Medica EasyRA Chemistry Analyzer Performance for Two Typical Chemistry Tests

Topic: Automation/computer/applications

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Description of the EasyRA Chemistry Analyzer:

A new random access chemistry analyzer, the Medica EasyRA™, which has a maximum throughput of 150 tests/hr. was evaluated for representative photometric chemistry performance. The analyzer utilizes RFID technology to manage the utilization and protocols for up to 24 on-board reagents. The analyzer uses absorbance photometry for the chemistry tests. It also contains 4 Medica ISE sensors that can perform Na, K, Cl, and Li analyses along with chemistry analyses on any sample. Chemistry reagents are packaged in liquid form in single or dual reagent wedges.

Principle of the Glucose Method:

The enzymatic endpoint reaction, based on the early work of Trinder and the later method of Burrin is as follows:

$$\text{Glucose} + O_2 \xrightarrow{\text{Glucose oxidase}} \text{Gluconic Acid} + 2H_20_2$$

$$2H_20_2 + \text{4-aminoantipyrine} + \text{phenol} \xrightarrow{\text{Peroxidase}} \text{quinoneimine dye} + 4\ H_20$$

The quinoneimine dye component is measured spectrophotometrically at an absorbance peak of 520 nm. The rate of the formation of the dye is directly proportional to the glucose in the sample.

Principle of the Urea-N (BUN) Method:

Based on the Talke and Schubert method:
In these two coupled enzymatic reactions, Urea is first hydrolyzed by urease to give ammonia and carbon dioxide (I):

$$\text{Urea} + H_2O \xrightarrow{\text{Urease}} 2NH_3 + CO_2$$

The ammonia produced in the first reaction reacts with 2-oxoglutarate and stabilized NADH analog3 in the presence of glutamate dehydrogenase (GLDH) to form glutamate and NAD (II).

$$NH_3 + \text{2-oxoglutarate} + \xrightarrow{\text{GLDH}} \text{L-glutamate} + \text{NAD}$$

The decrease in the concentration of the reduced cofactor (NADH), monitored at 340 nm is proportional to the concentration of the urea in the sample.

Description of Reagent Packaging:

Reagents are ready-to-use as supplied in reagent wedges. Each reagent wedge has a RFID tag affixed to it that contains all the instructions needed for performing the test: protocol, reagent lot number, expiration date, on-board stability, calibration frequency, and blank frequency.

MATERIALS:
Medica GLU-T Reagent Wedge, Cat. No. 10201
Medica BUN Reagent Wedge, Cat. No. 10202
Medica Easy Cal (chemistry), Cat. No. 10651
Medica EasyQC Chemistry, 2 levels, Cat. No. 10791,2
Medica Precision Test Dye, Cat. No. 10764
Medica Cleaner Kit, Cat. No. 10760
Medica Diluent Additive (Brij 35), Cat. No. 10650
Linearity Material: Verichem 9500

Performance Characteristics:
Performance characteristics for precision, linearity and accuracy (method comparison) are presented for two typical chemistry tests, Glucose (Trinder) and BUN, using serum samples.

ACCURACY/METHOD COMPARISON (NCCLS, EP9-A2):

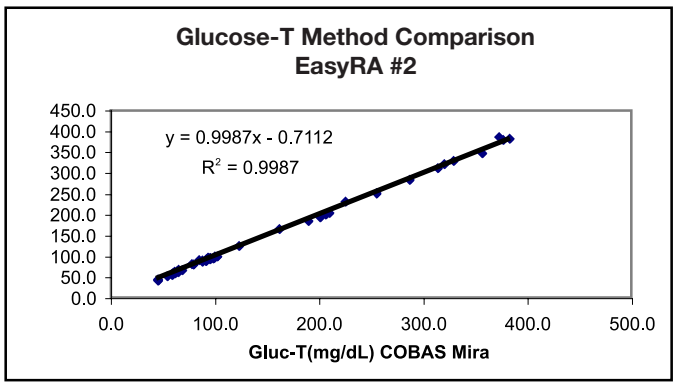
GLU-T:
The following table lists the data obtained in a comparison of the Medica Glucose Trinder reagent on the Medica EasyRA Chemistry Analyzer (y) to the performance of a similar Glucose reagent (x) on the Roche COBAS MIRA Analyzer. Values ranged from 45 to 377 mg/dL. The data shown below are the results for single results obtained on two Medica EasyRA Chemistry Analyzers vs. the average of 2 replicate values obtained on the Roche COBAS MIRA Analyzer.

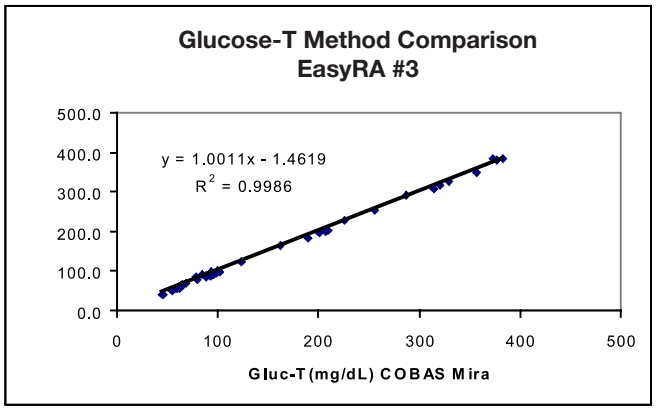
EasyRA #2:

Number of Samples	45
Slope	0.9987
Y Intercept	-0.71
Correlation Coefficient	0.9987

EasyRA #3:

Number of Samples	45
Slope	1.00
Y Intercept	-1.46
Correlation Coefficient	0.9986





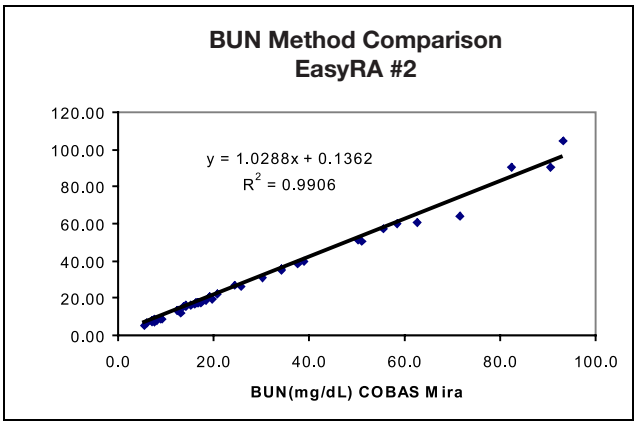
BUN:
The following table lists the data obtained in a comparison of the Medica UREA-N (BUN) reagent on the Medica EasyRA Chemistry Analyzer (y) to the performance of the Roche BUN reagent (x) on the Roche COBAS MIRA Analyzer. Values ranged from 7.1 to 62.6 mg/dL. The data shown below are the results for single results obtained on two Medica EasyRA Chemistry Analyzers vs. the average of 2 replicate values obtained on the Roche COBAS MIRA Analyzer.

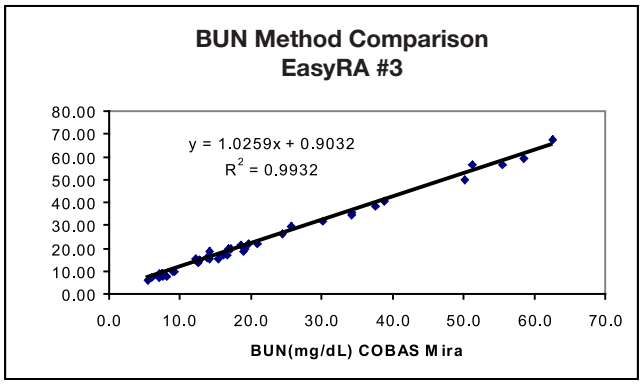
EasyRA #2:

Number of Samples	45
Slope	1.0288
Y Intercept	0.14
Correlation Coefficient	0.9906

EasyRA #3:

Number of Samples	41
Slope	1.0259
Y Intercept	0.90
Correlation Coefficient	0.9932





IMPRECISION (NCCLS, EP5-A2)

GLU-T
Within run imprecision: Five replicates of each of two levels of commercial human serum-based QC material were tested 5 replicates per day over 5 days.
CVs ranged from 0.59% to 1.06% over the 4 days.

QC Level	Within Run SD	Within Run CV
mg/dL	mg/dL	%
272	1.94	0.71%
109	0.87	0.79%
60 1.00	1.69	

GLU-T
Total Imprecision: Duplicate measurements of each of three levels of QC material were tested twice a day for 20 days.

QC Level	Total Imprecision SD	Total Imprecision CV
mg/dL	mg/dL	%
263.93	4.39	1.66%
105.86	1.62	1.53%
60.43	1.30	2.16

BUN
Within run imprecision: Five replicates of each of two levels of commercial human serum-based QC material were tested 5 replicates per day over 5 days.

QC Level	Av. Within Run SD	Within Run CV
mg/dL	mg/dL	%
21.59	0.34	1.59%
55.99	0.40	0.71%

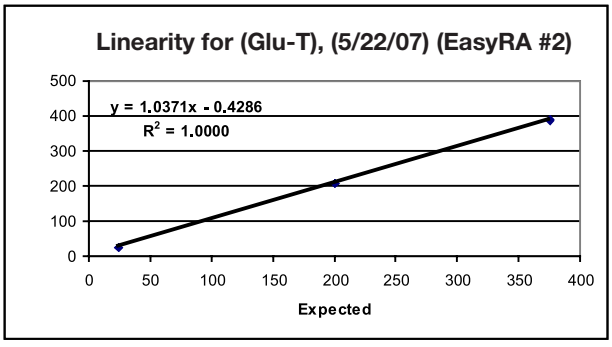
BUN
Total Imprecision: Duplicate measurements of each of two levels of QC material were tested twice a day for 20 days.

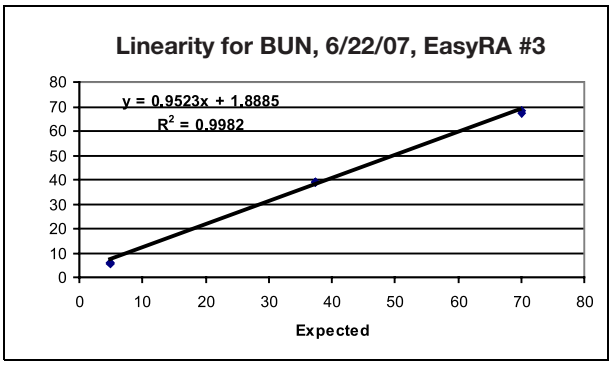
QC Level	Total Imprecision SD	Total Imprecision CV
mg/dL	mg/dL	%
21.3	0.40	1.86
55.0	0.67	1.21

LINEARITY (NCCLS, EP6-A)

GLU-T:
When performed as directed, the assay is linear from 20 to 400 mg/dL before automatic on-board dilution. Use of on-board dilution (using half the sample volume) effectively extends the linear range to 800 mg/dL.

BUN:
When performed as directed, the assay is linear from 2 to 70 mg/dL before automatic on-board dilution. Use of on-board dilution (using half the sample volume) effectively extends the linear range to 140 mg/dL.





INTERFERING SUBSTANCE DATA (NCCLS, EP7-A)

GLU-T:
Criteria for significant interference for bilirubin, lipemia and hemoglobin were >5% variance from control values.
No significant interference was found with levels up to 300 mg/dL of Hemoglobin.
No significant interference was found with levels up to 5 mg/dL of Bilirubin in a sample with a value of 72 mg/dL.
No significant interference was found with levels up to 5 mg/dL of Ascorbic Acid in a sample with a value of 112 mg/dL. Ascorbic Acid above 5 mg/dL produces a negative bias in glucose levels.
There is a significant interference to lipemia (Intralipid) at 200 mg/dL in sample with a value of 72 mg/dL. Intralipid produces a positive bias in glucose values.
Young gives a list of drugs and other substances that interfere with clinical laboratory tests.

BUN:
Ammonia will seriously and adversely affect assay results.
Criteria for significant interference for bilirubin, lipemia and hemoglobin were >5% variance from control values.
Less than 5% interference was found in levels of up to 300 mg/dL of hemoglobin in a urea-N sample with a value of 16.2 mg/dL.
Less than 5% interference was found in levels up to 20 mg/dL of bilirubin (unconjugated), in a sample with a urea-N value of 16.0 mg/dL.
Less than 5% interference was found at levels of up to 1174 mg/dL of Intralipid* (0-3000 mg/dL Triglycerides) in a sample with a urea-N value of 22.5 mg/dL.

SENSITIVITY/ LIMIT OF DETECTION:

BUN:
The analytical sensitivity of BUN is 0.3 mg/dL.
The functional sensitivity (CV% < 20%) is 1.5 mg/dL.

GLU-T:
The analytical sensitivity of GLU-T is 0.5 mg/dL
The functional sensitivity (CV% < 20%) is 1.9 mg/dL

SAMPLE CARRYOVER (NCCLS EP10-A2):
Sample carryover was determined by testing the proscribed sequence of samples Mid, High, Low, Mid, Mid, Low, Low, High, High, Mid. The High sample was a spiked serum sample near the upper end of the linear range. The Low sample was a serum sample diluted in saline to approximately at the level of functional sensitivity. The Mid sample was prepared by mixing equal volumes of the High and Low Samples.

There was no significant sample carryover of a High sample into a Low sample, or a Low sample into a High sample for either BUN or GLU-T.

REAGENT CARRYOVER:
There was no evidence of any reagent carryover problems between either GLU-T or BUN with any of the other 23 tests on the initial release menu. Testing the entire matrix of each reagent with every other reagent is in our plans.

Conclusion:
The EasyRA chemistry analyzer is an accurate and precise instrument for the analysis of chemistry analytes such as Glucose and BUN.
NOTE: The EasyRA analyzer is under FDA review and a 510K clearance is pending.