HEMODOSE: A set of multi-parameter biodosimetry tools

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There continues to be important concerns of 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 (BM) injury. This is due to the fact that hematopoietic system is a 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.

In this work we describe the HEMODOSE web tools, which 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 to assess the severity of BM radiation injury. 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. 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.

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