Abstract: This study was conducted to determine optimal handling conditions and recommendations for accurate erythrocyte sedimentation rate (ESR) analysis with Streck ESR-Vacuum Tubes. The Modified Westergren method was employed as a benchmark method to generate data for comparison. In summary, samples collected in Streck ESR-Vacuum Tubes and stored at 2-10°C produced accurate sedimentation rate results for 144 hours, or six days. Samples collected in ESR-Vacuum Tubes are stable six times longer than blood collected in standard EDTA tubes analyzed by manual methods.

Introduction: ESR is the measure of the rate that red blood cells settle to the bottom of a specialized tube. Increased sedimentation rates occur when plasma protein concentrations are altered by conditions such as inflammation, infection or cancer. Elevated sedimentation rates can be a sign of any of these conditions; however, further testing is needed to identify the problem. Traditionally, sedimentation rates have been performed manually using methods like the Modified Westergren. While this method is considered the benchmark for ESR analysis, it is not without significant limitations. Samples must be set up and analyzed within four hours of blood collection when samples are stored at room temperature and within 12 hours when samples are stored at 4°C. In addition, sedimentation data must be visually evaluated by a professional technician or nurse at precisely 60 +/- 1 minute and manually recorded.

Streck ESR-Vacuum Tubes provide a closed blood collection system that reduces exposure to potentially hazardous material and eliminates the possibility of biasing results with improper sodium chloride dilutions. Automated instrumentation systems, like the ESR-Auto Plus™, simplify the testing procedure and eliminate the need for a technician or nurse to be present at exactly 60 minutes to record results.

Technology like ESR-Vacuum Tubes, that extends sample storage or transport times to six days from collection to ESR analysis, is a significant advantage for the clinical laboratory.

Methods: Sample Collection Blood from three healthy donors was drawn into six 1.2mL Streck ESR-Vacuum Tubes and six standard EDTA tubes. Samples collected in ESR-Vacuum Tubes were inverted six to eight times after collection, allowing the air bubble to reach the end of the tube with each inversion. Samples collected in EDTA tubes were inverted six to eight times after collection. Tubes were stored at 2-10°C.

Sample Preparation for Modified Westergren Test Method Blood samples collected in standard EDTA tubes, were warmed to room temperature for 30 minutes, and mixed on a rotator for two minutes. Aliquots of 1.0mL of blood were added to the fill line of Dispette tubes, capped and mixed by inversion. Following product instructions, Dispette tubes were grasped at the 180mm region and inserted through the cap membrane of the filling reservoir. They were then gently inserted to the bottom of the reservoir and placed on a level stand. ESR levels were recorded in mm/hr after the samples were allowed to stand for exactly 60 minutes.

Sample Preparation for ESR-Auto Plus Test Method ID numbers associated with each donor were entered into the ESR-Auto Plus instrument. When prompted, samples in ESR-Vacuum Tubes that were mixed for at least three minutes on the Streck ESR-657 Mixer were inserted into a free position in the ESR-Auto Plus and testing was initiated. The ESR-Auto Plus automatically scanned each sample and printed the results.

Results: Figure 1 illustrates the data obtained from EDTA tubes and Streck ESR-Vacuum Tubes stored at 2-10°C analyzed by the Modified Westergren method and the ESR-Auto Plus, respectively. Refrigeration increased the acceptable storage time prior to sedimentation rate analysis with EDTA tubes to 24 hours from 4-6 hours when stored at room temperature. However, accurate ESR data was obtained through 144 hours with Streck ESR-Vacuum Tubes (Fig.1). ESR-Vacuum Tubes extend the stability of patient blood samples for ESR analysis by an additional 120 hours.

References:
2 The extended stability of samples in ESR-Vacuum Tubes does not apply to samples stored at room temperature. Standard laboratory processing methods should be employed when samples are stored at room temperature.
Figure 2 illustrates data obtained from a donor sample with higher ESR levels. Samples from this donor were analyzed for ESR with the Modified Westergren method and the ESR-Auto Plus. The samples drawn into ESR-Vacuum Tubes and analyzed with the ESR-Auto Plus also displayed stable results through 144 hours. This data indicates that accurate ESR rates can be obtained with ESR-Vacuum Tubes from samples with elevated sedimentation rates. (Fig. 2).

Discussion:
Samples collected in EDTA tubes for erythrocyte sedimentation rate analysis must be setup within four hours when stored at room temperature and within 12 hours when stored at 2-10°C. Streck ESR-Vacuum Tubes are capable of extending storage prior to analysis to 144 hours at refrigerated temperatures.

Manual methods for ESR have many limitations. These limitations include strict requirements for sample preparation and analysis, as well as a professional to record results within +/- 1 minute of test completion. Additionally, results will be compromised if the dilution with sodium chloride is inaccurate or tubes are slightly tilted during the ESR test.

Streck ESR-Vacuum Tubes and the ESR-Auto Plus offer a unique and convenient means to circumvent these issues. This novel sample collection tube and automated instrument eliminate the requirements for sample handling and dilution. The ESR-Auto Plus eliminates the need for a nurse or technologist to be present at the exact time of test completion because the system automatically prints the results at the conclusion of the test.

The extended stability of Streck ESR-Vacuum Tubes increases the laboratory’s options for sample transport and testing by extending the time for analysis to 144 hours. In addition, samples drawn into Streck ESR-Vacuum Tubes can be analyzed on the ESR-Auto Plus instrument with no requirements for sample transfer. ESR-Vacuum Tubes in combination with the ESR-Auto Plus are a safe and effective alternative to standard blood collection tubes and manual methods for ESR analysis.

Figure 1. ESR-Auto Plus vs. Modified Westergren
Normal Patient Values

Figure 2. ESR-Auto Plus vs. Modified Westergren
Elevated Patient Values

Sedimentation rate results from EDTA (blue) and ESR (red) tubes stored at 2-10°C for up to 144 hours. Samples were analyzed using the Modified Westergren method and the ESR-Auto Plus.