

Purpose: To automate astronaut organ and effective dose calculations from occupational X-ray and computed tomography (CT) examinations incorporating PCXMC and ImPACT tools and to estimate the associated lifetime cancer risk per the National Council on Radiation Protection & Measurements (NCRP) using MATLAB®.

Methods: NASA follows guidance from the NCRP on its operational radiation safety program for astronauts. NCRP Report 142 recommends astronauts be informed of the cancer risks from reported exposures to ionizing radiation from medical imaging. MATLAB® code was written to retrieve exam parameters for medical imaging procedures from a NASA database, calculate associated dose and risk, and return results to the database, using the Microsoft .NET Framework. This code interfaces with the PCXMC executable and emulates the ImPACT Excel spreadsheet to calculate organ doses from X-rays and CTs, respectively, eliminating the need to utilize the PCXMC graphical user interface (except for a few special cases) and the ImPACT spreadsheet.

Results: Using MATLAB® code to interface with PCXMC and replicate ImPACT dose calculation allowed for rapid evaluation of multiple medical imaging exams. The user inputs the exam parameter data into the database and runs the code. Based on the imaging modality and input parameters, the organ doses are calculated. Output files are created for record, and organ doses, effective dose, and cancer risks associated with each exam are written to the database. Annual and post-flight exposure reports, which are used by the flight surgeon to brief the astronaut, are generated from the database.

Conclusions: Automating PCXMC and ImPACT for evaluation of NASA astronaut medical imaging radiation procedures allowed for a traceable and rapid method for tracking projected cancer risks associated with over 12,000 exposures. This code will be used to evaluate future medical radiation exposures, and can easily be modified to accommodate changes to the risk calculation procedure.

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