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Using thermochromic ink for medical simulations

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Background: In medical simulation and training, blood is used to exhibit its different behaviors in context. In some cases, blood color differential is an imperative visual effect to ensure high-fidelity training and practical understanding. High simulation realism is usually achieved by using animal or artificial blood (which mimics some biological features of blood), which has high cost, requires disposable equipment such as oxygenators, and entails contamination or infection risks.

Methods: A novel method for blood simulation is introduced. Using the thermal properties of thermochromic ink, its color can be altered by adjustment of temperature.¹ The unique red color of blood can be mimicked to a high fidelity using a custom hue of thermochromic ink. Then, by adjusting its temperature, realistic dark and bright red can be employed to simulate the low and high oxygen concentrations of blood, respectively. Although thermochromic ink currently does not imitate other blood properties such as viscosity and clotting, it has superior merits when color change simulation is a paramount priority. The major advantages of the proposed solution are reusability and cost. Thermochromic ink can be used for multiple simulations without any noticeable change in quality. It also costs significantly less than using actual or artificial blood.

Results: Testing results of the proposed solution in extracorporeal membrane oxygenation (ECMO) simulation has proven its efficacy as a practical solution for medical simulations (see [Figure 1](#)). To prevent membrane occlusion because of the thermochromic ink, the latter needs to be pierced. In addition to ECMO simulation, other medical applications are being considered.

Conclusions: The use of thermochromic ink in medical training provides reproducible color change simulation features of blood while maintaining

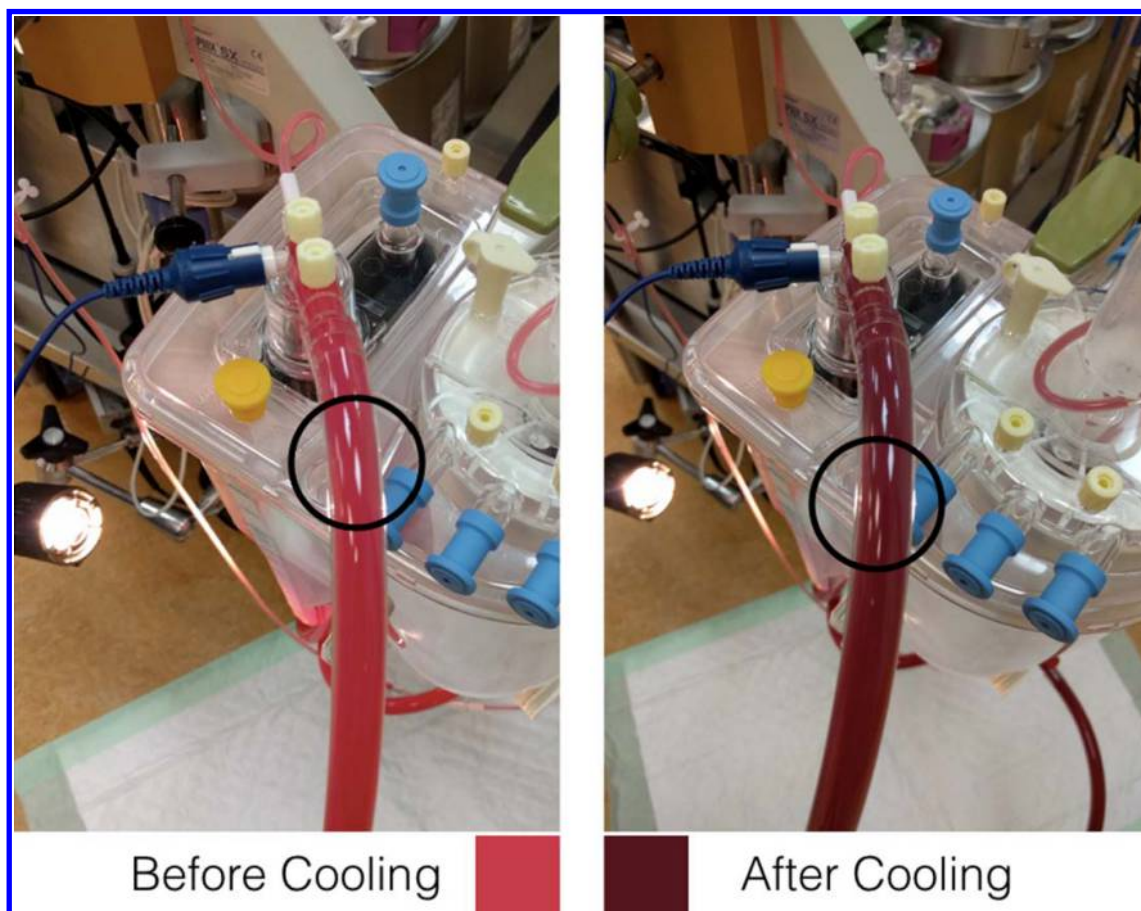


Figure 1. Preliminary experimental results of simulating blood color change using thermochromic ink.

significantly lower equipment costs and contamination risks as all circuit components can be reused.

Keywords: medical training, medical simulation, blood simulation, thermochromic ink, extracorporeal membrane oxygenation (ECMO)

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