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# Development Of An Ultrahigh-Throughput Robotically-Based Biodosimetry Workstation Using In-Situ Assays

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## Abstract

Following a mass radiological event, there will be a significant requirement to assess, within a few days, the radiation doses received by tens or hundreds of thousands of individuals. We present the design of a fully automated high-throughput robotic biodosimetry workstation, based on in-situ analysis in multiwell plates, capable of assessing radiation exposure in up to 30,000 blood samples per day.

The inputs to the system are 50 µl blood samples in plastic hematocrit capillaries, collected in the field using a standard lancet. After the capillary is input into the system, no further operator handling is involved. The samples are centrifuged to separate the lymphocytes, and a preliminary lymphocyte count indicates if emergency treatment is required. The capillary is then laser cut below the lymphocyte band, and the lymphocytes and plasma are deposited into a filter bottomed multiwell plate.

Depending on the time since exposure, either the micronucleus or the γ-H2AX assay is then performed in an automated liquid handling system with custom made robotic incubators. The use of filter bottomed plates allows rapid washes without the need to pellet and resuspend after each step, simplifying the liquid handling system and increasing throughput. Finally the filter bottoms are transferred to a rigid substrate for automated imaging and final archiving. Transfer between the various stations uses a selective compliant articulated robot arm with custom designed grippers.

Both assays require initial separation of lymphocytes from whole blood. 50 µl of whole blood and 50 µl of lymphocyte separating medium is used, centrifuged at 40g for 20 minutes. This yields good separation of the lymphocytes as a well defined white band, for guiding the cutting laser. The lymphocyte separating medium with a density of 1.114 g/ml yielded better lymphocyte counts and sharper bands, as compared with lower-density (1.077 g/ml) separation medium.

Both assays have been optimized for processing in filter bottomed multiwell plates and are being optimized both for sensitivity and speed. We will present the layout of the system as well as preliminary results of the various components and optimized assays.

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