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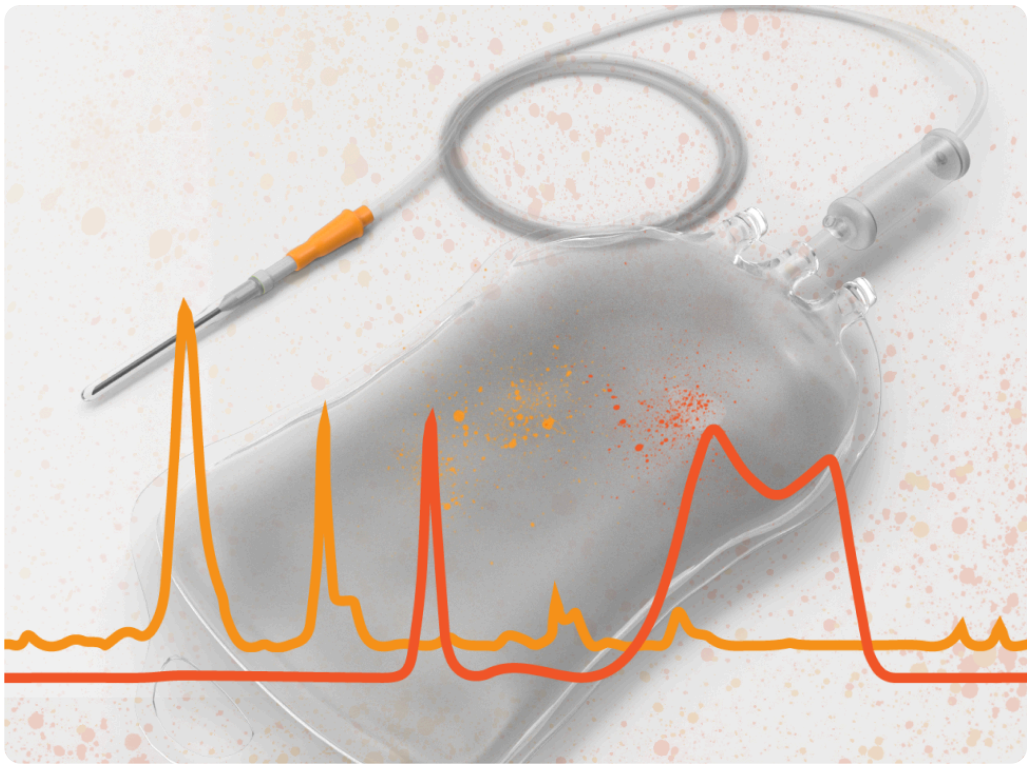
Microplastics in Medical Devices: Investigation of Intravenous Fluid Systems as a Potential Source of Human Exposure

by Photothermal Spectroscopy Corp. | April 11, 2025
| Webinar brief (https://www.photothermal.com/webinar-brief/)



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This article is based on a webinar hosted by Photothermal Spectroscopy Corp, featuring insights from Dr Junli Xu, Assistant Professor, School of Biosystems and Food Engineering, University College Dublin, Ireland

Recent research conducted by the UCD Microplastic Research Group has revealed concerning findings about microplastic release from common medical devices, particularly intravenous (IV) fluid systems. While microplastic contamination has been widely studied in environmental contexts, this new research sheds light on a direct pathway for microplastic exposure in medical settings.

Background on Microplastics

Microplastics are defined as plastic particles smaller than 5 millimeters in size. These particles have been detected throughout the environment and in various human tissues, raising significant health concerns. Recent literature has reported microplastic presence in human blood, with particles ranging from 0.7 to 500 microns, which has prompted questions about their origin and biological plausibility.

Study Focus: IV Fluid Systems

The research team investigated standard intravenous fluid infusion systems as potential sources of microplastic contamination. The study examined various components:

- IV bags of different volumes (100ml, 200ml, 250ml, and 1L)
- Giving sets
- Catheters
- Impact of infusion pump usage

Materials Analysis

The researchers first identified the polymer composition of different IV system components:

- IV bags: Polypropylene
- Giving chamber and sterile spike: Polystyrene
- Puncture tip: Polydimethylsiloxane (PDMS)
- Tubing: Polyvinyl chloride (PVC)
- Catheter: Mixture of PDMS and polyimide

Methodology

The study employed Optical Photothermal Infrared (O-PTIR) spectroscopy to analyze particles captured on aluminum oxide filters. Key methodological aspects included:

- Scanning of 41 regions (covering 4% of the total filter area)
- Collection of spectra from three spots per particle
- Polymer identification through comparison with parent materials and databases
- Analysis of particle morphology (area, circularity, length, width)

Key Findings

Particle Counts:

- Approximately 900 microplastic particles per liter of IV fluid under normal conditions
- Increased to 1,570 particles when using an infusion pump
- Most prevalent particle size range: 3-12 microns

Polymer Types:

- PDMS was consistently detected across all samples
- PCP (phthalate-containing microplastics) derived from PDMS degradation
- Epoxy resins from medical adhesives were also commonly found

Catheter-Specific Results:

- After 72 hours of water immersion, catheters released primarily PDMS particles
- Various polyamide types were detected, consistent with catheter composition

Study Limitations

The researchers acknowledged several limitations:

1. Subsampling strategy necessity due to time constraints
2. Spectral identification uncertainties
3. Inability to characterize nanoplastics (particles smaller than 1 micron)
4. Limited number of replicates (four)

Implications and Future Directions

This research raises important questions about medical device safety and the need for regulatory consideration regarding microplastic release. The findings suggest that particular attention should be paid to components made with PDMS, as these were identified as significant sources of microplastic particles.

The study also highlights the need for:

- Development of faster scanning and analysis methods
- More robust spectral identification techniques
- Investigation of nanoplastic release
- Additional research with larger sample sizes
- Assessment of potential health impacts from medical device-derived microplastics

This research represents an important step in understanding medical devices as potential sources of microplastic exposure and may influence future medical device design and regulation to minimize microplastic release during medical procedures.

For more detailed information watch the webinar:
Advances in submicron IR and simultaneous Raman for Microplastics Characterization (https://www.photothermal.com/webinars/advances-in-submicron-ir-and-simultaneous-raman-for-microplastics-characterization/)

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