Analytical Performance of Specific-Protein Assays on the Abbott Aeroset System, Ellen B. Duly, George Barnes, Sandra Grimason, and Thomas R. Trinick (Clinical Chemistry Laboratory, Ulster Hospital, Dundonald, BT16 1RH, Northern Ireland; author for correspondence: fax 44-0-2890487131, e-mail ellen.duly@ucht.n-i.nhs.uk)

The Abbott Aeroset is an automated, discrete, random-access clinical chemistry analyzer with a stated throughput of up to 2000 tests per hour and is capable of rate and end-point photometry, turbidimetry, and potentiometry. Abbott has recently developed turbidimetric assays for proteins [IgG, IgA, IgM, transferrin, haptoglobin, prealbumin, apolipoproteins (apo) A1 and B, and complements C3, C4] for the Aeroset system. The purpose of this study was to evaluate the analytical performance of these Abbott Aeroset specific-protein assays and, in particular, their ability to correctly handle antigen excess frequently found in immunoglobulin estimations.

Patient samples that had been sent to the laboratory for routine clinical chemistry investigations were collected and frozen over a 3-month period. The study was approved by the local Medical Ethics Committee. Samples were also obtained from the United Kingdom National External Quality Assessment Scheme and the Welsh External Quality Assessment Scheme. Assays were performed according to the manufacturer’s recommendations on the Abbott Aeroset analyzer. Sample volume requirements were 2.0–6.5 μL with reagent volumes <200 μL. The Beckman Array Nephelometer and specific-protein reagents were used for comparison studies.

Precision was evaluated according to NCCLS protocol EP5-T2 (1) by use of single lots of reagents, calibrators, and controls (normal and high Biorad Immunochemistry controls, LVT1 and LVT2) for the entire study. Within-run imprecision (CV; n = 20) ranged from 0.4% for IgM (mean = 1.17 g/L) to 2.0% for apo A1 (mean, 1.32 g/L). Between-day and total imprecision were measured on two daily analytic runs for 20 days over a 67-day period by use of two control replicates per test (n = 80). The between-day CVs for control samples were <3.0% for all assays with the exception of apo B [LVT2, 6.5% (mean, 0.55 g/L); LVT1, 4.0% (mean, 1.09 g/L)]. The mean total CV across all specific-protein applications was 2.7%. The total CV for 19 of 20 controls was ≤5%, which met the minimum precision criteria on the basis of medical need (2, 3). The exception was apo B (6.9% CV; mean, 0.55 g/L; minimum precision goal of 5.2%). Of the 10 specific-protein applications evaluated, all met the manufacturer’s claims for total SD.

Linearity, evaluated by NCCLS protocol EP6-T (4), showed all assays linear across the ranges of their calibration curves: IgG, 1.25–37.36 g/L; IgA, 0.29–7.23 g/L; IgM, 0.14–3.43 g/L; transferrin, 0.54–5.38 g/L; haptoglobin, 0.11–2.77 g/L; prealbumin, 0.12–0.60 g/L; apo A1, 0.33–3.32 g/L; apo B, 0.26–2.56 g/L; complement C3, 0.14–3.22 g/L; and complement C4, 0.03–0.60 g/L.

Detection limits were determined by measuring 20 replicates of saline and 20 replicates of the lowest concentration calibrator and calculating the mean concentration of saline +2 SD of the lowest concentration calibrator. The limit of detection for assays was 0–0.02 g/L, with the exception of IgG at 0.11 g/L.

A within-run precision profile was constructed for IgA by analysis of 20 replicates of 15 patient samples with concentrations near the expected limit of detection (range, 0.01–0.11 g/L). Imprecision (CV) was then calculated for each patient sample and plotted as a function of observed analyte concentration. A 20% CV was seen at 0.02 g/L and a 10% CV at 0.03 g/L. The quoted lowest reportable concentration for the Beckman array IgA is 0.07 g/L.

Method comparison was performed according to NCCLS protocol EP9-T (5). Patient samples were measured on both the Aeroset and Beckman Array within a 2-h time span. A minimum of 52 serum samples were selected for each assay, with analyte concentrations evenly distributed over the assay range. Results of Bland-Altman analysis (6) are shown in Table 1. Overall, we found the Abbott Aeroset turbidimetric methods were in agreement with the Beckman Array nephelometric methods. The on-board Aeroset assay protocol for IgA and IgM includes an automated dilution step, so that each sample is analyzed undiluted and diluted, and a ratio is calculated. Results outside a user-defined acceptability criterion for the ratio (e.g., outside 0.5–1.5) suggests antigen excess, and patient results are flagged. Flagged samples are subsequently further diluted (1:10) manually with saline and reassayed. All antigen-excess samples observed for IgA and IgM were appropriately detected by the analyzer. The quoted upper limit for IgG before antigen excess is reached is 95 g/L. The highest concentration of IgG in the current study was 81.4 g/L.

Four replicates of each sample obtained from United Kingdom National External Quality Assessment Scheme and Welsh External Quality Assessment Scheme were measured on both the Abbott Aeroset and Beckman Array within a 2-h time span. The mean bias from the overall mean method value for each sample was calculated.
Results for Aeroset were within −13.2% (IgM) to +7.4% (apo B) of overall method mean values and for Beckman Array, −0.65% (apo B) to +23.8% (apo A1). The bias observed in some external quality-assessment samples may have been attributable to matrix effects on stored samples because fresher nonfrozen patient samples showed better agreement between both instruments. A carryover study that was performed according to ECCLS guidelines (7), with the IgG assay as a representative specific protein, showed carryover <0.1% for a specimen containing 63.8 g/L IgG.

The effect of endogenous interference by either hemolysis or lipemia was evaluated according to NCCLS protocol EP7-P (8) on haptoglobin and apo B. Negligible interference (<10%) occurred on both assays with triglyceride (20% Intralipid) concentrations up to 10 g/L. Increasing the concentration of hemoglobin up to 10 g/L produced <10% interference on apo B. At a haptoglobin concentration of 0.96 g/L, the Abbott Aeroset haptoglobin showed less interference (−20%) at a concentration of 2.5 g/L hemoglobin than the Beckman Array, which showed interference (−40%), an effect that has been demonstrated previously on the Beckman Array (9).

In conclusion, the precision of 9 of the 10 Abbott Aeroset specific-protein methods studied in this evaluation met goals based on medical needs, and results were comparable to established methods on the Beckman Array. Consolidation of these specific-protein assays on a single chemistry analyzer can improve laboratory efficiency through decreased analyzer maintenance and decreased sample splitting. The small sample size required for these assays facilitates testing of pediatric samples.

<table>
<thead>
<tr>
<th>Assay</th>
<th>n</th>
<th>Mean range, g/L</th>
<th>Bias, g/L (SD)</th>
<th>Lower 95% limit of agreement (SD)</th>
<th>Upper 95% limit of agreement (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IgG</td>
<td>54</td>
<td>1.22–78.29</td>
<td>0.85 (0.37)</td>
<td>−4.36 (0.61)</td>
<td>6.07 (0.61)</td>
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<td>IgA</td>
<td>52</td>
<td>0.05–45.4</td>
<td>−0.23 (0.29)</td>
<td>−4.32 (0.49)</td>
<td>3.87 (0.49)</td>
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<td>IgM</td>
<td>90</td>
<td>0.05–54.04</td>
<td>−1.86 (0.34)</td>
<td>−8.27 (0.58)</td>
<td>4.56 (0.58)</td>
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<tr>
<td>Transferrin</td>
<td>60</td>
<td>0.82–3.65</td>
<td>−0.11 (0.01)</td>
<td>−0.27 (0.02)</td>
<td>0.05 (0.02)</td>
</tr>
<tr>
<td>Haptoglobin</td>
<td>60</td>
<td>0.04–3.67</td>
<td>0.01 (0.02)</td>
<td>−0.25 (0.03)</td>
<td>0.26 (0.03)</td>
</tr>
<tr>
<td>Prealbumin</td>
<td>60</td>
<td>0.10–0.55</td>
<td>−0.01 (0)</td>
<td>−0.03 (0)</td>
<td>0.01 (0)</td>
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<tr>
<td>Apo A1</td>
<td>60</td>
<td>0.59–2.08</td>
<td>0.03 (0)</td>
<td>−0.03 (0)</td>
<td>0.08 (0)</td>
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<tr>
<td>Apo B</td>
<td>60</td>
<td>0.38–2.88</td>
<td>−0.04 (0)</td>
<td>−0.10 (0.01)</td>
<td>0.03 (0.01)</td>
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<tr>
<td>C3</td>
<td>60</td>
<td>0.72–1.93</td>
<td>−0.01 (0)</td>
<td>−0.07 (0.01)</td>
<td>0.05 (0.01)</td>
</tr>
<tr>
<td>C4</td>
<td>60</td>
<td>0.14–0.44</td>
<td>0 (0)</td>
<td>−0.04 (0)</td>
<td>0.03 (0)</td>
</tr>
</tbody>
</table>

Table 1. Bland-Altman analysis of method differences with mean of methods.

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References

Lead Poisoning: A New Biochemical Perspective on the Differentiation Between Acquired and Hereditary Neuroporphyria, Riikko Mamet,1 Mario Sztern,2 Avinoam Rachtel,3 Bracha Stahl,4 Daniel Flusser,3 and Nili Schoenfeld4,5∗

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Hereditary neuroporphyrias [aminolevulinate dehydratase deficiency porphyria, acute intermittent porphyria, hereditary coproporphyria, or variegate porphyria (VP)], and lead poisoning (LP), which is thought to be an acquired form of neuroporphyria, are characterized by enzymatic inhibitions along the heme biosynthetic pathway (1–3). As a result, they share a few biochemical and clinical features. For this reason, LP may erroneously be diagnosed as hereditary porphyria, especially in cases when LP arises from unexpected sources such as consumption of Chinese herbal tea (4) and others (5, 6). Because LP is not suspected, direct determination of blood lead is not analyzed and LP is misdiagnosed. This work addresses the problem from a biochemical rather than a clinical standpoint, aiming at defining biochemical criteria that can differentiate LP from acute neuroporphyria and