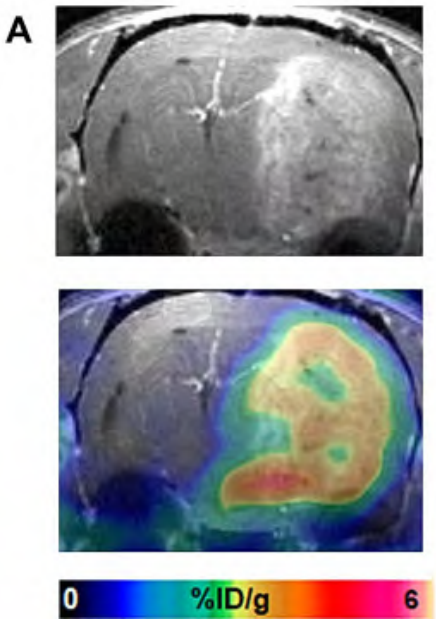


The Innovation: Dr. Israt Alam and the James lab, in collaboration with Pfizer, developed the first PET radiotracer targeting OX40, a marker selectively expressed on activated T cells. The tracer, ^{89}Zr-Ivuxolimab, was created by radiolabeling the clinically evaluated human OX40-specific monoclonal antibody with zirconium-89, providing a key translational advantage through existing pharmacokinetic and safety data.

CRF's Role: The CRF provided essential radiochemistry infrastructure for the development of the ^{89}Zr-ivuxolimab radiolabeling strategy, including isotope sourcing, quality control, and support for IND-enabling studies.

Impact: This is the first demonstration of an immunoPET tracer targeting human OX40 to visualize activated T cells in living subjects. Because OX40 expression on tumor-infiltrating lymphocytes in melanoma, colorectal cancer, and non-small cell lung cancer, has significant prognostic value, this new imaging approach may enable earlier prediction of immunotherapy outcomes and guide patient-specific treatment strategies. An IND application (IND 177487) has been filed with the FDA, and first-in-human imaging studies in head and neck squamous cell carcinoma patients are anticipated in 2026. This project is supported by R01 CA286998 from the National Cancer Institute.





Ferroptosis Imaging and Radiotheranostics

Principal Investigator: Corinne Beinat, PhD — Radiology / MIPS

The Challenge: Ferroptosis is a regulated form of cell death that shows great promise for selectively killing cancer cells, but clinicians currently lack imaging tools to identify which cancers are sensitive to ferroptosis-inducing therapies and to monitor drug engagement in patients.

The Innovation: The Beinat lab developed ^{18}F-hGTS13, a radiotracer specific for the system xc- antiporter, and demonstrated that it can distinguish ferroptosis-sensitive from resistant cancer cell lines and monitor engagement of ferroptosis-inducing drugs in orthotopic glioblastoma models. This is the first and foundational example of molecular imaging in the context of cancer ferroptosis. In parallel, the Beinat lab is pioneering the fluorine-18/bromine-77 theranostic isotope pair for amino acid radiolabeling and has developed ^{11}C-AMG to visualize glioma integration into brain neural circuits.

CRF's Role: The CRF provides isotope production, radiolabeling optimization, purification and detection infrastructure, and has advanced ^{18}F-hGTS13 toward clinical use through cGMP method development and CMC section preparation for IND filing.

Impact: ^{18}F-hGTS13 is currently undergoing clinical translation for first-in-human studies in lung cancer patients. The bromine-77 work represents the first demonstration of amino acids radiolabeled with this isotope, opening a new frontier in targeted radiotherapy. The glioma glutamate tracer serves as both a research tool and a potential companion diagnostic for targeted therapies. Supported by R01CA291644 from the National Cancer Institute.

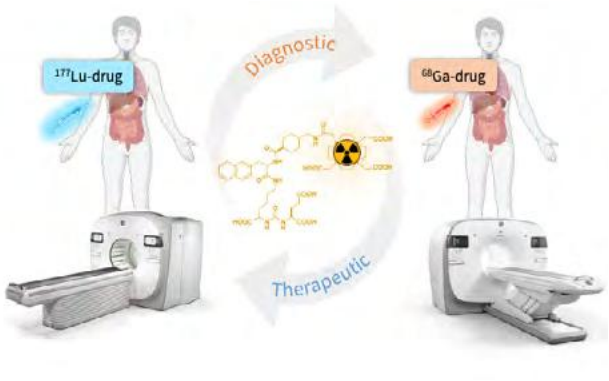
Micro-Radiolabeling for Imaging and Therapy (MiRIT)

Principal Investigator: Katherine Ferrara, PhD — Radiology/MIPS
Collaborators: Possu Huang, PhD — Stanford Bioengineering; University of California Los Angeles, DropletPharma Corp

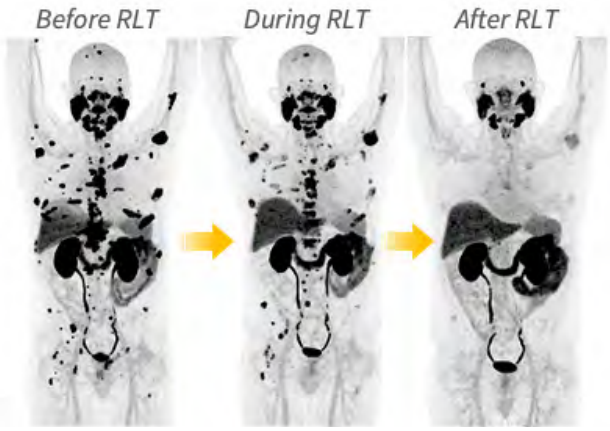
The Challenge: The field of theranostics is experiencing unprecedented growth, yet only a handful of radiopharmaceuticals exist for a limited number of molecular targets. Ovarian cancer and head and neck cancer remain areas of unmet need as no screening tests exist for these diseases, despite how common premalignant lesions are. Current theranostic treatments also require costly, complex infrastructure and are not widely available to patients who need them.

The Innovation: The Micro-Radiolabeling for Imaging and Therapy (MiRIT) project aims to leverage artificial intelligence to computationally design molecules that bind to disease-specific protein changes. The research team has already identified key cancer cell targets, as well as designed and radiolabeled peptides against these targets. The MiRIT project will expand this portfolio and translate resulting drugs through miniaturized radiolabeling technology that enables individual patient dose production with high efficiency, dramatically reducing costs and simplifying regulatory compliance.

CRF's Role: The CRF provides the radioisotopes needed for the miniaturized radiolabeling technology, and CRF staff provides radiolabelling knowledge and supports the radiosynthesis of newly designed peptides.
This work is being supported by a contract from the Advanced Research Projects Agency for Health (ARPA-H) for up to $35 million.



Clinical Response to Radioligand Therapy (RLT)
(Pluvicto for prostate cancer)



Impact: This project will accelerate the discovery and translation of new theranostic agents while democratizing radiopharmaceutical manufacturing and ensuring global access through high-throughput radiochemistry experimentation and low-cost distribution. The platform could broadly extend patient access to advanced radiopharmaceuticals for molecular imaging to guide biopsy, surgery, and patient-specific therapy selection.

Targeted Alpha Therapy for Cancer Treatments

Principal Investigator: Gunilla Jacobson, PhD — Radiology/CRF
Collaborators: Atley Solutions



The Challenge: ^{211}At is rapidly emerging as one of the promising alpha-emitting radionuclides, increasingly recognized for its clinical potential in targeted radionuclide therapy, particularly in metastatic cancer. Yet access to the isotope remains extremely limited, particularly in the western United States. California currently lacks sustainable access to ^{211}At. This initiative will build and demonstrate the infrastructure required for future clinical translation of ^{211}At radiopharmaceuticals in the region.

The Innovation: The CRF is validating the performance of ^{211}At targets from Atley Solutions that will be bombarded at UC Davis and received at the CRF for isotope purification and radiolabelling. This will provide proof-of-concept for establishing a pipeline for ^{211}At to Stanford, using a dedicated synthesis module for producing Stanford's first theranostic tracer produced for human use, a landmark milestone for the CRF and the Department of Radiology.

CRF's Role: CRF@Page Mill's dedicated theranostic workspace and solid target handling capabilities are essential to this project. The CRF provides the radiochemistry expertise, cGMP manufacturing infrastructure, and regulatory support required to translate this therapy from bench to bedside.

Impact: This project will establish Stanford as a national center for astatine-211 chemistry. Through a joint collaboration with Atley, the CRF is building expertise in this rare isotope that is available at only a handful of facilities worldwide. Success would demonstrate a new paradigm for treating brain tumors using targeted radionuclide therapy.



Financial Impact

The CRF's Gross Mission Value

Financial Impact

The CRF is the engine behind a vast research and clinical enterprise. The grants, trials, and collaborations it enables represent the facility's true "Gross Mission Value" — the total dollar value of activity that depends on CRF-produced radiopharmaceuticals, radiochemistry expertise, and manufacturing infrastructure.

Grant-Funded Research Enabled by the CRF

Research grants across multiple departments depend on CRF-produced radiopharmaceuticals, radiochemistry expertise, and manufacturing infrastructure. The table below summarizes total grant funding by department group:

Department	Total Grants Funded
Radiology	$36,047,461
Neurology	$26,934,986
Other Departments	$21,285,097
Department Total	**$84,267,544**

Other Departments include Anesthesia, Radiation Oncology, Surgery, and Otolaryngology.

The CRF enables approximately $84 million in research and clinical revenue over a five-year period through funded grants and clinical trials. The initial industry investment to establish a new tracer at the CRF serves as a stepping stone for up to 6x additional funding for continued clinical trials within Stanford Health Care.

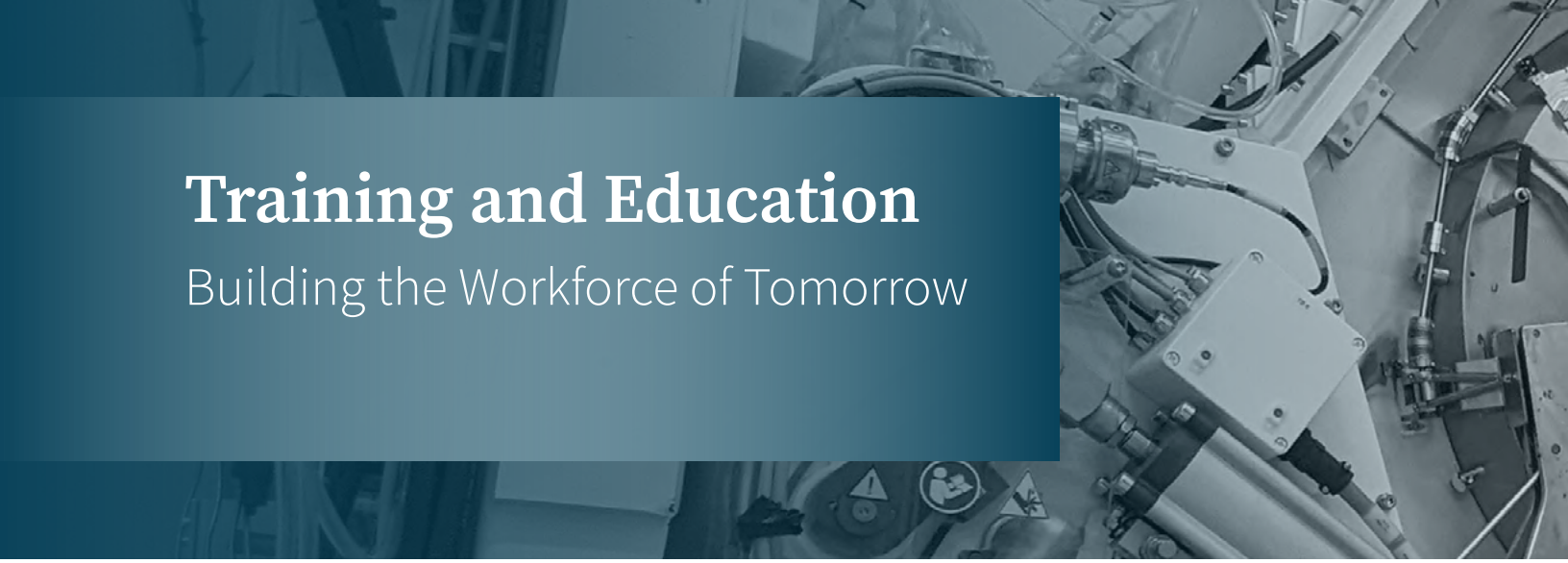


CRF Faculty Users

The CRF supports principal investigators across 14+ departments. Faculty whose current research has depended on CRF capabilities over the past five years include:

Carina Mari Aparici	Radiology
Corinne Beinat	Radiology
Sandip Biswal	Radiology
Fernando Boada	Radiology
Heike Daldrup-Link	Radiology
Guido Davidzon	Radiology
Katherine Ferrara	Radiology
Benjamin Franc	Radiology
Garry Gold	Radiology
Henry Guo	Radiology
Andrei Iagaru	Radiology
Michelle James	Radiology
Feliks Kogan	Radiology
Craig Levin	Radiology
Farshad Moradi	Radiology
Jianghong Rao	Radiology
Vipul Sheth	Radiology
Hong Song	Radiology
Greg Zaharchuk	Radiology
Behnaz Jarradi	Anesthesiology
Patrick Purdon	Anesthesiology, Perioperative and Pain Medicine
Jennifer Hah	Anesthesiology, Perioperative and Pain Medicine
Christine Jacobs-Wagner	Biology

John W. Day	Emergency Medicine
Eric Appel	Materials Science and Engineering
Matthew Baker	Medicine
Katrin Andreasson	Neurology and Neurological Sciences
Daniel Chang	Neurology and Neurological Sciences
Elizabeth Mormino	Neurology and Neurological Sciences
Kathleen Poston	Neurology and Neurological Sciences
Sharon Sha	Neurology and Neurological Sciences
Gary Steinberg	Neurosurgery
Anand Veeravagu	Neurosurgery
Heng Zhao	Neurosurgery
Dean Felsher	Oncology
Billy Loo	Oncology
Fred Baik	Otolaryngology
George Poulsides	Otolaryngology
Eben Rosenthal	Otolaryngology
Tom Montine	Pathology
Jong Yoon	Psychiatry and Behavioral Sciences
Guillem Pratx	Radiation Oncology
Murat Surucu	Radiation Oncology
Nicholas Leeper	Surgery
Minal Vasanawala	VAPAHCS/Radiology



Training and Education

Building the Workforce of Tomorrow

Training and Education

The CRF is not only a production and research facility — it is a training ground for the next generation of radiochemists, nuclear medicine specialists, and bioengineers. As the demand for radiopharmaceutical expertise grows nationally, the CRF's educational mission becomes increasingly strategic.

2025 Training Highlights

- **7 postdocs and graduate students** trained in radiation safety, radiolabeling chemistry, and quality control.
- **2 students and staff** trained in CMC section writing for IND submissions.
- **BioE 224 and BioE 222:** The CRF supports two classes in the Stanford Bioengineering program — BioE 224 for graduate students and BioE 222 for radiology residents.

Building Stanford's Radiochemistry Education Program

Stanford is establishing its own educational program in radiochemistry to address the growing national shortage of talent across the sector. This initiative positions the CRF as both a research leader and a workforce development hub, ensuring that Stanford trains the scientists who will drive the next wave of radiopharmaceutical innovation.


Stanford
MEDICINE
Cyclotron & Radiochemistry Facility
TRACERlab FX



Looking Forward

Strategic Priorities for the Next Five Years

Looking Forward

The CRF is at an inflection point. With expanded manufacturing capacity, a growing portfolio of first-in-human studies, and deepening industry partnerships, the facility is positioned to dramatically increase its impact over the next five years.

Strategic Priorities

- **Scale Theranostic Capabilities** Position Stanford as a preeminent center for precision theranostics by leveraging our unique dual-cyclotron infrastructure and diversified isotope supply chains that combine in-house manufacturing with strategic collaboration to ensure consistent, high-quality patient care and expand therapeutic options for complex oncologic and neurologic conditions.
- **Optimize Infrastructure for Enterprise-Wide Growth** Activate the full capacity of CRF infrastructure to support clinical demand across the Stanford Medicine network, enabling reliable access to advanced molecular imaging and theranostics for patients at all Stanford Health Care sites while building a sustainable revenue model.
- **De-Risk and Accelerate the Innovation Pipeline** Advance a prioritized portfolio of novel imaging and therapeutic candidates to clinical milestones, with a strategic focus on unmet patient needs in oncology and neurodegenerative disorders, translating breakthrough discoveries into new care options that improve outcomes and expand treatment possibilities.
- **Build Strategic Partnerships and Workforce Capacity** Establish high-impact industry collaborations that enhance supply chain resilience and accelerate the delivery of innovative diagnostics and therapeutics to patients, while developing a radiochemistry training program to address critical talent gaps and ensure long-term operational excellence in patient care.





Our Team

The People Behind the Science

Our Team

The CRF's success depends on a dedicated team of radiochemists, production specialists, quality assurance experts, and administrative professionals who together ensure safe, reliable, and innovative radiopharmaceutical production every day.

Leadership

Joseph DeSimone, PhD — Vice Chair for Strategy, Department of Radiology; Co-Director, Canary Center; Sanjiv Sam Gambhir Professor of Translational Medicine
Gunilla Jacobson, PhD — Technical & Strategic Director, CRF
Hai Vu, PharmD, PhD — Director, CRF

Radiochemists

David Anders, PhD — Director of Research
Noeen Malik, PhD — Lead Radiochemist and Industry Partnership Lead
Bo Zhang, PhD — Senior Radiochemist
Jun Hyung Park — Senior Radiochemist
Aimara Morales — Radiochemist
Grace Inay — Radiochemist
Richard Ma — Radiochemist

Production & Quality Assurance

Gurucharan Singh — Production Lead
Palak Kaur — QA Specialist
Ka Ho — Clinical Production Technician
Mateo Tayamen — Production Specialist

Administration & Program Development

Regie Ledesma — CRF Administration
Mandy Myers — Business Plan and Budgets



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https://crf.stanford.edu





Key Publications

Selected High-Impact Publications

The CRF's capabilities have led to several high-impact publications in 2025, contributing to advances in immuno-PET imaging, Alzheimer's disease research, cancer therapy monitoring, and surgical innovation.

Immuno-PET Imaging of Tumor Macrophages

B7-H4 ImmunoPET Imaging Tracks Tumor-Associated Macrophage Changes in Prostate Cancer. Mol Pharm, 2025. Kumar M, et al.

Significance: Advances non-invasive immune response monitoring in prostate cancer.

T-Cell Function Detection via PET

Advancing In Vivo Detection of T-Cell Function: Development and Preclinical Evaluation of 89Zr-Ivuxolimab. J Nucl Med, 2025. Kalita M, et al.

Significance: First human OX40 PET tracer for real-time monitoring of T-cell activity in cancer patients.

Tau PET Across the Alzheimer's Spectrum

[^{18}F]PI-2620 Tau PET signal across the aging and Alzheimer's disease clinical spectrum. Imaging Neurosci, 2024. Young CB, et al.

Significance: Characterizes tau PET signals across the aging-to-Alzheimer's continuum.

Apoptosis Imaging After Radiotherapy

Augmentation of [^{18}F]-C-SNAT4 PET imaging of apoptosis after radiotherapy using a cold mixing strategy. EJNMMI Research, 2025. Qiu J, et al.

Significance: Enhanced method for detecting cancer cell death after radiation treatment.

AR-Guided Sentinel Lymph Node Localization

Localization of sentinel lymph nodes using augmented-reality system: a cadaveric feasibility study. Eur J Nucl Med Mol Imaging, 2025. Duan H, et al.

Significance: Combines nuclear medicine with augmented reality for surgical guidance.

Tau PET in Lewy Body Disease

^{18}F-PI-2620 Tau PET is associated with cognitive and motor impairment in Lewy body disease. Brain Communications, 2025. Winer JR, et al.

Significance: Extends tau PET research into Lewy body disease, linking imaging to clinical symptoms.

STANFORD CRF

Impact Report 2026

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