Overview of Biodosimetry Projects in the NIH Radiation/Nuclear Countermeasures Program

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Very few medical products exist to counter the variety of acute and long-term injuries that can result from nuclear or radiological attacks. In addition, there is currently no high throughput post-exposure method available to measure the radiation dose received by individuals. Because triage and medical treatment decisions depend on understanding the dose an individual receives, the development of biodosimetry devices that can rapidly and accurately distinguish individuals who need therapy from those who do not is critically important.

The Centers for Medical Countermeasures against Radiation (CMCRs) are multidisciplinary extramural research centers supported by NIAID and comprised of academic, commercial and government laboratories. The CMCRs support basic, translational, and applied research leading to new treatments for radiation injury. Biodosimetry projects in the CMCRs include development of 1) high-throughput, minimally-invasive, robotics-controlled automated image acquisition systems that will analyze micronuclei and H2AX –loci from lymphocytes, exfoliated buccal cells, and urinary bladder cells; 2) a biodosimetry tool with a fully integrated biochip and an integrated micro/nanofluidic cartridge that can perform whole-blood microarrays for radiation-injury-specific gene expression signatures; 3) a portable biodosimeter based on radiation-induced metabolomics expression signatures; 4) hand-held lateral flow diagnostics based on radiation-induced protein biomarkers; 4) flow-cytometry based high-throughput bone marrow biodosimetry assay that can measure cytogenetic damage to hematopoietic cells in bone marrow; 5) techniques for assessing skin exposure by measuring DNA damage in skin cells; 6) a hand-held EPR dosimeter using nails, hair and tooth chips; and 7) a biodosimeter based on optically stimulated bioluminescence. In addition, the CMCR program also supports innovative biodosimetry techniques through pilot projects. The centers will conduct basic research to identify the biomarkers of radiation damage as well as develop state of the art devices and translate the basic knowledge into products for use in the field.

In addition, NIAID has established interagency agreements with the Armed Forces Radiobiology Research Institute (AFRRI) and the National Cancer Institute (NCI). Under this agreement, AFRRI conducted an inter-laboratory comparison of the dicentric cytogenetic assay. AFRRI will also develop automated techniques to facilitate initial processing of 500 or more samples in a 7-day interval. NCI will conduct epidemiological studies to develop computer modeling for dose estimation.