Chuang J; Sadler MA; Witt DM Impact of evacuated collection tube fill volume and mixing on routine coagulation testing using 2.5-ml (pediatric) tubes. Chest 2004;126:1262–6.

BACKGROUND: Anecdotal observations by pharmacists monitoring anticoagulated patients indicate that blood samples collected in 2.7-mL (pediatric) evacuated tubes frequently produced falsely elevated international normalized ratio (INR) results. OBJECTIVE: To evaluate the impact of various preanalytical variables (fill volume, sample mixing, and elapsed time between sample collection and mixing) on INR test results using pediatric collection tubes in healthy volunteers and patients receiving warfarin anticoagulation therapy. Fifteen patients receiving warfarin and the 15 healthy volunteers participated in each study arm. METHODS: Multiple blood samples for coagulation testing were obtained from study subjects in full-draw pediatric collection tubes made of siliconized glass. The impact of sample mixing was evaluated by randomly varying the number of times each tube (five tubes total) was inverted following sample collection between one and five. The impact of timely sample mixing was evaluated by randomly varying the elapsed time between sample collections and mixing between 0 min and 4 min in each of five samples. The impact of incomplete collection tube filling was evaluated by randomly varying the volume of six tubes between 50% and 100%. Duplicate coagulation assays were performed on each sample by a centralized hematology laboratory, and the average result was reported. RESULTS: Statistical analysis revealed that neither sample mixing nor the elapsed time between sample collection and mixing had a statistically significant effect on INR test results. For patients receiving warfarin, tube fill volume had a statistically significant effect on the reported INR results ($p < 0.001$). The mean (+/- SD) INR derived from sample tubes filled 100% was 3.2 +/- 1.2, compared to 9.9 +/- 4.2 for tubes filled only 50% full ($p < 0.01$). Statistically significant INR elevations became apparent for sample tube fill volumes of < 90%. CONCLUSION: Pediatric blood collection tubes should be filled at least 90% full to ensure accurate INR test results. Anticoagulation therapy providers should routinely inquire about the type of collection tube used (adult vs pediatric) and the adequacy of sample collection volume before deriving therapeutic plans in asymptomatic excessively anticoagulated patients.