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## Intravenous fluids in hot pre-hospital environments: Thermal and physical stability of normal saline after exposure to simulated stress conditions

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### ABSTRACT

**Background:** Normal saline 0.9 % (NS) is the most widespread crystalloid used as a life-saving intravenous (IV) fluid.<sup>1</sup> NS contains sodium and chloride in equal concentrations and is subject to thermal stress conditions while stored and transported by clinicians in the pre-hospital environment.<sup>2</sup> This study aimed to investigate the effect of high-temperature exposure on NS bags used by the Hamad Medical Corporation Ambulance Service in Qatar.

**Methods:** Five-hundred mL polyolefin NS soft bags (Qatar-Pharma, BN:1929013008) were divided into 4 groups of 24 each and stored at constant temperature (22, 50, or 70°C), or subjected to a temperature of 70°C for 8 hours followed by 22°C for 16 hours repeatedly over 28 days. Inspection and chromatographic analysis of the bags was performed at 0, 12, 24, 48, and 72 hours in the 72-hour study, and at 1, 2, 3, and 4 weeks in the 28-day study.

**Results:** NS bags slightly bulged at 50°C and significantly bulged at 70°C or in the long experiment with temperature variation (Figure 1). During the exposure period, there was no discoloration, turbidity, or leaching of plastic components observed in the NS fluid. The pH readings were  $5.59 \pm 0.08$  (22°C-Control sample),  $5.73 \pm 0.04$  (50°C),  $5.86 \pm 0.02$  (70°C), and  $5.79 \pm 0.03$  following prolonged temperature variation. The sodium and chloride levels for the short-term study ranged from  $100.2 \pm 0.26\%$  to  $107.9 \pm 0.75\%$  and from  $99.04 \pm 0.76$  to  $102.11 \pm 1.71\%$ , and for the long-term study they ranged from  $101.93 \pm 0.90\%$  to  $111.27 \pm 2.61$  and from  $99.05 \pm 0.94\%$  to  $110.95 \pm 1.63\%$ ; respectively (Figure 2) in comparison to manufacturer stated concentrations.

**Conclusion:** There was no evidence to suggest that the NS fluid inside the PO bags is physically and chemically different when exposed up to 28 days to 50°C, 70°C, and prolonged temperature variations compared to 22°C. These simulated conditions are subject to further testing under real-life pre-hospital care emergency conditions in a hot country.

**Keywords:** Normal Saline, Thermal and physical stability, Pre-hospital, Sodium chloride, Ambulance Service

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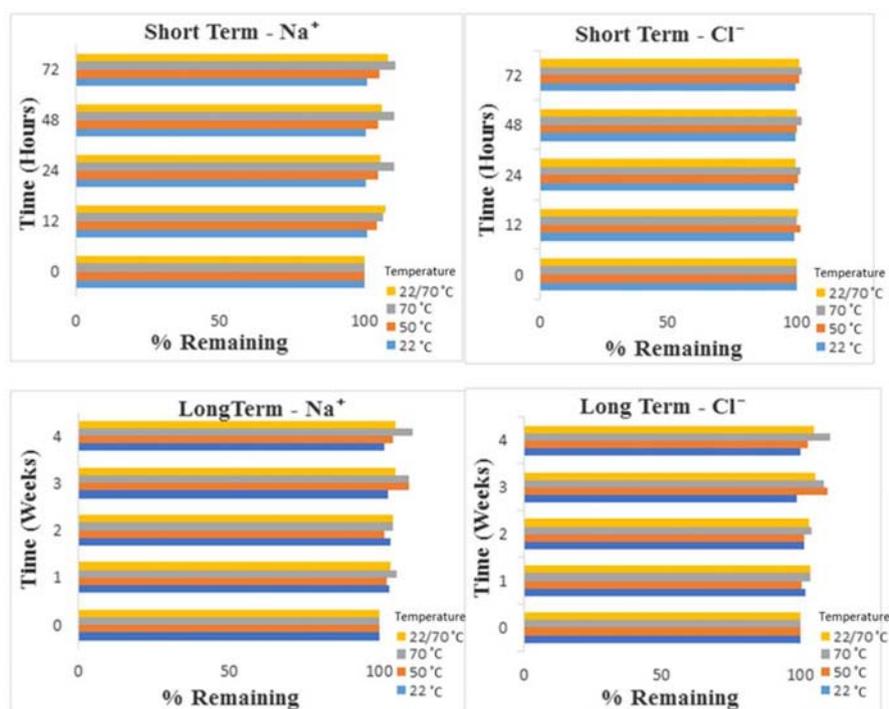
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**Figure 1.** Influence of temperature on bulging of PO bags of normal saline after 28 days.



**Figure 2.** Remaining percentages of sodium and chloride (n = 9) in both short- and long-term stability studies relative to manufacturer's stated concentrations.

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