Beckman Coulter DxI 9000 Immunoassay Analyzer assay performance meets new CLIA 2024 PT goals with highest proportion of Six Sigma performance amongst manufacturers.

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INTRODUCTION

In July 2024, the Clinical Laboratory Improvement Act (CLIA) updated the proficiency testing (PT) criteria, with some goals tightening by up to 40%. It is the first time since 1992 that PT criteria are being updated. It is assumed, but not known or proven, that all methods and instruments will be able to achieve these goals. Labs can meet CLIA PT with up to a 20% failure rate, so the bar on the Six Sigma scale is set as low as 2.3 Sigma.

Using these new CLIA 2024 benchmarks, estimates of current instrument group performance from an international proficiency testing (PT) survey have shown significant differences in quality, calling into question which instruments and methods can easily pass PT. Across immunoassay methods, 9 to 30% of major diagnostic platforms achieve analytical quality of only 2 to 3 Sigma, indicating potential failures in future PT.
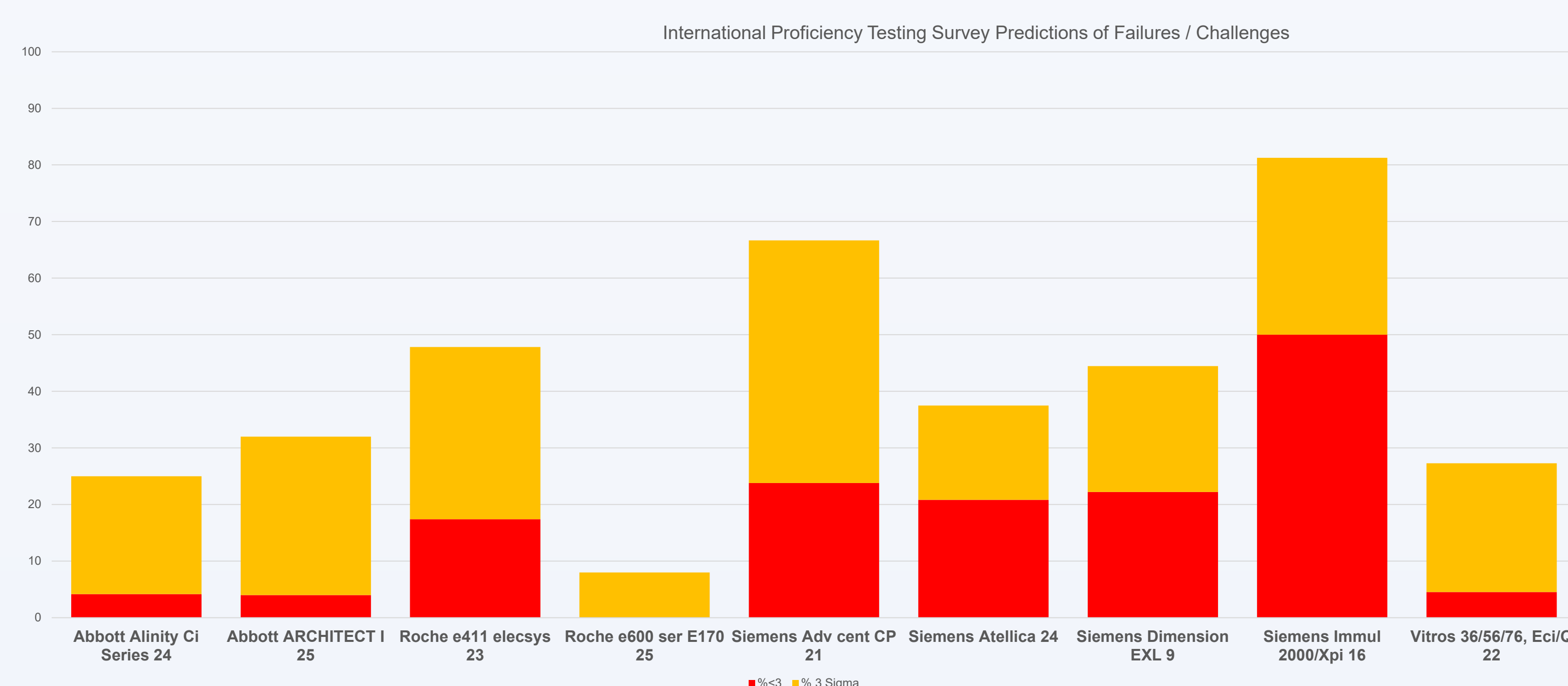

Figure 1. Each instrument group lists the number of biochemistry assays that are benchmarked on the Six Sigma scale. The percentage of those assays that achieve Three Sigma are marked in yellow. Assays that achieve below Three Sigma are marked in red. Assays that are below Three Sigma are at heightened risk for proficiency testing failure. The methodology of estimating analytical Six Sigma performance through Proficiency Testing survey data is described in references 1-2.

MATERIALS AND METHODS

Assays on the DxI 9000 Immunoassay Analyzer* were assessed for Sigma metric performance, including Beta hCG, Cortisol, Creatine Kinase MB (CK-MB), Estradiol, Folate, Para-thyroid hormone (PTH), Total Prostate specific antigen (Total PSA), Testosterone, Troponin I, Thyroid Stimulating Hormone (TSH), Total Triiodthyronine (TT3), Free Thyroxine (FT4) and Vitamin B12. Three reagent lots were used to assess performance. Imprecision and Bias were calculated following the CLSI EP05 and EP09 guidelines, respectively. Imprecision was assessed at 3 or more levels. Analytical Sigma Metrics were calculated for each level.

Six Sigma strives to reduce the defect ratio via providing "a common language and a common approach to problem solving" [3]. The analytical Sigma Metric relates performance specifications (bias and imprecision) to tolerance limits to provide a measure to represent defect rate. James O. Westgard adapted the industrial Sigma Metric approach into a formula appropriate for the medical laboratory [4]:

$$\text{Sigma-metric} = (TEa - |Bias|)/SD.$$

The analytical Sigma Metric predicts not only future problems with PT, but also potential optimization of QC procedures, including fewer Westgard Rules, control levels, even reduced QC frequency.[5]

RESULTS

Half of the DxI 9000 immunoassay assay performance achieves 6 Sigma (see Figure 2), while greater than 78% of the DxI 9000 CLIA regulated IA menu achieves 4, 5, and 6 Sigma (not pictured). These assays are unlikely to face PT difficulties and can be optimized for reduced Westgard Rules, reduced control levels, and potentially reduced QC frequency.
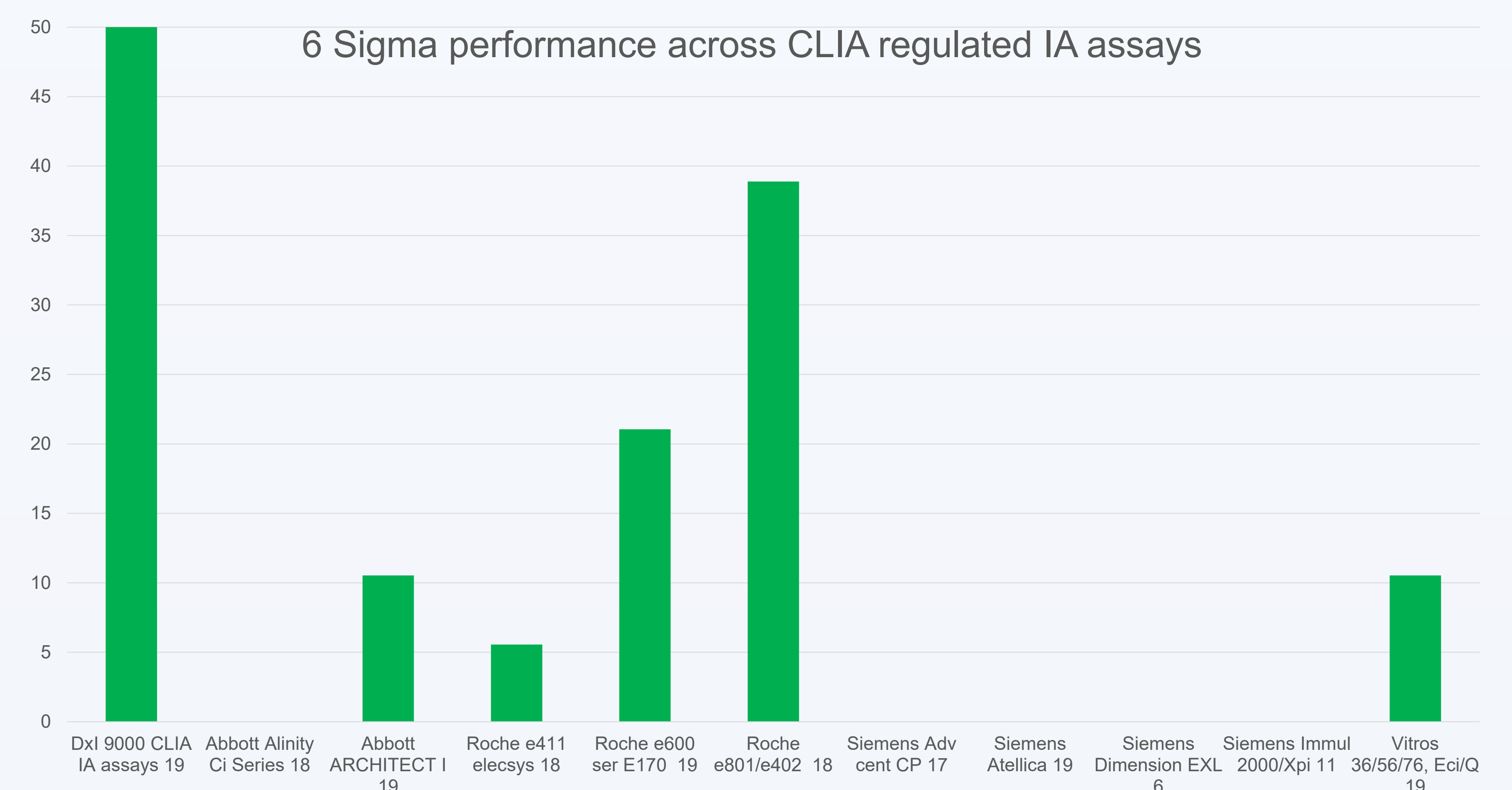

Figure 2. Here, the focus is on the percentage of performance of IA assays that achieve 6 Sigma under the new CLIA 2024 goals. The number at the end of the notation of the instrument groups indicates how many assays were assessed.

DISCUSSION

CLIA's new proficiency testing criteria represent the biggest tightening of goals in more than 30 years. Given that all methods and instruments currently on the market were engineered with the requirement of meeting only the 1992 goals, there are demonstrated differences in the ability of these instruments and methods to meet the 2024 goals. The pain of new CLIA PT criteria will not be felt equally across methods, instruments and laboratories. While some proficiency testing organizations assert that the number of labs failing the new goals will not be significant, it remains the responsibility – and anxiety – of each individual laboratory to determine whether or not it is one of the "insignificant."

Assays with performance below 3 Sigma face the greatest danger of failures in the new Proficiency Testing scheme. Assays where there is consistent performance above 3 Sigma will face fewer worries. Performance of 4, 5, and 6 Sigma will allow laboratories to consider reducing the number of "Westgard Rules" implemented, reducing the number of control levels, and offer the benefit of reducing outliers, trouble-shooting, and delayed TAT. The simplest tool for optimization is the Westgard Sigma Rules.[5]

CONCLUSION

DxI 9000 analyzer assay immunoassay performance leads the diagnostic landscape in achieving analytical Six Sigma performance under CLIA 2024's new PT criteria. Further, the level of quality achieved will enable laboratories to optimize and reduce QC effort.

REFERENCES

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