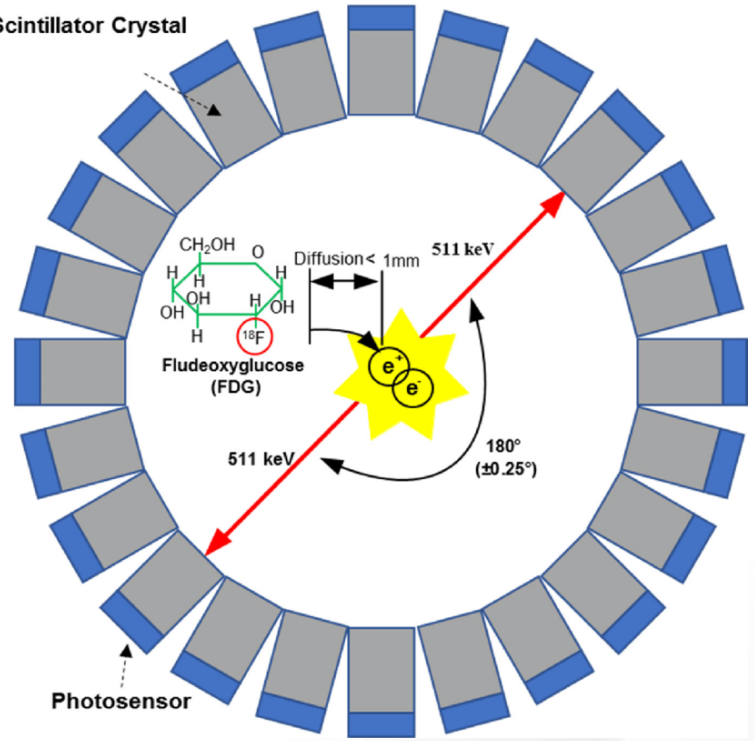
PET/CT and Theranostics
The Future in Cancer Treatment

Shared Medical Services: EXCELLENCE IN IMAGING

PET/CT: What is it and how does it work?

- PET/CT is a specialized area of Nuclear Medicine.
- Imaging is done on a dedicated PET/CT scanner.
  - CT: Low dose CT is performed for attenuation correction and to create the roadmap of the anatomy for the Radiologist.
  - PET: Positron Emission Tomography is the Nuclear Medicine imaging.



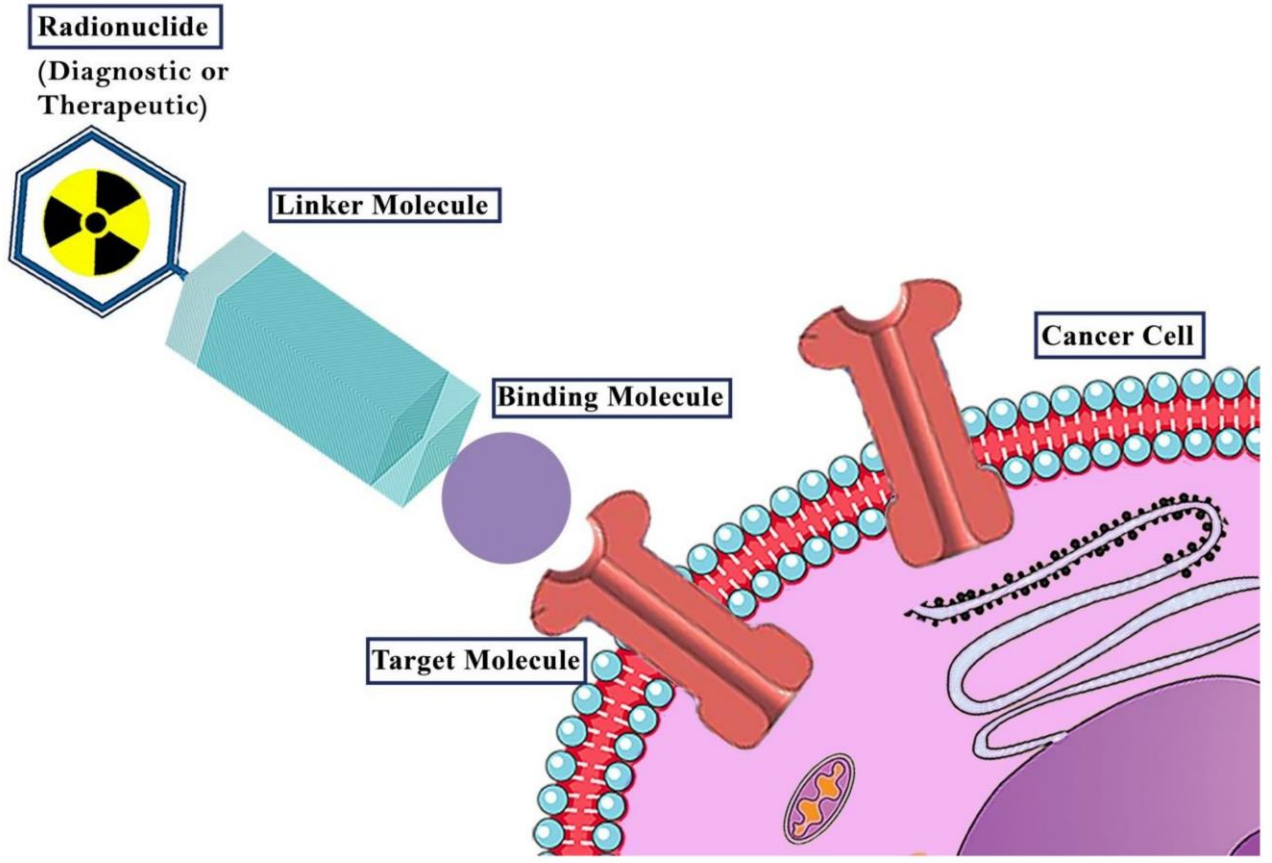
PET/CT: What is it and how does it work?

Commonly Used Imaging Agents

- **FDG**: Most commonly used agent for PET/CT.
  - Labelled with F-18
  - Easiest explanation, we're imaging glucose metabolism.
  - Cancer cells are extremely inefficient and require a lot of energy to replicate.
- **PSMA:** Prostate Specific Membrane Antigen
  - Comes labelled with F-18 or Ga-68
  - Why does this work? Prostate cancer cells have a specific antigen on the cell membrane the agent binds to and can be imaged.
  - PSMA will also "seek" our prostate specific metastatic disease.
- **Dotatate:** Neuroendocrine Tumor Specific
  - Comes labelled with Ga-68 or Cu-64
  - Cells with somatostatin receptors attract and attach to the dotatate.
  - Neuroendocrine tumors have higher than normal somatostatin expression.
- **Other Agents:**
  - Rb-82 for cardiac imaging, Beta-Amyloid agents for alzhiemers and dementia imaging.

Introduction to Theranostics: How does it work?

- First, we need to find a unique molecule that doesn't exist anywhere else in the body. This is called the receptor, or target molecule.
- Second, we need a ligand, or binding molecule, that will ONLY bind to the target molecule.
- Third, we need a chelator to attach the radioactive particle to.
- This is when the magic happens!



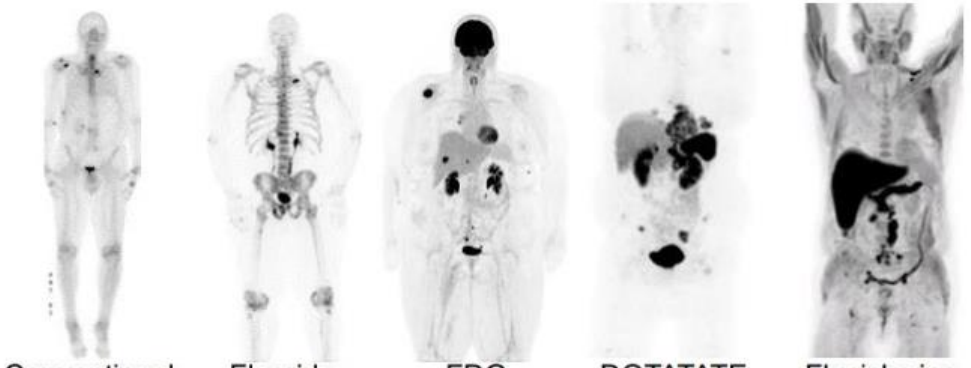
Introduction to Theranostics: Radiation Matters

Different Types of Radiation

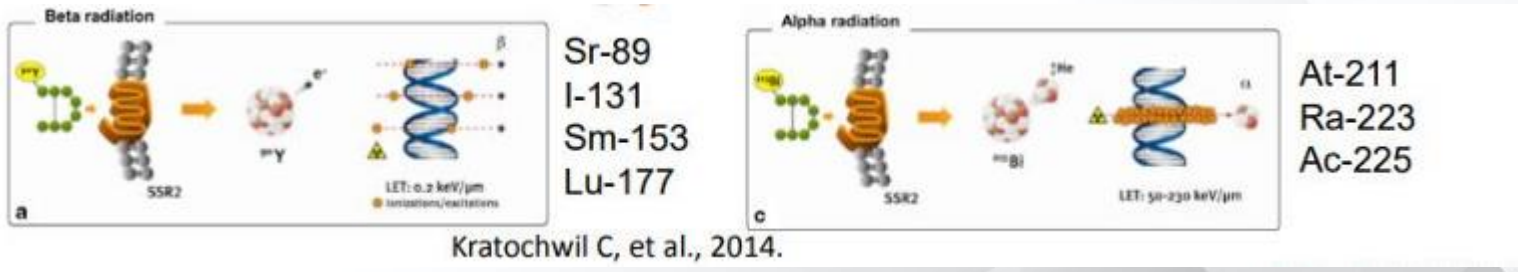
- **Gamma:**
  - Used for imaging because of the high energy and ability to travel long distance.
- **Alpha and Beta:**
  - Big, heavy particles, travel very short distances and deliver a big punch. These are used for therapy.

VS

Imaging Agents:



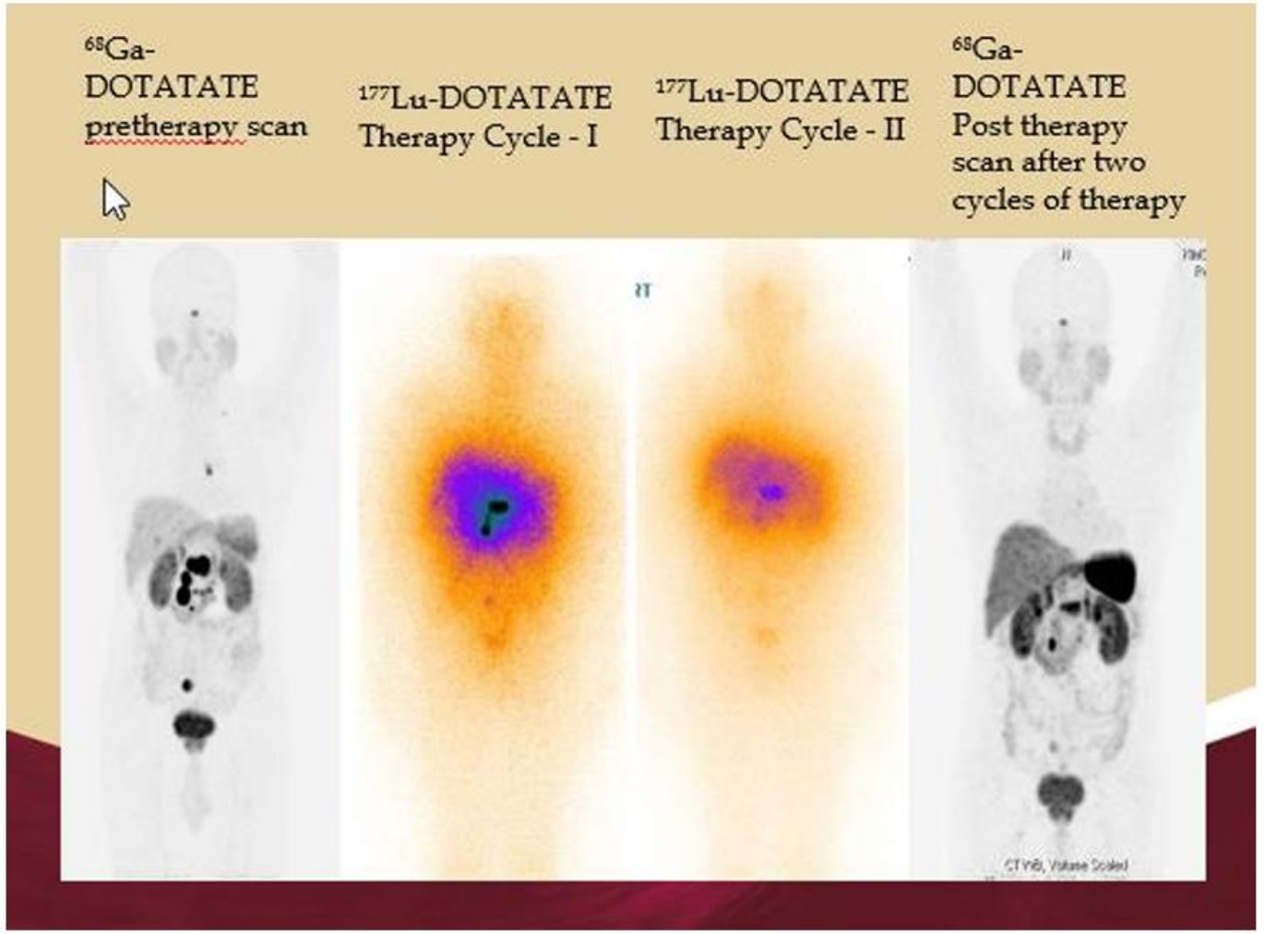
Therapeutic Agents:



Kratochwil C, et al., 2014.

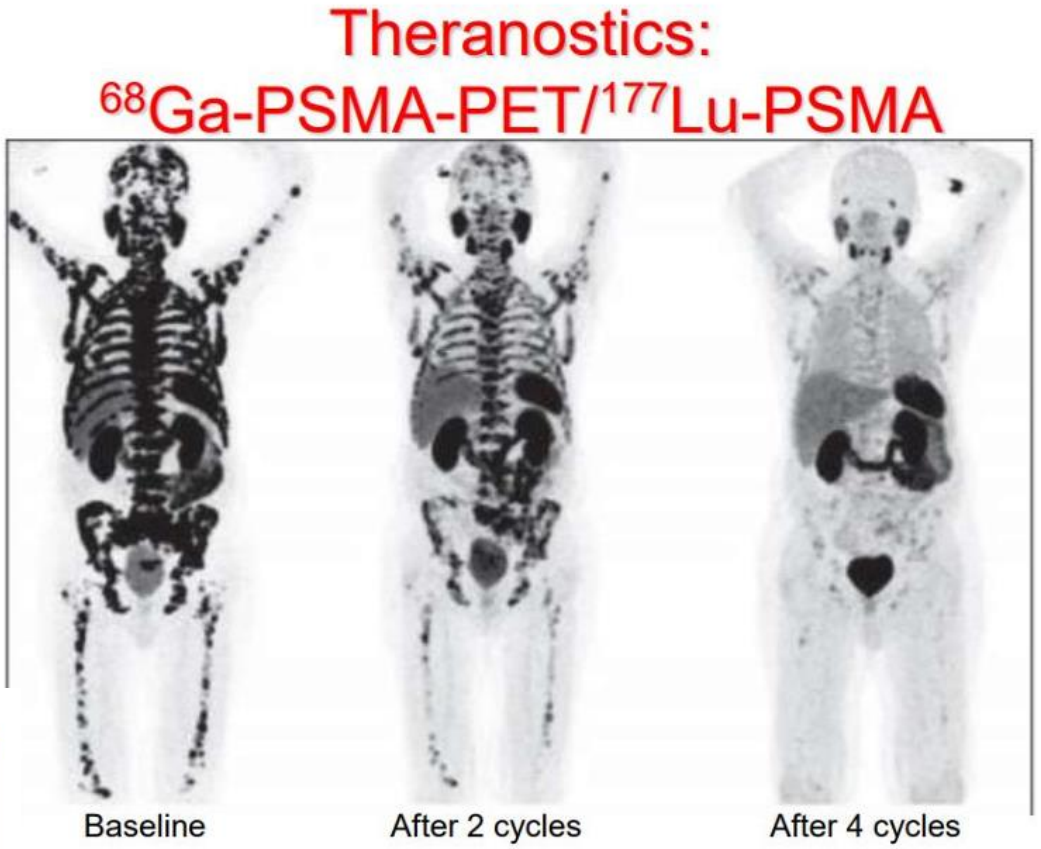
Lutathera: Neuroendocrine Radiotherapy

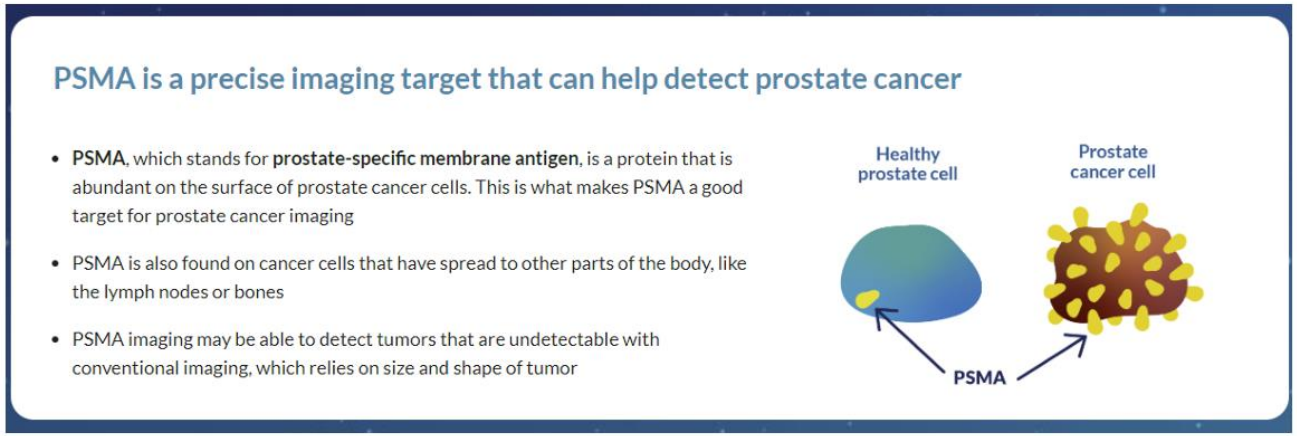
- Diagnostic agent: Ga-68 or Cu-64 Dotatate
- Therapeutic agent: Lu-177 Lutathera
- Lutecuim 177 is a beta emitter
  - Short range in soft tissue
  - Diameter of a human hair
  - Packs a big punch!



Pluvicto: PSMA Radiotherapy

- Diagnostic agent: Ga-68 or F-18 PSMA
- Therapeutic agent: Lu-177 PSMA
- See what is happening here?





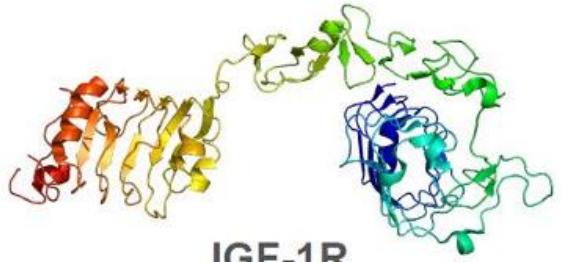
What is coming next?

Scientists are working a radiotherapy for ER+ breast cancer. Estrogen is the receptor molecule.

University of Minnesota is in a Phase 1 trial for Ac-225 FPI-1434. FPI is expressed in ALL solid tumors.

[^{225}Ac]-FPI-1434 Background

Type I insulin-like growth factor receptor (IGF-1R) is a transmembrane protein which is overexpressed in solid tumors



IGF-1R

Implicated in:

- Increased cellular proliferation
- Metastatic potential
- Cell survival
- Chemotherapy and radiotherapy resistance

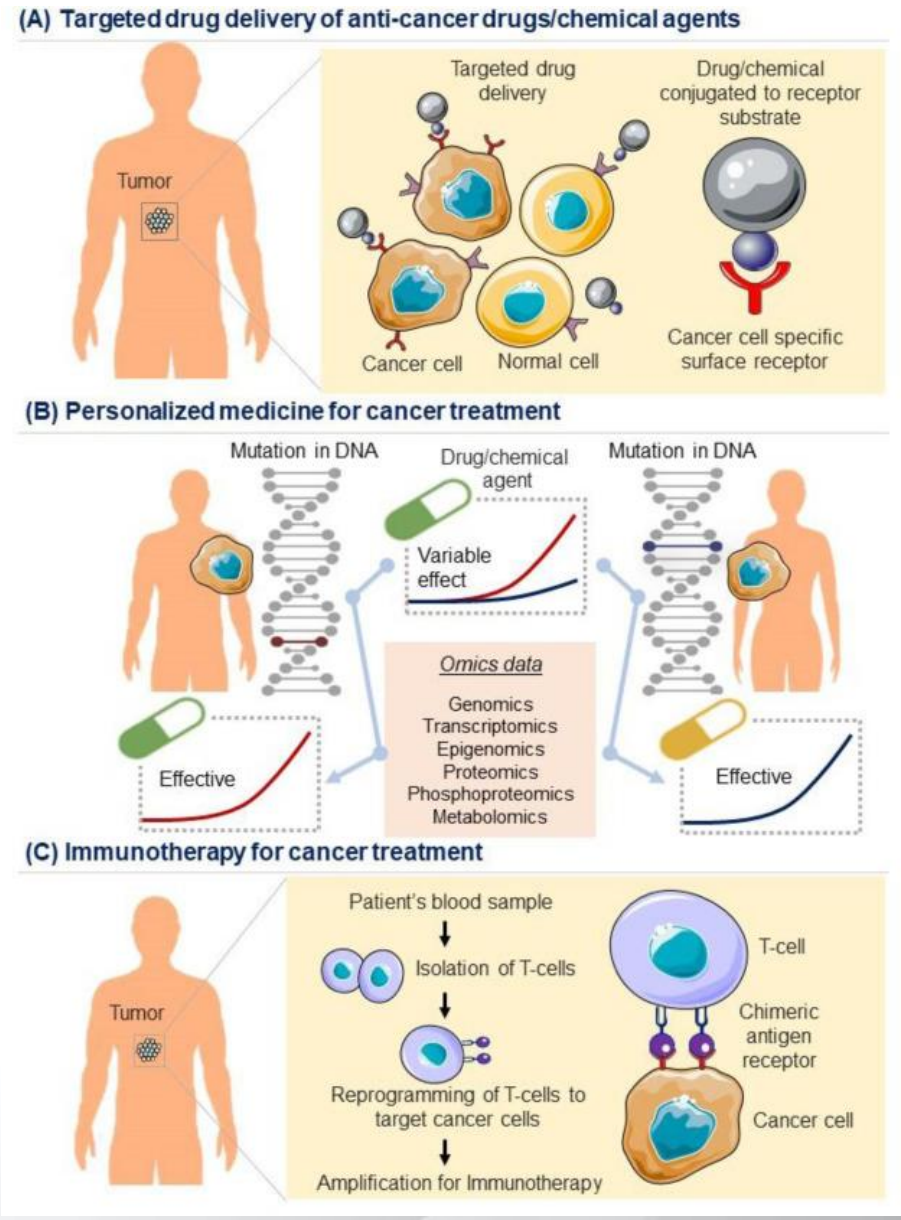
IGF-1R Expression in Solid Tumors

100%	Ovarian
100%	Bladder
90%	Sarcomas
62%	Head & Neck
62%	Prostate
59%	NSCLC
57%	Pancreatic
50%	Colorectal
50%	Liver
47%	Breast
43%	Small Cell Lung
40%	Esophagus
36%	Renal
36%	ACC

SHARED MEDICAL SERVICES

Why is this different from conventional chemo and radiation therapy?

- **Chemotherapy**
  - Kills good and bad cells. Chemotherapies cannot differentiate.
  - It is highly effective but causes multiple side effects.
- **Radiation Therapy**
  - Kills good and bad cells around the primary treatment area.
  - Highly effective but also has many side effects.
- **Theranostics:**
  - Targeted therapy with very little to no collateral damage.
  - Spares the good cells while killing the cancer cells.
  - Research process takes time to discover the ligands and unique target molecules for each cancer.



DISCOVER

THE SMS DIFFERENCE

ESTABLISHED 1980