The practice of EMS in Arizona can be a challenge this time of year. We adapt our practice to ensure that we stay safe - focusing on staying hydrated, monitoring our co-workers for signs of heat-related illness and being vigilant to ensure that we recognize and treat heat-related illness in our patients. We must also take care of our equipment and medications to ensure that we do everything possible to minimize the impact of Arizona’s summer temperatures on the out-of-hospital medications we store in our vehicles.

“Out-of-Hospital Medication Storage Temperatures,” a 2004 article published in Prehospital Emergency Care, reviewed and summarized 15 years of research on the storage of out-of-hospital medications. Proper storage of out-of-hospital medications for access and security has its challenges. However, storing OHM during Arizona’s hot summer temperatures in a manner that maintains the manufacturer’s recommended storage temperatures poses special challenges to EMS providers. Medication attributes (potency, efficacy, etc.) can be affected when medications are stored for periods of time (sustained or cumulative short intervals) outside their recommended temperature ranges.

**Temperature-Dependent Degradation of OHMs**

If you look at any of the medications in your drug box you will see an expiration date. What you may not know is that date presumes that the medication has been in a temperature controlled environment. Several studies have looked at the impact of temperature on OHMs. What’s important from a practice perspective is that each EMS agency adopt policies and procedures to minimize the impact of temperature swings on the medications stored on vehicles and used by its crews. Two policies come to mind: (1) drug rotations schedules, and (2) temperature control policies. A **drug rotation policy**, frequently developed by the ALS base hospital, identifies a schedule for rotating OHMs from vehicles back into a controlled temperature environment to minimize the time the agents spend in an uncontrolled environment.

The **temperature control policy** establishes the expectations that a vehicle’s interior (or a special cabinet) be connected to a battery system (or to a building’s AC system when parked) to ensure OHMs are maintained in a controlled environment.

**Studies on Temperature-Dependent Degradation of OHMs**

Arizona participated in a 2010 study on the 60-day temperature-dependent degradation of lorazepam and midazolam stored in EMS environments with large changes in ambient temperature. The data revealed a small but statistically significant degradation of lorazepam after 60 days and no degradation of midazolam - even in temperatures above 104°F (Prehospital Emergency Care Jan 2013, Vol. 17, No. 1: 1-7).
Studies on Temperature-Dependent Degradation of OHMs (Cont.)

A 1999 study (Gottwald, et al), investigated the stability of injectable diazepam and lorazepam under three temperature conditions for 210 days: refrigerated (39.2-50°F); ambient (59-86°F); and heated (98.6°F). After 210 days, concentration reductions of diazepam were 7% (refrigerated), 15% (ambient), and 25% (heated). The concentration reductions of lorazepam were 0% (refrigerated), 10% (ambient), and 75% (heated). When stored at ambient temperatures, the study recommended diazepam and lorazepam be replaced every 30-60 days. When stored at temperatures exceeding 86°F, more frequent replacement or refrigeration steps were recommended (Am J Emerg Med. 1999 Jul; 17(4): 333-7).

A 1995 study on the stability of drugs on New Jersey ALS vehicles used two methods to monitor temperatures during summer and winter months. Manufacturer labels for 37 prehospital drugs specified storage at controlled room temperature. One temperature monitoring method placed miniature electronic recorders in drug boxes. The other method placed color-changing time-temperature indicators in drug boxes. Logged temperatures inside drug boxes exceeded 86°F during the summer 3% to 29% of the time, and below 59°F 16% to 90% of the time during the winter (one location recorded a temperature below 32°F). Controlled room temperature was exceeded even by ambulances parked in climate-controlled garages for brief periods. The hottest and coldest temperatures were in ambulances parked outside (Acad Emerg Med. 1999 Nov;6(11):1098-103).

In 1989, Valenzuela, et al. studied four sets of 23 prehospital medications in Plano drug boxes exposed to temperatures from 77° to 100°F for four-weeks. Twenty-one of the drugs showed no evidence of degradation, but isoproterenol showed 11% loss of parent compound, and epinephrine showed a change in its ionized state (Ann Emerg Med. 1989 Feb;18(2):173-6).

The literature, of which the preceding is but a sample, supports the consensus that the prehospital environment subjects medications to temperature variations that result in sustained or intermittent excursions from manufacturer recommended storage and transport temperatures.

Approaches to Temperature Maintenance

Challenges in maintaining manufacturer storage temperatures in prehospital conditions include storage compartment, cooling devices, access to a continuous energy source, economics, and staff education.

Do your policies and procedures concerning out-of-hospital medication storage temperature-control reflect best practices that minimize or prevent your medications from exposure to temperatures outside the manufacturer’s recommended range? Do you consistently inspect your out-of-hospital medications for temperature excursions that may shorten their expiration dates or otherwise impact their efficacy?

The Bureau challenges you to review your agency’s policies and procedures on out-of-hospital medication temperature control maintenance. If your review identifies potential risks, point them out to your EMS agency.

HELPFUL RESOURCES

United States Pharmacopeia - (USP), General Chapter 1070 “Emergency Medical Services Vehicles and Ambulance-Storage of Preparations,” provides guidance on storing and handling medications in EMS vehicles to assist in preserving the medication’s original attributes established by manufacturers. Guidance includes storage cabinet monitoring, vehicle parking, stock rotation, portable carrying cases and monitoring, use of time-temperature indicators, and other practices.

Commission on Accreditation of Ambulance Services (CAAS). Standard 203.03.04 requires ambulance services’ medication storage policies and procedures allow for the protection of medications from “extreme temperature changes,” including actions to be taken if medications are exposed to extreme temperatures.

American Ambulance Association – Position paper advocates that ambulance services create EMS medication storage policies and procedures using the approach in CAAS Standard 203.03.04 and USP General Chapter 1070.