

Comparative Evaluation of Column Agglutination Technology Methods for Red Blood Cell Alloantibody Identification



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Introduction

Accurate identification and exclusion of red blood cell (RBC) alloantibodies are essential in transfusion medicine and antenatal testing to ensure compatible transfusion and assess the risk of hemolytic disease of the fetus and newborn (HDFN). The complexity of antibody mixtures encountered in routine immunohematology practice highlights the need to compare antibody identification methodologies. This study compared the analytical and operational performance of RBC antibody identification panels from different column agglutination technology (CAT) manufacturers.

Methods

This comparative analytical study evaluated RBC antibody identification methods from Bio-Rad Laboratories and QuidelOrtho using CAT. Bio-Rad testing included IH-Cell I-II-III and IH-Panel 11 as first-line methods, with IH-Panel Plus 6 and IH-Panel 11P used for unresolved cases. QuidelOrtho testing included antibody screening cells Surgiscreen I, II, and III and RESOLVE Panel C as first-line methods, with Panel B and ficin-treated Panel C used when additional investigation was required. All tests were carried out using Bio-Rad IH-Centrifuge L and IH-Incubator L and QuidelOrtho Workstation (centrifuge and incubator). Thirty-three plasma samples containing clinically significant alloantibodies were tested, including 17 single antibodies (52%), 14 double-antibody combinations (42%), and 2 triple-antibody combination (6%), overall involving 51 antibodies from the Rh, Kell, Kidd, Duffy, Lewis, and MNS blood group systems. Reference characterization was established using either tube indirect antiglobulin testing with polyethylene glycol (PEG) or solid phase. Performance was assessed based on correct antibody identification, exclusion of additional clinically significant antibodies, and overall antibody resolution using a predefined scoring system (Table 1) incorporating analytical performance and workflow efficiency.

Table 1. Scoring system for antibody identification performance.

Score	Criteria
5	Complete identification and exclusion with screening + first-line panel
4	Identification with first-line panel; additional panels required for exclusion
3	Identification and exclusion achieved using additional panels
2	Identification achieved; exclusion incomplete despite additional panels
1	Identification only after additional panels; exclusion incomplete
0	Identification and exclusion incomplete

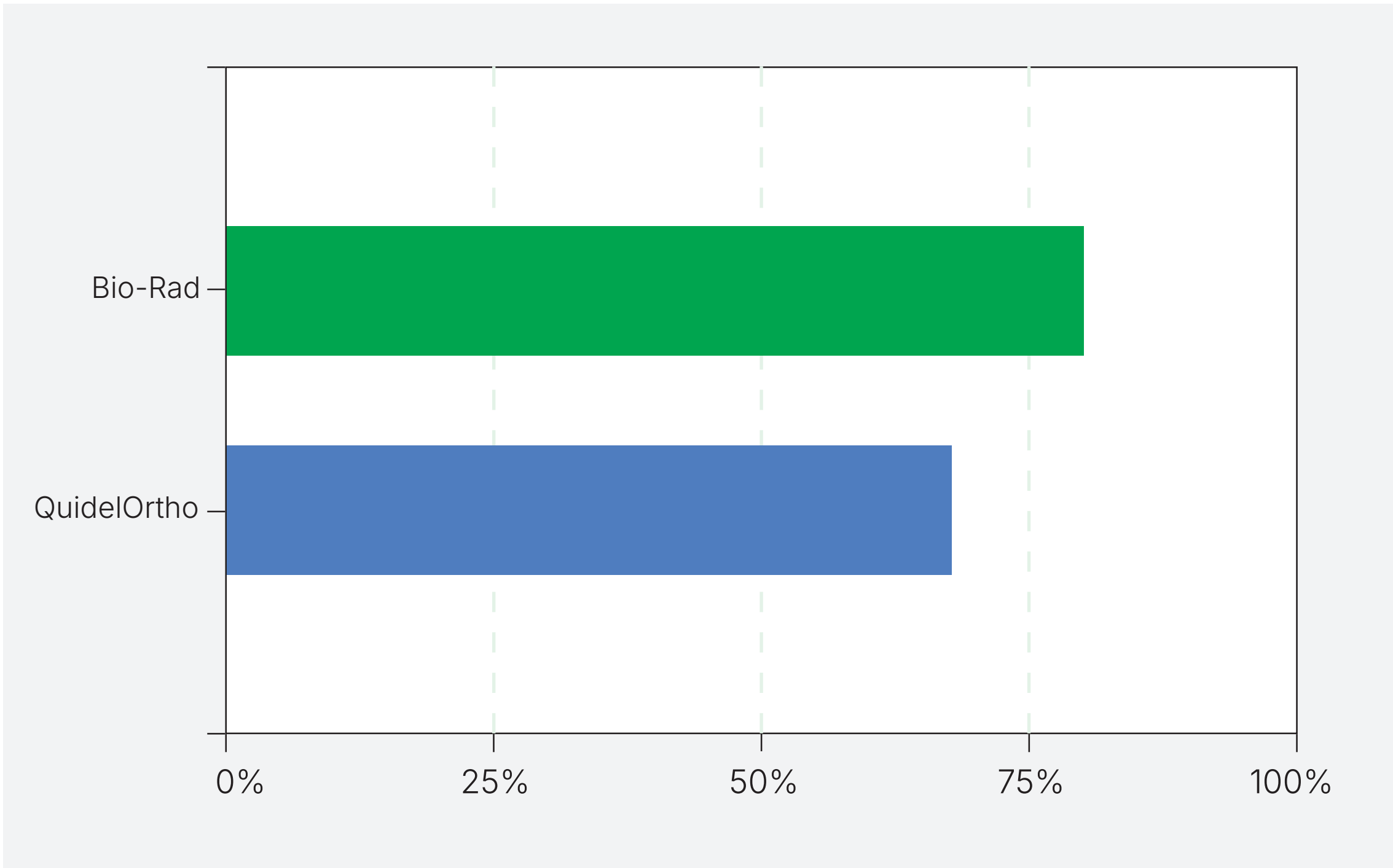


Fig. 1. Overall performance score. Shown is the percentage of total possible points achieved by each method.

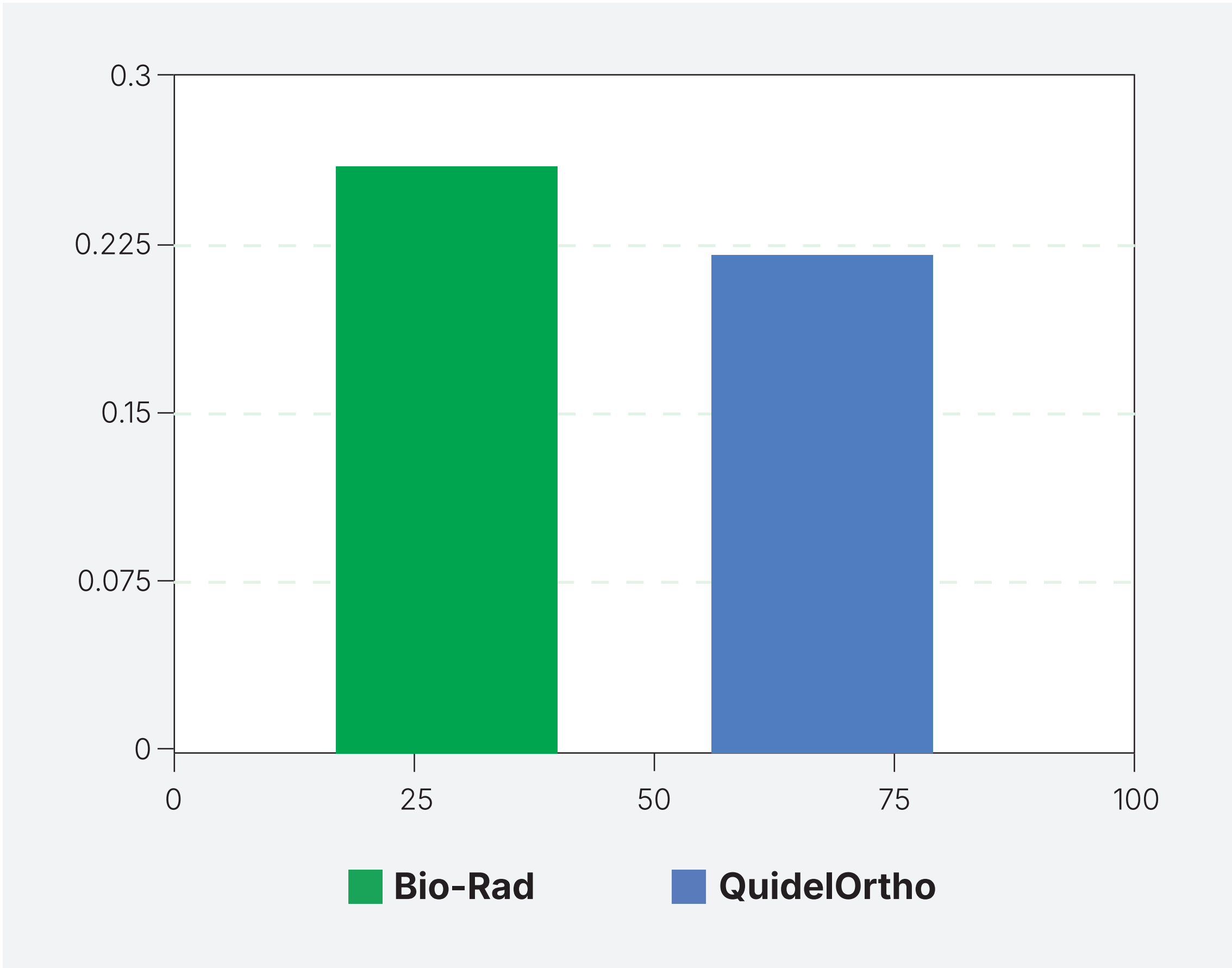


Fig. 2. Relative efficiency. Shown is the diagnostic value per reagent cell for Bio-Rad versus QuidelOrtho.

Results

Overall, 47 and 44 antibodies were identified using the Bio-Rad and QuidelOrtho workflows, respectively. The odds of identifying an antibody were 1.87-fold higher with Bio-Rad identification panels (95% CI: 0.50–6.99). Both reagent lines showed similar performance in terms of antibodies not ruled out, with 18 antibodies not ruled out with Bio-Rad vs. 19 with QuidelOrtho, corresponding to a mean of 0.5 and 0.6 antibodies not ruled out per sample, respectively. Scoring according to Table 1 demonstrated a clear difference between the two reagent lines, with 134 points for Bio-Rad vs. 116 points for QuidelOrtho, corresponding to 81% and 70% of the total possible score, respectively (Figure 1). A Wilcoxon signed-rank test confirmed that Bio-Rad scores were significantly higher than QuidelOrtho scores ($W = 0$, $n = 9$ non-zero pairs, two-sided $P = 0.0059$). A further difference was observed in the number of reagent RBCs required to complete antibody identification. For Bio-Rad panels, 510 test cells were used to analyze 33 samples, compared with 534 cells for QuidelOrtho, corresponding to 15.5 versus 16.2 cells per sample, respectively, or 0.73 fewer cells per sample with Bio-Rad. The relative efficiency ratio, calculated as the numerical score divided by the number of reagent RBCs used, was 0.26 for Bio-Rad vs. 0.22 for QuidelOrtho. Thus, the Bio-Rad method generated approximately 21% greater diagnostic value per reagent RBC than did the QuidelOrtho method (Figure 2). Overall, Bio-Rad detection identified three additional antibodies, had one fewer antibody not ruled out, and required 24 fewer reagent RBCs (4.5% fewer) while achieving a higher overall performance score than QuidelOrtho detection (Table 2).

Table 2. Overall summary of antibody identification performance.

Measure	Bio-Rad	QuidelOrtho	Difference
Antibodies identified	47	44	3
Antibodies not ruled out	18	19	–1
Cells used	510	534	–24
Total score	134	116	18

Conclusion

In this limited study, Bio-Rad CAT panels identified more antibodies and left fewer antibodies not ruled out while requiring fewer reagent RBCs to complete the antibody identification process compared with QuidelOrtho panels. These findings show that Bio-Rad CAT panels provide an efficient approach to RBC antibody identification, potentially improving diagnostic performance while optimizing reagent cell utilization. A limitation of the study is the specific nature of the investigation, and further evaluation using a larger and more diverse sample set would be valuable to confirm these findings across a broader range of antibody identification scenarios.

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