

Design personal radiation protective equipment for interventional cardiologists with more protection and lower weight

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Introduction - Interventional cardiology procedures generate substantial scatter radiation, and interventional cardiologists experience the highest cumulative occupational exposure among catheterisation-laboratory personnel, exceeding that of other medical specialities. Conventional lead-based personal protective equipment (PPE) imposes substantial ergonomic limitations, highlighting the need for advanced, lightweight, and ergonomically optimised radiation shielding technologies in interventional cardiology.

Objective - To identify and synthesize suitable lightweight materials for incorporation into a textile with enhanced radiation shielding properties, and to evaluate the effectiveness of the developed textile in providing superior protection for interventional cardiologists.

Method - We performed a targeted review of candidate shielding fillers and substrates and screened options against pre-specified criteria: theoretical attenuation potential, areal density, flexibility, manufacturability, and user acceptability.

We then designed a multilayer laminate and developed a vest-skirt concept with region-specific thicknesses for anatomical zones with some area modifications.

Results - Tungsten polymer was selected as the optimal non-lead alternative for radiation shielding due to its favourable protective and mechanical properties. The proposed laminate comprises a central tungsten-polymer layer flanked by lead-incorporated nonwoven laminated fabric on both outer surfaces. The innovative design employs efficient radiation control, uses less metal and offers greater flexibility and ease of use. The lightweight design incorporates nonwoven fabric that aims to reproduce the look and feel of what interventional cardiologists are used to. The design incorporates varying fabric thicknesses in the different areas of the body to achieve an optimal balance of protection and comfort.

Even if the lack of adequate facilities for practical testing was a constraint, a basic layered material model was built and serves as a starting point for future development

Conclusions - We present a feasible laminate-and-garment concept for a lighter, ergonomically improved, non-lead-dominant PPE alternative to traditional lead-based PPE for interventional cardiology.