

Evaluation of the Accuracy and Precision of the CoaguChek[®] XS System

This paper summarizes a study conducted to evaluate the performance of the CoaguChek XS System compared to traditional laboratory methods for PT/INR testing.

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INTRODUCTION

The CoaguChek XS System is a third-generation portable monitor used for prothrombin time (PT) testing, with results typically provided in International Normalized Ratio (INR) units. It is intended for use by healthcare professionals to evaluate the PT/INR of individuals using oral anticoagulants, e.g., warfarin.

Careful monitoring of patients on warfarin therapy is important; under-anticoagulation increases the risk of stroke, while over-anticoagulation increases the risk of bleeding episodes. The appropriate therapeutic range for individuals undergoing conventional warfarin therapy is typically from 2.0 to 3.0 INR. Individuals who receive more intense therapy, such as mechanical heart valve replacement patients, often have a target range from 2.5 to 3.5 INR.¹

The CoaguChek XS monitor offers a convenient, quick way to confirm that a patient is within the appropriate target range, right at the point of care. The monitor uses a lot-specific code chip and takes a single drop of capillary or venous whole blood. It displays the result in approximately one minute, and can be configured to display results in INR, seconds, or % Quick. The CoaguChek XS PT test strips are manufactured with a human recombinant tissue factor and have an International Sensitivity Index (ISI) of 1.0.

The purpose of this study was to evaluate the performance of the CoaguChek XS System – specifically in terms of accuracy and precision – compared to standard traditional laboratory methods.

METHODS

Prothrombin Time test results were obtained from CoaguChek XS monitors from three external sites, using both capillary and venous whole blood.

The PT results are presented in INR (International Normalized Ratio) units. The INR was created to allow for differences in the sensitivity of different thromboplastins. The sensitivity of a thromboplastin is defined by its International Sensitivity Index (ISI). Thromboplastins with lower ISI values are said to be more sensitive to factor deficiencies. Generally, a manufacturer of a commercial thromboplastin reagent assigns an ISI to the reagent. The INR is calculated according to the following formula:

$$\text{INR} = (\text{patient PT}/\text{mean normal PT})^{\text{ISI}}$$

The patient PT is the patient result in seconds, the mean normal PT is the normal PT as defined by the manufacturer, and the ISI is the International Sensitivity Index assigned to the reagent.²

Precision

The precision of a system is its ability to replicate measurements to give similar results. Whole blood precision was analyzed separately for normal donors (those patients not on warfarin) and warfarinized donors. The study measured precision for both capillary and venous whole blood on the CoaguChek XS system.

For the capillary testing, the investigator performed a duplicate fingerstick; the first drop was applied to one CoaguChek XS monitor and the second drop was applied to a second CoaguChek XS monitor. A rotation scheme was used to ensure that the same instrument was not always dosed first. For the venous testing, blood was applied from a syringe; no rotation scheme was used.

Accuracy

The accuracy of a system is evaluated by performing a method comparison. The samples are analyzed on the method under evaluation and the results are compared to the results from a standard laboratory reference.

In this study, the portable monitor samples were obtained by fingerstick and venipuncture and were analyzed on a CoaguChek XS System using a human recombinant thromboplastin calibrated to an ISI of 1.0. The lab reference sample was obtained using a 3.2% sodium citrate Vacutainer® and was run on a Sysmex analyzer using Dade Innovin® thromboplastin. To cover as much of the reading range as possible, the study included 100 patients per site who were being treated with warfarin therapy and 20 patients per site who were not.

RESULTS/DISCUSSION

Precision

The numerical results for the capillary and venous whole blood precision of patient duplicates are shown in Tables 1 and 2; a visual representation is provided in Graphs 1 and 2. Acceptable results were obtained for both capillary (CV \leq 7.5%) and venous (CV \leq 4.5%) blood.

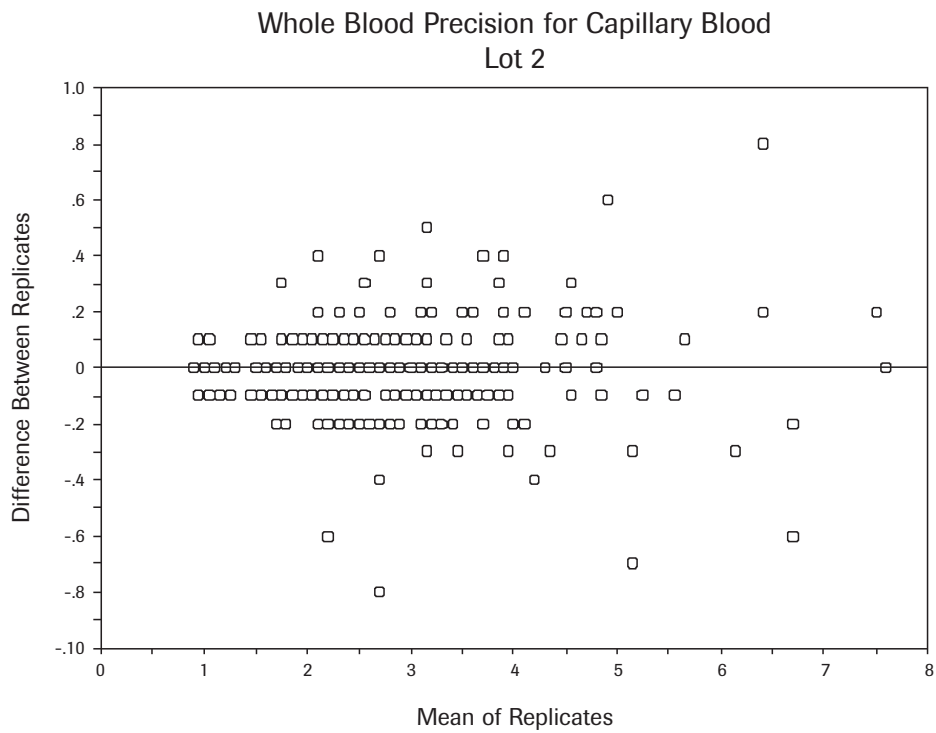
Table 1 – CoaguChek XS System Capillary Blood Precision – Lot # 022

INR	N	Mean	SD	% CV
< 2.0	103	1.31	0.05	4.05
> 2.0 – 3.0	131	2.49	0.11	4.33
> 3.0 – 4.5	87	3.50	0.12	3.54
> 4.5	23	5.51	0.23	4.18
Entire Range	344	2.59	0.11	4.35

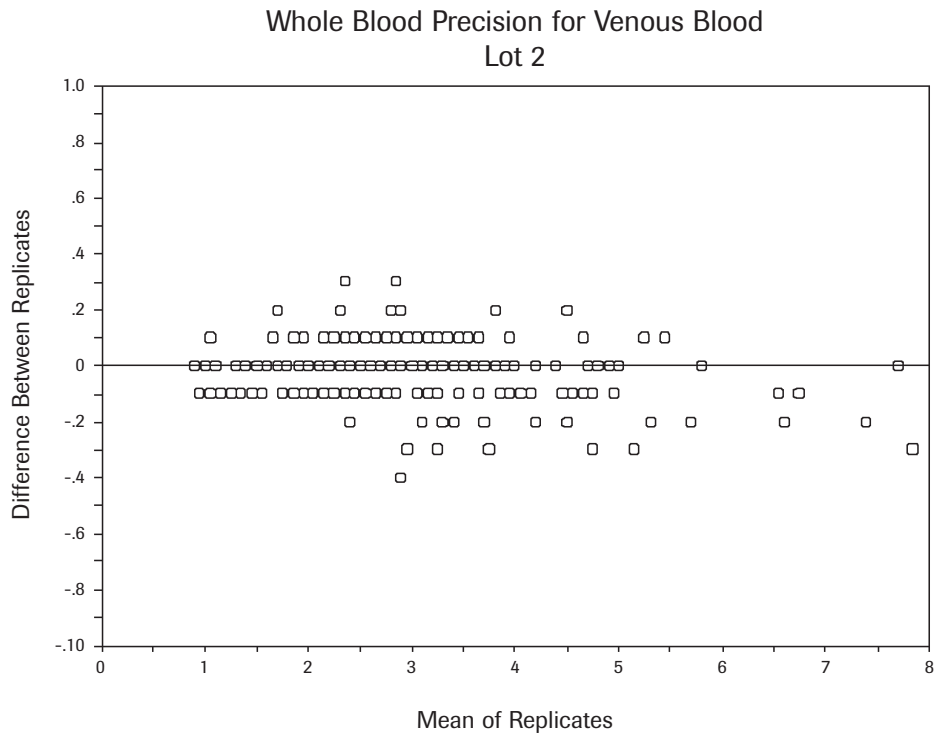
Table 2 – CoaguChek XS System Venous Blood Precision – Lot # 022

Sample type	N	Mean	SD	% CV
< 2.0	109	1.30	0.04	2.76
> 2.0 – 3.0	132	2.49	0.07	2.62
> 3.0 – 4.5	92	3.49	0.07	1.96
> 4.5	24	5.54	0.11	1.90
Entire Range	357	2.59	0.06	2.42

Graph 1 – CoaguChek XS System Capillary Blood Precision – Lot # 022



Graph 2 – CoaguChek XS System Venous Blood Precision – Lot # 022



Accuracy (Method Comparison)

The correlation of the results of the CoaguChek XS System lot 022 (capillary blood) tests to the results of the Dade Innovin/ Sysmex Analyzer tests is shown in Figure 1. Linear regression (n=701) yielded a slope of 1.00 with an intercept of 0.04. The correlation coefficient is 0.976.

Figure 1

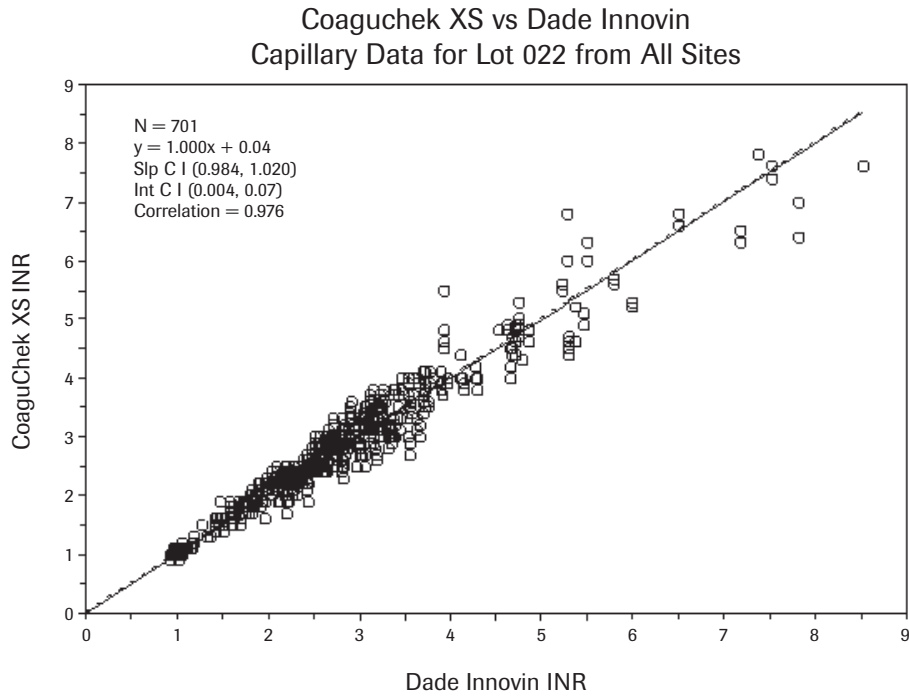


Figure 2 shows the comparison of the CoaguChek XS System lot 022 (venous blood) results to the Dade Innovin/Sysmex Analyzer results. Regression analysis (n=713) yielded a slope of 1.02 and an intercept of 0.002. The correlation was 0.980.

Figure 2

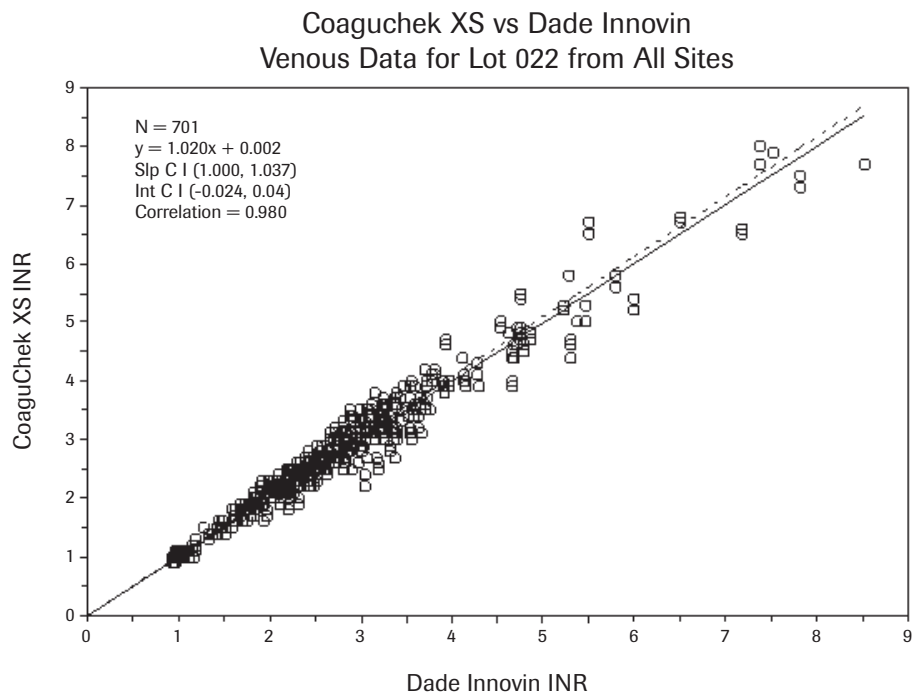


Figure 3 shows the bias plot comparing the CoaguChek XS System capillary results to Dade Innovin/Sysmex results. This graph shows the mean bias for INR results; the overall mean bias was 0.03.

Figure 3

CoaguChek XS Data from Sites 1, 2 and 3
Bias Plot for Lot 022 with Capillary Blood

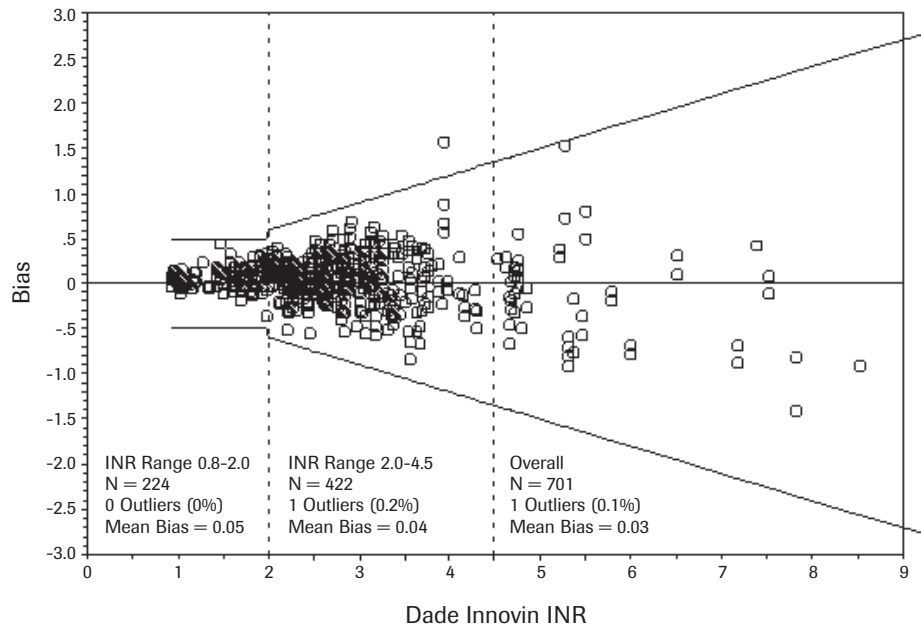
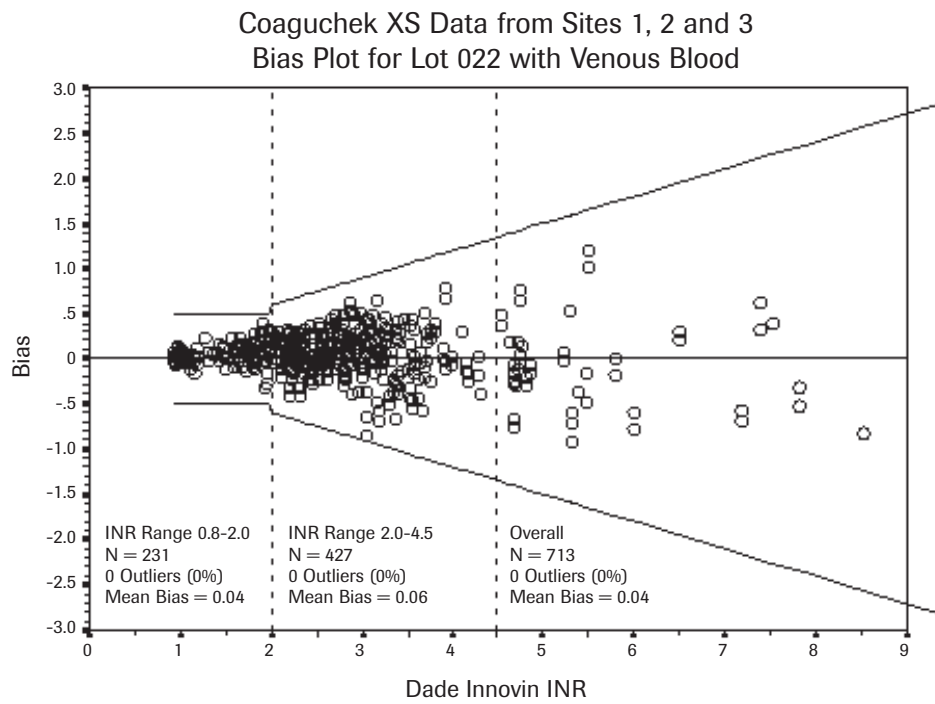


Figure 4 shows the bias plot comparing the CoaguChek XS System venous results to Dade Innovin/Sysmex results. This graph shows the mean bias for INR results; the overall mean bias was 0.04.

Figure 4



CONCLUSION

Prothrombin Time testing is not standardized across systems – whether they are lab instruments or portable point-of-care monitors – and there is no defined “gold” standard for acceptable performance.

However, in this comparison study, regression statistics yielded correlation coefficients of 0.97 or greater for all comparisons.

The Coefficients of Variation presented for precision of whole blood duplicates indicate that the precision of the CoaguChek XS monitor for both capillary and venous whole blood samples is very good.

These results and the findings of several independent studies support the fact that point-of-care PT/INR testing with the CoaguChek XS monitor is a viable alternative to drawing a venous sample and sending it the lab, in terms of both accuracy of results and the cost-effectiveness of care.³⁻⁸

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