A multiple parameters biodosimetry tool with various blood cell counts – the HemoDose approach

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There continue to be important concerns about the possibility of the occurrence of acute radiation syndromes following nuclear and radiological terrorism or accidents that may result in mass casualties 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 radiation induced biological changes to assess the severity of radiation injury to sensitive organ systems. Among these the peripheral blood cell counts are widely used to assess the extent of radiation induced bone marrow injury. This is due to the fact that the 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 a practical and recommended laboratory test to estimate radiation dose and injury.

Based upon years of physiological and pathophysiological investigation of mammalian hematopoietic systems, and rigorous coarse-grained bio-mathematical modeling and validation on species from mouse, to dog, monkey, and human, we have developed a set of software tools Hemodose, which can use single or serial granulocyte, lymphocyte, leukocyte, or platelet counts after exposure to estimate absorbed doses of adult victims very rapidly and accurately. Some patient data from 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. Most significant to the improvement of national and local preparedness of a potential nuclear/radiological disaster, this HemoDose approach establishes 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 the very late phase (up to 4 weeks) after exposure.