HEMODOSE: A set of multi-parameter biodosimetry tools

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After the events of September 11, 2001 and recent events at the Fukushima reactors in Japan, there is an increasing concern of the occurrence of nuclear and radiological terrorism or accidents that may result in large casualty in densely populated areas. To guide medical personnel in their clinical decisions for effective medical management and treatment of the exposed individuals, biological markers are usually applied to examine the radiation induced changes at different biological levels. Among these the peripheral blood cell counts are widely used to assess the extent of radiation induced injury. This is due to the fact that hematopoietic system is the most vulnerable part of the human body to radiation damage. Particularly, the lymphocyte, granulocyte, and platelet cells are the most radiosensitive of the blood elements, and monitoring their changes after exposure is regarded as the most practical and best laboratory test to estimate radiation dose.

The HEMODOSE web tools are built upon solid physiological and pathophysiological understanding of mammalian hematopoietic systems, and rigorous coarse-grained bio-mathematical modeling and validation. Using single or serial granulocyte, lymphocyte, leukocyte, or platelet counts after exposure, these tools can estimate absorbed doses of adult victims very rapidly and accurately. Some patient data in historical accidents are utilized as examples to demonstrate the capabilities of these tools as a rapid point-of-care diagnostic or centralized high-throughput assay system in a large scale radiological disaster scenario. Unlike previous dose prediction algorithms, the HEMODOSE web tools establish robust correlations between the absorbed doses and victim's various types of blood cell counts not only in the early time window (1 or 2 days), but also in very late phase (up to 4 weeks) after exposure.