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Evaluation of COBAS c111 and COBAS INTEGRA 800 automated analyzers

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Objective : *To evaluate the analytical performance of a small automated analyzer, COBAS c111, in comparison with a single platform analyzer, COBAS INTEGRA 800, from Roche Diagnostics.*

Methods : *To compare usual biochemistry parameters from both analyzers: substrates (glucose, HbA_{1C}, BUN, creatinine, uric acid, cholesterol, triglyceride, HDL-cholesterol, LDL-cholesterol), electrolytes (sodium, potassium, chloride, bicarbonate), enzymes (AST, ALT, ALP, CK, CK-MB and γ-GT), total proteins, albumin. The inter-, intra-variable precisions and comparison analyzers were analyzed.*

Results : *In inter-, intra-variable precisions study, coefficient of variation (CV,%) of all parameters for precinorm (normal) and precipath (abnormal) control sera were lower than limits suggested by the CLIA'88 performance rules. The comparative study indicated good correlation with COBAS c111 and COBAS INTEGRA 800 and correlation coefficients (r) were above 0.961.*

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Conclusion : *Both analyzers showed satisfactory precision and accuracy and good correlation with each other. They are suitable for routine use in laboratories of different sizes. COBAS c111 is fit to laboratories of small size while COBAS INTEGRA 800 is suitable for medium to laboratories of large size.*

Keywords : *Automated analyzers, COBAS c111, COBAS INTEGRA 800.*

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วัตถุประสงค์ : *ศึกษาเปรียบเทียบผลการตรวจวิเคราะห์ระหว่างเครื่องอัตโนมัติขนาดเล็ก COBAS c111 และเครื่องอัตโนมัติเบ็ดเสร็จขนาดใหญ่ COBAS INTEGRA 800 เพื่อประเมินถึงความสอดคล้องของผลการตรวจระหว่างห้องปฏิบัติการ*

วิธีการ : *ทำการเปรียบเทียบค่าวิเคราะห์ทางชีวเคมี ได้แก่ กลูโคส ,HbA_{1C}, BUN, creatinine, กรดยูริค, cholesterol, triglyceride, HDL-cholesterol, LDL-cholesterol), ค่าเกลือแร่ (โซเดียม,โพแทสเซียม,คลอไรด์,ไบคาร์บอเนต), เอนไซม์ (AST, ALT, ALP, CK, CK-MB และ γ-GT), ค่าโปรตีนรวม และอัลบูมิน โดยนำผลดังกล่าวมาวิเคราะห์ค่าความแปรปรวนทั้งรายวันและระหว่างวัน ตลอดจนความแม่นยำทางสถิติ*

ผลการศึกษา : *ค่าความแปรปรวนรายวัน ค่าความแปรปรวนระหว่างวัน พบว่าค่าสัมประสิทธิความแปรปรวนของทุกค่าชี้วัดสำหรับตัวควบคุมค่าปกติ และค่าผิดปกติ มีค่าต่ำกว่าเกณฑ์ของ CLIA'88 และค่าสัมประสิทธิความสอดคล้องของทุกค่าชี้วัดมีค่าสูงกว่า 0.961*

สรุปผล : *พบความแม่นยำ ความถูกต้อง และความสอดคล้องที่ดีระหว่างเครื่องอัตโนมัติทั้งสองเครื่อง ถึงแม้ว่าการใช้งานในเชิงปฏิบัติจะแตกต่างกัน กล่าวคือเครื่อง COBAS c111 เหมาะกับห้องปฏิบัติการขนาดเล็กและเครื่อง COBAS INTEGRA 800 เหมาะกับห้องปฏิบัติการขนาดใหญ่*

คำสำคัญ : *เครื่องตรวจเคมีคลินิกอัตโนมัติ, COBAS c111, COBAS INTEGRA 800*

At the beginning of the 21st century, large and small clinical laboratories are confronted with medical requirement for faster turnaround times. To meet this challenge, laboratories are increasingly relying on automation. [1]

The COBAS family analyzer from Roche Diagnostics is a new approach to automation for the clinical chemistry laboratory. They allow several analyzers that customize configuration for various laboratory workloads. Cobas c111 is the newest member of the COBAS family analyzers. It is intended to do the automated testing in small laboratories. As for large laboratories, a single analytical platform technology, Cobas Integra 800, offers to reduce the number of workstations and its production costs.[2,3] However, a good analytical performance of the diagnostic automated analyzers is the most important for offering laboratory services to the patients. The aim of this study was to evaluate the performance of Cobas c111 for analyzing biochemistry parameters, comparing the results to those obtained with the same samples using Cobas Integra 800.

Materials and methods

Instruments

Cobas c111 and Cobas Integra 800 (Roche Diagnostics, Penzberg, Germany) analyzers were used for measuring the usual biochemistry parameters: substrates (glucose, HbA_{1C}, BUN, creatinine, uric acid, cholesterol, triglyceride, HDL - cholesterol, LDL-cholesterol), electrolytes (sodium, potassium, chloride, bicarbonate), enzymes (AST, ALT, ALP, CK, CK-MB and γ-GT), total proteins and albumin. The same optics, reagents, cuvettes and calibrators were used in both analyzers.

Intra- and Inter-variability assay

The assays were performed using two commercial controls (Roche Diagnostic Precinorm® (normal) and Precipath® (abnormal) Universal control sera). For intra-variability (within-run) assays, each level of commercial controls was analyzed and assayed 20 times on Cobas c111 and Cobas Integra 800. Furthermore, the same two commercial controls were run every day for 20 consecutive days (total runs: 20) to assess inter-variability (between-run) assay.

Comparison Analyzers

The 40 excess serum samples from service at Department of Laboratory Medicine, King Chulalongkorn Memorial Hospital were collected for analysis by Cobas c111 and Cobas Integra 800 as comparison analyzers. The assays were performed according to their manufacturing procedure.

Statistical Analyses

Coefficients of variation (CVs) were calculated for all parameters using mean and standard deviation using Microsoft Excel. The same software was used for method of comparison by employing the Pearson's correlation coefficients. Mean percent bias was calculated using the following formula: [(Cobas c111-Cobas Integra 800)/ Cobas Integra 800]x100.

Results

Replicate measurements for all biochemistry parameters were performed on the Roche Precinorm® and Precipath® Universal control sera. The intra- (within-run) and inter-variable (between-run) precision (CVs) values for both analyzers are shown

Table 1. Precision of biochemistry parameters as coefficients of variation (%).

Biochemistry parameters		Cobas c111		Cobas Integra 800	
		Precinorm n = 20	Precipath n = 20	Precinorm n = 20	Precipath n = 20
Glucose	Mean (Intra)				
	Intra-variable CV	92.30 mg/dL0.7	254 mg/dL0.5	99.7 mg/dL1.5	247 mg/dL1.4
	Mean (Inter)				
	Inter-variable CV	90.6 mg/dL1.0	252 mg/dL0.5	101 mg/dL0.9	247 mg/dL0.8
HbA_{1c}	Mean (Intra)				
	Intra-variable CV	6.21 %1.96	10.7 %3.06	6.0 %1.9	10.5 %2.0
	Mean (Inter)				
	Inter-variable CV	6.13%0.81	11.2 %0.54	5.9 %1.5	10.5 %1.1
BUN	Mean (Intra)				
	Intra-variable CV	17.75 mg/dL0.9	62.58 mg/dL1.1	18.68 mg/dL1.2	64.91 mg/dL1.1
	Mean (Inter)				
	Inter-variable CV	18.30 mg/dL1.1	65.38 mg/dL0.6	18.91 mg/dL1.0	65.85 mg/dL0.9
Creatinine	Mean (Intra)				
	Intra-variable CV	0.97 mg/dL2.35	3.95 mg/dL0.91	1.10 mg/dL2.1	3.85 mg/dL1.2
	Mean (Inter)				
	Inter-variable CV	0.97 mg/dL2.29	3.95 mg/dL1.16	1.11 mg/dL1.2	3.89 mg/dL0.6
Uric acid	Mean (Intra)				
	Intra-variable CV	4.26 mg/dL0.8	10.9 mg/dL0.9	4.47 mg/dL1.5	11.1 mg/dL1.6
	Mean (Inter)				
	Inter-variable CV	4.17 mg/dL0.3	10.7 mg/dL0.3	4.54 mg/dL0.9	11.1 mg/dL0.7
Cholesterol	Mean (Intra)				
	Intra-variable CV	93.6 mg/dL1.01	189.4 mg/dL1.10	89.3 mg/dL1.6	188 mg/dL1.6
	Mean (Inter)				
	Inter-variable CV	92.8 mg/dL0.45	185.6 mg/dL0.69	88.5 mg/dL1.1	183 mg/dL0.9
Triglyceride	Mean (Intra)				
	Intra-variable CV	120 mg/dL1.58	207 mg/dL1.74	123 mg/dL2.0	206 mg/dL1.6
	Mean (Inter)				
	Inter-variable CV	115 mg/dL0.58	195 mg/dL0.75	125 mg/dL0.9	212 mg/dL0.8
HDL-Cholesterol	Mean (Intra)				
	Intra-variable CV	47.6 mg/dL1.21	27.4 mg/dL1.54	51.8 mg/dL0.9	34.0 mg/dL1.5
	Mean (Inter)				
	Inter-variable CV	46.4 mg/dL0.67	35.6 mg/dL1.03	53.4 mg/dL0.4	34.4 mg/dL1.0
LDL-Cholesterol	Mean (Intra)				
	Intra-variable CV	101 mg/dL1.29	179 mg/dL1.73	102 mg/dL2.7	209 mg/dL2.3
	Mean (Inter)				
	Inter-variable CV	106 mg/dL1.20	192 mg/dL1.38	107 mg/dL0.7	212 mg/dL0.8

Table 1. Precision of biochemistry parameters as coefficients of variation (%). (Continuous)

Biochemistry parameters		Cobas c111		Cobas Integra 800	
		Precinorm n = 20	Precipath n = 20	Precinorm n = 20	Precipath n = 20
Sodium	Mean (Intra)				
	Intra-variable CV	124.3 mmol/L 0.51	145.97 mmol/L 0.52	126 mmol/L 0.65	149 mmol/L 0.46
	Mean (Inter)				
	Inter-variable CV	124.3 mmol/L 0.48	146.43 mmol/L 0.30	126 mmol/L 0.72	149 mmol/L 1.93
Potassium	Mean (Intra)				
	Intra-variable CV	3.41 mmol/L 0.48	6.95 mmol/L 0.65	3.59 mmol/L 1.6	6.5 mmol/L 1.15
	Mean (Inter)				
	Inter-variable CV	3.41 mmol/L 0.47	6.99 mmol/L 0.33	3.57 mmol/L 0.84	6.5 mmol/L 0.62
Chloride	Mean (Intra)				
	Intra-variable CV	87.74 mmol/L 0.53	115.79 mmol/L 0.5 1	85.5 mmol/L 0.97	119 mmol/L 0.7
	Mean (Inter)				
	Inter-variable CV	84.12 mmol/L 0.41	115.40 mmol/L 0.21	84.5 mmol/L 0.81	118 mmol/L 0.94
Bicarbonate	Mean (Intra)				
	Intra-variable CV	18.2 mmol/L 1.41	31.2 mmol/L 0.81	17.6 mmol/L 1.3	30.5 mmol/L 1.4
	Mean (Inter)				
	Inter-variable CV	18.7 mmol/L 0.72	31.6 mmol/L 0.84	16.1 mmol/L 1.0	26.5 mmol/L 0.7
AST	Mean (Intra)				
	Intra-variable CV	47.7 U/L2.9	142 U/L1.2	36.7 U/L1.3	130 U/L0.8
	Mean (Inter)				
	Inter-variable CV	48.3 U/L1.3	139 U/L0.7	36.6 U/L1.3	128 U/L0.8
ALT	Mean (Intra)				
	Intra-variable CV	42.0 U/L1.6	130 U/L0.7	39.3 U/L1.4	120 U/L1.0
	Mean (Inter)				
	Inter-variable CV	41.5 U/L1.5	132 U/L0.4	39.5 U/L0.6	120 U/L0.4
ALP	Mean (Intra)				
	Intra-variable CV	90.0 U/L1.0	229 U/L0.8	92.8 U/L2.4	224 U/L1.7
	Mean (Inter)				
	Inter-variable CV	87.5 U/L0.5	229 U/L0.7	99.2 U/L0.7	241 U/L0.6
CK	Mean (Intra)				
	Intra-variable CV	154 U/L0.8	447 U/L0.63	153.2 U/L0.99	456 U/L0.71
	Mean (Inter)				
	Inter-variable CV	167 U/L0.41	456 U/L0.65	153 U/L0.82	452 U/L1.16
CK-MB	Mean (Intra)				
	Intra-variable CV	39.6 U/L1.48	227 U/L0.7	171 U/L2.0	-
	Mean (Inter)				
	Inter-variable CV	39.2 U/L1.42	226 U/L0.5	179 U/L0.3	-

Table 1. Precision of biochemistry parameters as coefficients of variation (%). (Continuous)

Biochemistry parameters		Cobas c111		Cobas Integra 800	
		Precinorm n = 20	Precipath n = 20	Precinorm n = 20	Precipath n = 20
Total Protein	Mean (Intra)				
	Intra-variable CV	6.25 g/dL2.13	4.63 g/dL1.79	6.79 g/dL2.4	5.07 g/dL1.7
	Mean (Inter)				
	Inter-variable CV	6.34 g/dL1.1	4.7 g/dL1.51	6.96 g/dL1.4	4.88 g/dL1.0
Albumin	Mean (Intra)				
	Intra-variable CV	4.62 g/dL1.87	2.97 g/dL1.45	4.81 g/dL0.83	3.02 g/dL2.32
	Mean (Inter)				
	Inter-variable CV	4.67 g/dL0.52	2.99 g/dL0.76	4.78 g/dL1.15	2.92 g/dL2.11
γ-GT	Mean (Intra)				
	Intra-variable CV	38.3 U/L1.89	194 U/L0.71	40.2 U/L1.47	198 U/L1.54
	Mean (Inter)				
	Inter-variable CV	44.2 U/L1.44	221 U/L0.4	45.3 U/L0.9	226 U/L0.7

in Table 1. Cobas c111 had intra-variable CVs $\leq$ 3.06 % (n = 20, single run) and inter-variable CV $\leq$ 2.29 % (n = 20, run every day for 20 consecutive days). Cobas Integra 800 had intra-variable CVs $\leq$ 2.7 % (n=20) and inter-variable CV $\leq$ 1.4 %. It was observed that the inter-variable CVs is lower than intra-variable CVs. A possible explanation might be the dilutional steps that were involved in sample preparation. Overall, Cobas Integra 800 showed slightly better precision than Cobas c111. This might be rationalized by the fact that Cobas Integra 800 is a single platform analyzer that reduces error by eliminating pre-treatment steps and manual sample handling.

The comparative performance of Cobas c111 with Cobas Integra 800 was assessed on 40 serum samples. Pearson's correlation coefficients and mean percent bias are displayed in Table 2. Cobas c111 showed good correlation (r > 0.961) and mean percent bias (< 6.13) for all biochemistry parameters with Cobas Integra 800.

Discussion

Workload in diagnostic tests for clinical chemistry allows a variety of automated analyzers. However, to enable laboratories to offer their suitable services, a good analyzer model must be cost-effective as well as precise.

In this study, the analytical performance of Cobas c111 (bench) analyzers was found to be comparable with that of Cobas Integra 800. The inter-variable and intra-variable precisions and mean percent bias for all biochemistry parameters from both analyzers were less than 3.06 % and 6.13%, respectively. Based on the CLIA'88 performance rules, both analyzers have high precision and acceptable accuracy level in this study.[4] Moreover, a high correlation (r > 0.961) between Cobas c111 and Cobas Integra 800 obviously demonstrated the compatibility and interchangeability of both analyzers.

Table 2. Correlation coefficients and mean percent bias for all biochemistry parameters obtained by both analyzers (n = 40).

Biochemistry parameters	Correlation	Mean percent bias
Glucose	0.999	2.11
HbA_{1C}	0.992	2.73
BUN	0.999	3.46
Creatinine	0.999	3.41
Uric acid	0.996	1.85
Cholesterol	0.995	2.67
Triglyceride	0.999	2.19
HDL-Cholesterol	0.994	2.87
LDL-Cholesterol	0.995	3.77
Sodium	0.961	1.59
Potassium	0.998	1.68
Chloride	0.984	1.20
Bicarbonate	0.987	5.28
AST	0.999	2.63
ALT	0.999	5.64
ALP	0.996	3.69
CK	0.998	1.88
CK-MB	0.999	4.97
Total Protein	0.992	2.12
Albumin	0.998	1.60
γ-GT	0.999	6.13

Efficiency assessment of Cobas c111 and Cobas Integra 800 were also conducted and showed that both analyzers are user friendly and utilize the same optics, reagents, cuvettes and calibrators. Therefore, both analyzers are suitable for routine use in clinical chemistry. However, Cobas Integra 800 has a better throughput; 885 tests per hour compared with c111 of only 80 tests per hour. For this reason, Cobas Integra 800 is suitable for large laboratory whereas Cobas c111 fits in with low to medium laboratory.

In conclusion, both analyzers fulfill the requirements of automated analyzer: acceptable precision and compatibility with each other. However, the important factor when selecting the automated analyzer is the demands for productivity (workload) as well as the cost-effectiveness, user friendliness and turn around time.

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