CIRP Implementation at the University of California

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Irradiators in the University of California System

- There are 10 campuses in the UC System, including 5 academic medical centers.
- 47 Cs & Co Irradiators, with a quarter of them at UCSF.

In 2017, the Office of Radiologic Security (ORS) introduced the Cesium Irradiator Replacement Project (CIRP) to the UC.

In February 2018, UC Chancellor Janet Napolitano heartily encouraged CIRP support in letters to the UC Chancellors and Hospital CEOs. She asked UC removals/replacements to be completed by June 2020.
Current Status of Irradiators in the UC System

47 UC Cs & Co Irradiators

- 9 Removed
- 15 Dates pending
- 16 To be scheduled
- 7 Retained

To get to this point, we have encountered challenges in two general areas which may be helpful for discussion:
- Researcher concerns regarding comparability
- Irradiator removal preparations and contingency planning
Researcher concerns: Polling of irradiator uses

- Medical: blood, vaccines, Gamma Knife therapy
- Research: primarily cell and mouse, but also nematode, fruit fly, cancer vaccine trials, bone sterilization, physical and chemical effects, food, degradation studies, etc.
  - Predominant purpose for irradiating cells is to expose feeder cells and to induce DNA damage responses in cell culture
  - Common animal uses are bone marrow ablation/chimeras
Researcher concerns: UC Workgroup

- A workgroup of researchers and physicists across the UC evaluated irradiator applications, concerns and recommendations for conversion from cesium to x-ray
  - UC Workgroup recommendations in April 2018
  - Health Physics Society paper in January 2020

- Overview summary and recommendations:
  - Transition should prove smooth, with some exceptions
  - X-ray irradiator outputs (energy, dose distributions) are more variable than for cesium
  - Standardization may be more difficult with x-ray than cesium
  - Labs needs to empirically assess the effects to their studies of converting from cesium to their specific x-ray irradiator
  - Labs starting studies needing irradiation should seriously consider using x-ray from the outset
Researcher concerns: selected key points

- Compared to cesium energy deposition in animal models, the depth dose curve for x-ray energy deposition is higher on the surface, similar for 160 kVp down to 2 cm, and similar for 320 kVp x-ray down to 4 cm. Higher energy machines with filters to block lower energy photons will permit decent penetration while sparing surface tissue.

- X-ray irradiation has better collimation & advanced features

- Wide variation of Relative Biological Effectiveness (RBE) values for x-ray compared to cesium, depending on specific x-ray machines, energy settings, filtration, etc.

- RBE is more important for sensitive animal tumor models than for inactivating feeder cells or bone marrow ablation

- Cost for 36 animal comparison study may be as high as $5k

- Facilitate communication between researchers
Irradiator removal preparation & coordination

- Extensive coordination among many stakeholders
  - Police, facilities, radiation safety, emergency management, public affairs/communications, regulators, FBI, NNSA, vendors for removal, rigging, transportation, etc.
  - UCSF has developed a 16 page institution-specific checklist over the course of our 5 removals.
Irradiator removal contingency planning

- Expecting the unexpected
- UCSF had a stuck cesium source during our blood bank irradiator removal
- After 4 hours of trying to extract the source, the decision was made to return the irradiator to secure location
- Came back a month later and removed by overpack
- Learning from each other