

REF			SYSTEM
04481798119	04481798500	100	cobas e 411 cobas e 601 cobas e 602

English

System information

For **cobas e 411** analyzer: test number 311

For **cobas e 601** and **cobas e 602** analyzers: Application Code Number 050

Please note

The measured AFP value of a patient's sample can vary depending on the testing procedure used. The laboratory finding must therefore always contain a statement on the AFP assay method used. AFP values determined on patient samples by different testing procedures cannot be directly compared with one another and could be the cause of erroneous medical interpretations. If there is a change in the AFP assay procedure used while monitoring therapy, then the AFP values obtained upon changing over to the new procedure must be confirmed by parallel measurements with both methods.

Intended use

Immunoassay for the in vitro quantitative determination of α_1 -fetoprotein in human serum and plasma.

This assay is intended for the use as:

- An aid in the diagnosis of hepatocellular carcinoma (HCC).
- An aid in the management of patients with non-seminomatous germ cell tumors.
- One component in combination with other parameters to evaluate the risk of trisomy 21 (Down syndrome). Further testing is required for diagnosis of chromosomal aberrations.

The electrochemiluminescence immunoassay "ECLIA" is intended for use on Elecsys and **cobas e** immunoassay analyzers.

Note: Please note that the catalogue number appearing on the package insert retains only the first 8 digits of the licensed 11-digit Catalogue Number: 04481798190 for the Elecsys AFP. The last 3 digits -190 have been replaced by -119 for logistic purpose.

Summary

Alpha1-fetoprotein (AFP), an albumin-like glycoprotein with a molecular weight of approximately 70 kDa, is formed in the yolk sac during fetal life, in non-differentiated liver cells, and the fetal gastro-intestinal tract.^{1,2}

Tumors that synthesize AFP are mainly testicular non-seminomatous germ cell tumors (NSGCT), yolk sac tumors of the ovary and hepatocellular carcinoma (HCC). Moreover AFP is an important part in the risk assessment for trisomy 21 in the second trimester of pregnancy together with hCG+ β and other parameters.³

Testicular cancer

Careful monitoring of the serum tumor markers AFP and human chorionic gonadotropin (hCG) is essential in the management of patients with germ cell tumors (GCT), as these markers are important for diagnosis, as prognostic indicators, in monitoring treatment response, and in the detection of early relapse.⁴ In addition, hCG and AFP are important parameters for estimating the survival rate of patients with advanced NSGCTs and are also recommended by the National Academy of Clinical Biochemistry for the management of such patients.⁵

Hepatocellular carcinoma

Hepatocellular carcinoma (HCC) is frequently the result of advanced liver disease and can develop in patients with and without cirrhosis.⁶ AFP has long been recognized as a biomarker for HCC, and has played a prominent role in the diagnosis of HCC. Substantially elevated AFP values can indicate primary liver cell carcinoma and it has been shown that AFP levels increase with tumor size.⁷ Diagnosis of HCC has primarily relied on the presence of typical features seen on contrast-enhanced imaging studies, histopathological assessment, and serum AFP levels.⁸ While AFP is elevated during hepato-carcinogenesis, it can also be found in other tumors such as testicular, embryonic or gastric cancer.^{9,10} AFP has reported sensitivities ranging from 39 to 65 %, and specificities from 76 to 94 % in HCC patients.¹¹ The divergence in sensitivity and specificity of AFP in these studies is probably due to a variety of factors including different etiologies, variable study designs, and different cutoff values. As the AFP values can

also rise during regeneration of the liver, moderately elevated values are found in alcohol-mediated liver cirrhosis and acute viral hepatitis.¹² Surveillance of patients at risk for developing HCC by abdominal ultrasonography in combination with AFP is recommended by several clinical practice guidelines.^{13,14,15}

Trisomy 21

Measurement of AFP makes a contribution to the risk assessment for trisomy 21 (Down syndrome) in the second trimester of pregnancy together with hCG+ β and other parameters, such as exact gestational age and maternal weight.³ In a trisomy 21 affected pregnancy the maternal serum concentration of AFP is decreased whereas the maternal serum hCG+ β concentration is approximately twice the normal median.¹⁶ The risk for a trisomy 21 affected pregnancy in the second trimester can be calculated by a suitable software (see "Materials required, but not provided" section) using the algorithm as described by Cuckle et al.¹⁷ and the respective assay specific parameters.^{18,19,20,21,22}

Test principle

Sandwich principle. Total duration of assay: 18 minutes.

- 1st incubation: 10 μ L of sample, a biotinylated monoclonal AFP-specific antibody, and a monoclonal AFP-specific antibody labeled with a ruthenium complex^{a)} react to form a sandwich complex.
- 2nd incubation: After addition of streptavidin-coated microparticles, the complex becomes bound to the solid phase via interaction of biotin and streptavidin.
- The reaction mixture is aspirated into the measuring cell where the microparticles are magnetically captured onto the surface of the electrode. Unbound substances are then removed with ProCell/ProCell M. Application of a voltage to the electrode then induces chemiluminescent emission which is measured by a photomultiplier.
- Results are determined via a calibration curve which is instrument-specifically generated by 2-point calibration and a master curve provided via the reagent barcode or e-barcode.

a) Tris(2,2'-bipyridyl)ruthenium(II)-complex (Ru(bpy)₃²⁺)

Reagents - working solutions

The reagent rackpack is labeled as AFP.

- M Streptavidin-coated microparticles (transparent cap), 1 bottle, 6.5 mL:
Streptavidin-coated microparticles 0.72 mg/mL; preservative.
- R1 Anti-AFP-Ab~biotin (gray cap), 1 bottle, 10 mL:
Biotinylated monoclonal anti-AFP antibodies (mouse) 4.5 mg/L;
phosphate buffer 100 mmol/L, pH 6.0; preservative.
- R2 Anti-AFP-Ab~Ru(bpy)₃²⁺ (black cap), 1 bottle, 10 mL:
Monoclonal anti-AFP antibodies (mouse) labeled with ruthenium complex 12.0 mg/L; phosphate buffer 100 mmol/L, pH 6.0; preservative.

Precautions and warnings

For in vitro diagnostic use.

Exercise the normal precautions required for handling all laboratory reagents.

Disposal of all waste material should be in accordance with local guidelines. Safety data sheet available for professional user on request.

This kit contains components classified as follows in accordance with the Regulation (EC) No. 1272/2008:

2-methyl-2H-isothiazol-3-one hydrochloride

EUH 208 May produce an allergic reaction.

Product safety labeling follows EU GHS guidance.

Avoid foam formation in all reagents and sample types (specimens, calibrators and controls).

Reagent handling

The reagents in the kit have been assembled into a ready-for-use unit that cannot be separated.

All information required for correct operation is read in from the respective reagent barcodes.

Storage and stability

Store at 2-8 °C.

Do not freeze.

Store the Elecsys reagent kit **upright** in order to ensure complete availability of the microparticles during automatic mixing prior to use.

Stability:	
unopened at 2-8 °C	up to the stated expiration date
after opening at 2-8 °C	12 weeks
on cobas e 411 and cobas e 601	8 weeks
on cobas e 602	4 weeks

Specimen collection and preparation

Only the specimens listed below were tested and found acceptable.

Serum collected using standard sampling tubes or tubes containing separating gel.

Li-heparin, K₂-EDTA and K₃-EDTA plasma.

Plasma tubes containing separating gel can be used.

Criterion: Slope 0.9-1.1 + intercept within $\pm 2x$ analytical sensitivity (LDL) + coefficient of correlation > 0.95 .

Stable for 5 days at 20-25 °C, 14 days at 2-8 °C, 6 months at -20 °C (± 5 °C). The samples may be frozen 3 times.

The suitability of plasma samples for estimating the risk of trisomy 21 has not been evaluated.

The sample types listed were tested with a selection of sample collection tubes that were commercially available at the time of testing, i.e. not all available tubes of all manufacturers were tested. Sample collection systems from various manufacturers may contain differing materials which could affect the test results in some cases. When processing samples in primary tubes (sample collection systems), follow the instructions of the tube manufacturer.

Centrifuge samples containing precipitates before performing the assay.

Do not use heat-inactivated samples.

Do not use samples and controls stabilized with azide.

Ensure the samples, calibrators and controls are at 20-25 °C prior to measurement.

Due to possible evaporation effects, samples, calibrators and controls on the analyzers should be analyzed/measured within 2 hours.

Materials provided

See "Reagents – working solutions" section for reagents.

Materials required (but not provided)

- REF 04487761190, AFP CalSet II, for 4 x 1.0 mL
- REF 11776452122, PreciControl Tumor Marker, for 4 x 3.0 mL
REF 11731416190, PreciControl Universal, for 4 x 3.0 mL
- REF 11732277122, Diluent Universal, 2 x 16 mL sample diluent or
REF 03183971122, Diluent Universal, 2 x 36 mL sample diluent

General laboratory equipment

cobas e analyzer

For risk calculation of trisomy 21:

- A suitable software, e.g.
REF 05126193, SsdwLab (V5.0 or later), single user licence
REF 05195047, SsdwLab (V5.0 or later), multi user licence
- REF 03271749190, Elecsys HCG+ β , 100 tests
- REF 03302652190, HCG+ β CalSet, for 4 x 1 mL

Additional materials for the **cobas e 411** analyzer:

- REF 11662988122, ProCell, 6 x 380 mL system buffer

- REF 11662970122, CleanCell, 6 x 380 mL measuring cell cleaning solution
- REF 11930346122, Elecsys SysWash, 1 x 500 mL washwater additive
- REF 11933159001, Adapter for SysClean
- REF 11706802001, AssayCup, 60 x 60 reaction cups
- REF 11706799001, AssayTip, 30 x 120 pipette tips
- REF 11800507001, Clean-Liner

Additional materials for **cobas e 601** and **cobas e 602** analyzers:

- REF 04880340190, ProCell M, 2 x 2 L system buffer
- REF 04880293190, CleanCell M, 2 x 2 L measuring cell cleaning solution
- REF 03023141001, PC/CC-Cups, 12 cups to prewarm ProCell M and CleanCell M before use
- REF 03005712190, ProbeWash M, 12 x 70 mL cleaning solution for run finalization and rinsing during reagent change
- REF 12102137001, AssayTip/AssayCup, 48 magazines x 84 reaction cups or pipette tips, waste bags
- REF 03023150001, WasteLiner, waste bags
- REF 03027651001, SysClean Adapter M

Additional materials for all analyzers:

- REF 11298500316, ISE Cleaning Solution/Elecsys SysClean, 5 x 100 mL system cleaning solution

Assay

For optimum performance of the assay follow the directions given in this document for the analyzer concerned. Refer to the appropriate operator's manual for analyzer-specific assay instructions.

Resuspension of the microparticles takes place automatically prior to use. Read in the test-specific parameters via the reagent barcode. If in exceptional cases the barcode cannot be read, enter the 15-digit sequence of numbers.

Bring the cooled reagents to approximately 20 °C and place on the reagent disk (20 °C) of the analyzer. Avoid foam formation. The system automatically regulates the temperature of the reagents and the opening/closing of the bottles.

Calibration

Traceability: This method has been standardized against the 1st IRP WHO Reference Standard 72/225.

Every Elecsys reagent set has a barcoded label containing specific information for calibration of the particular reagent lot. The predefined master curve is adapted to the analyzer using the relevant CalSet.

Calibration frequency: Calibration must be performed once per reagent lot using fresh reagent (i.e. not more than 24 hours since the reagent kit was registered on the analyzer).

Calibration interval may be extended based on acceptable verification of calibration by the laboratory.

Renewed calibration is recommended as follows:

- after 1 month (28 days) when using the same reagent lot
- after 7 days (when using the same reagent kit on the analyzer)
- as required: e.g. quality control findings outside the defined limits

Quality control

For quality control, use PreciControl Tumor Marker or PreciControl Universal.

In addition, other suitable control material can be used.

Controls for the various concentration ranges should be run individually at least once every 24 hours when the test is in use, once per reagent kit, and following each calibration.

The control intervals and limits should be adapted to each laboratory's individual requirements. Values obtained should fall within the defined limits. Each laboratory should establish corrective measures to be taken if values fall outside the defined limits.

If necessary, repeat the measurement of the samples concerned.

Follow the applicable government regulations and local guidelines for quality control.

Calculation

The analyzer automatically calculates the analyte concentration of each sample either in IU/mL, ng/mL, kIU/L or additionally in IU/L with **cobas e 601** and **cobas e 602** analyzers.

Conversion factors: IU/mL x 1.21 = ng/mL
ng/mL x 0.83 = IU/mL

Limitations - interference

The assay is unaffected by icterus (bilirubin < 1112 µmol/L or < 65 mg/dL), hemolysis (Hb < 1.4 mmol/L or < 2.2 g/dL), lipemia (Intralipid < 1500 mg/dL) and biotin (< 738 nmol/L or < 180 ng/mL).

Criterion: Recovery within ± 10 % of initial value.

Samples should not be taken from patients receiving therapy with high biotin doses (i.e. > 5 mg/day) until at least 8 hours following the last biotin administration.

No interference was observed from rheumatoid factors up to a concentration of 1500 IU/mL.

There is no high-dose hook effect at AFP concentrations up to 1 million IU/mL (1.21 million ng/mL).

In vitro tests were performed on 26 commonly used pharmaceuticals. No interference with the assay was found.

In rare cases, interference due to extremely high titers of antibodies to analyte-specific antibodies, streptavidin or ruthenium can occur. These effects are minimized by suitable test design.

AFP values can also rise during regeneration of the liver, moderately elevated values are found in alcohol-mediated liver cirrhosis and acute viral hepatitis.¹² In addition, false positive AFP measurements may result from pregnancy, active liver disease, embryonic tumor and certain gastrointestinal tumors.^{9, 10, 25}

For diagnostic purposes, the results should always be assessed in conjunction with the patient's medical history, clinical examination and other findings.

Limits and ranges

Measuring range

0.500-1000 IU/mL or 0.605-1210 ng/mL (defined by the lower detection limit and the maximum of the master curve). Values below the detection limit are reported as < 0.500 IU/mL or < 0.605 ng/mL. Values above the measuring range are reported as > 1000 IU/mL or > 1210 ng/mL (or up to 50000 IU/mL or 60500 ng/mL for 50-fold diluted samples).

Lower limits of measurement

Lower detection limit of the test

Lower detection limit: 0.50 IU/mL (0.61 ng/mL)

The Lower Detection Limit represents the lowest measurable analyte level that can be distinguished from zero. It is calculated as the value lying two standard deviations above that of the lowest standard (master calibrator, standard 1 + 2 SD, repeatability study, n = 21).

Dilution

Samples with AFP concentrations above the measuring range can be diluted with Diluent Universal. The recommended dilution is 1:50 (either automatically by the analyzers or manually). The concentration of the diluted sample must be > 20 IU/mL (> 24 ng/mL).

After manual dilution, multiply the result by the dilution factor.

After dilution by the analyzers, the software automatically takes the dilution into account when calculating the sample concentration.

Expected values

Results of following studies using the Elecsys AFP assay see below:

a) Multicenter study "Elecsys 2010 analyzer" status September 1997 and reference range study in Germany and France, data evaluated in September 1998.

Following AFP values were found in serum samples from 646 healthy test subjects:

≤ 5.8 IU/mL or ≤ 7.0 ng/mL for 95 % of the results.

AFP median values for completed weeks of pregnancy (defined as completed weeks of pregnancy beginning with the start of the last menstruation phase):

Weeks	14	15	16	17	18	19
N	382	1782	2386	975	353	146

Weeks	14	15	16	17	18	19
IU/mL	23.2	25.6	30.0	33.5	40.1	45.5
ng/mL	27.9	30.9	36.1	40.4	48.3	54.8

b) Multicenter study to determine reference values for evaluating the risk of trisomy 21 in maternal serum (study No. BO1P019, status March 2003).

Values from serum samples of 1753 pregnant women in total (relevant gestational weeks 14 to 18) were evaluated.

Measurements with the Elecsys HCG+β assay and the Elecsys AFP assay were conducted in 5 clinical centers in Belgium, France, and Germany.

The gestational age in days determined by ultrasound was given for each sample. From a log-linear regression analysis of all 1753 AFP values versus gestational age the following median values were calculated for the middle of the respective weeks (e.g. week 14 + 3 days):

Weeks	14	15	16	17	18
IU/mL	20.9	24.0	27.6	31.7	36.4
ng/mL	25.3	29.0	33.3	38.3	44.0

Note: For prenatal testing it is recommended that the median values be re-evaluated periodically (1 to 3 years) and whenever methodology changes.

The transferability of the reference values to plasma samples has not been verified.

Each laboratory should investigate the transferability of the expected values to its own patient population and if necessary determine its own reference ranges.

Elecsys AFP as an aid in the diagnosis of HCC

A prospective multicenter study (Roche study No. RD002542 and RD002543) to evaluate the clinical performance of Elecsys AFP as an aid in the diagnosis of HCC included 376 patients with liver disease, of which 168 had HCC and 208 had liver disease but no diagnosis of HCC (control).

	Median age	Gender (% male)	Race				
			Asian (%)	Caucasian (%)	Black (%)	Other (%)	Missing (%)
Control	53	60.6	47.6	48.6	1.4	0	2.4
HCC	64	83.9	42.3	56.5	0	0.6	0.6

a) Range of AFP concentration in HCC cases compared to controls

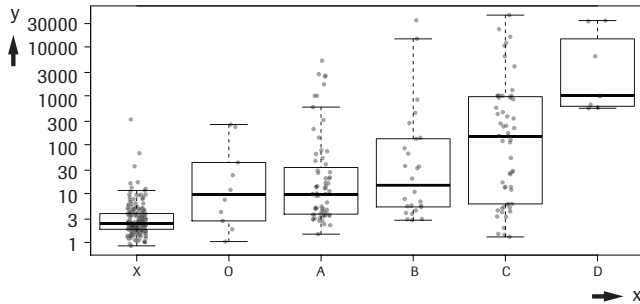
The following table and graph show the range of AFP concentration in samples from HCC patients staged according to Barcelona clinic liver cancer classification (BCLC)²³ compared to controls. For the 168 patients with a diagnosis of HCC, the AFP concentration increased with disease progression, especially in late stage disease. All concentrations in the table are in IU/mL and (ng/mL), while concentrations in the graph are in IU/mL. The thick line in the box plots represents the median value.

Disease stage	N	Min/Max	Mean ± SD	Median	25 th -75 th perc. ^{b)}
Control ^{c)}	208	0.85/327.84 (1.03/396.69)	5.33±23.15 (6.45 ±28.01)	2.42 (2.92)	1.86-3.89 (2.25-4.71)
Early (Stage 0 + A)	77	1.04/5224 (1.26/6322)	252±799 (305 ±966)	9.7 (11.7)	3.72-39.6 (4.5-47.9)
BCLC Stage 0	10	1.04/258 (1.26/312)	58.4±98.9 (70.7±120)	9.67 (11.7)	-
BCLC Stage A	67	1.48/5224 (1.79/6322)	281±852 (340 ±1031)	9.7 (11.7)	3.72-39.6 (4.5-47.9)
Late (Stages B, C and D)	91	1.3/44687 (1.57/54071)	2874±8259 (3478 ±9994)	119 (144)	5.95-909 (7.2-1100)
BCLC Stage B	26	2.85/34944 (3.45/42282)	1989±7301 (2407±8834)	15.5 (18.8)	5.33-132 (6.45-160)
BCLC Stage C	57	1.3/44687 (1.57/54071)	2313±7079 (2798 ±8566)	150 (182)	6.14-959 (7.43-1160)

Disease stage	N	Min/Max (674/41782)	Mean ± SD (9751±15043 (11799 ±18201)	Median (1209)	25 th -75 th perc. b)
BCLC Stage D	8				-

b) not calculated if sample size is 20 or below

c) In the graphical representation below, this group is designated with an "X"



x ----> X: Control; O: Stage 0; A: Stage A; B: Stage B; C: Stage C; D: Stage D

y ----> AFP (IU/mL)

b) AFP concentration and disease etiology

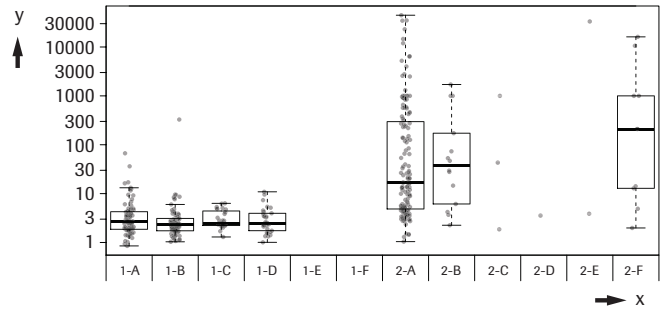
The AFP concentration as function of etiology for the two patient groups (Control, 1-A to 1-F and HCC, 2-A to 2-F) is shown in the following table and graph. All concentrations in the table are in IU/mL and (ng/mL), while concentrations in the graph are in IU/mL. The thick line in the box plots represents the median value.

Label	Etiology ^{d)}	N	Min/Max	Mean ±SD	Median	25 th -75 th perc.
1-A	Cirrhosis	79	0.851/66.9 (1.03/80.9)	4.92±8.59 (5.95±10.4)	2.63 (3.19)	1.85-4.34 (2.24-5.25)
1-B	Hepatitis B	72	1.03/328 (1.25/397)	7.4±38.3 (8.95±46.4)	2.31 (2.79)	1.73-3.11 (2.1-3.76)
1-C	Hepatitis C	27	1.3/6.33 (1.57/7.66)	3.23±1.43 (3.9±1.73)	2.49 (3.01)	2.21-4.73 (2.67-5.73)
1-D	NASH ^{e)}	30	1.01/10.9 (1.22/13.2)	3.36±2.36 (4.06±2.86)	2.48 (3.00)	1.74-3.96 (2.11-4.79)
1-E	ALD ^{f)}	0	-	-	-	-
1-F	Others	0	-	-	-	-
2-A	Cirrhosis	139	1.04/44687 (1.26/54071)	1536±6096 (1859±7377)	16.6 (20.1)	4.82-320 (5.84-387)
2-B	Hepatitis B	14	2.25/1711 (2.73/2070)	296±536 (358±649)	38.2 (46.2)	-
2-C	Hepatitis C	3	1.86/999 (2.25/1209)	348±564 (421±683)	43.1 (52.1)	-
2-D	NASH	1	-	3.55 (4.3)	-	-
2-E	ALD	2	3.87/33288 (4.69/40278)	16646±23535 (20141±28478)	16646 (20141)	-
2-F	Others	9	1.98/16115 (2.4/19499)	3216±5924 (3891±7168)	210 (254)	-

d) All etiologies except cirrhosis are non-cirrhotic

e) Non-alcoholic steatohepatitis

f) Alcoholic liver disease



y ----> AFP (IU/mL)

c) Clinical performance of the Elecsys AFP assay in detecting HCC

The sensitivity and specificity of the Elecsys AFP assay in detecting HCC at a cut-off of 165 IU/mL (200 ng/mL) and 16.5 IU/mL (20 ng/mL), and the results of the Receiver Operating Characteristics (ROC) analysis are shown below.

		All HCC	Early Stage HCC ^{g)}	Late Stage HCC ^{h)}
AFP cut-off 200 ng/mL	Sensitivity (95 % CI)	31.5% (24.6%, 39.2%)	15.6% (8.3%, 25.6%)	45.1% (34.6%, 55.8%)
	Specificity (95 % CI)	99.5% (97.4%, 100%)		
AFP cut-off 20 ng/mL	Sensitivity (95 % CI)	51.8% (44%, 59.5%)	36.4% (25.7%, 48.1%)	64.8% (54.1%, 74.6%)
	Specificity (95 % CI)	98.1% (95.1%, 99.5%)		
ROC AUC ⁱ⁾		88% (84.5%, 91.5%)	84.5% (79.3%, 89.7%)	90.9% (86.8%, 95.1%)

g) BCLC stages 0, A

h) BCLC stages B,C,D

i) Area under the Curve

d) AFP values in different types of benign and malignant disorders

The following table and graph show the AFP concentration in IU/mL and (ng/mL) in a panel of samples from patients with either a benign liver disease, an immune disorder, or a malignancy other than HCC (N total 397; median age 54 years, 58 % female, 39 % Asian and 61 % Caucasian).

Label	Etiology	N	Min/Max	Mean ± (SD)	Median	25 th -75 th perc.
A	Benign liver diseases ^{j)}	87	0.843/999 (1.02/1209)	14.3±107 (17.3±129)	2.20 (2.66)	1.73-3.48 (2.10-4.21)
B	Rheumatoid arthritis	38	1.11/11.7 (1.34/14.2)	2.80±1.84 (3.39±2.22)	2.28 (2.75)	1.77-2.99 (2.14-3.62)
C	Crohn's disease	37	0.676/10.0 (0.819/12.1)	3.21±2.40 (3.88±2.90)	2.42 (2.93)	1.63-3.58 (1.97-4.34)
D	Ulcerative colitis	30	1.20/7.27 (1.45/8.80)	2.58±1.35 (3.12±1.63)	2.37 (2.86)	1.63-2.94 (1.97-3.56)
E	Other autoimmune diseases ^{k)}	26	0.909/7.93 (1.10/9.60)	3.16±1.72 (3.83±2.08)	2.62 (3.16)	2.02-3.97 (2.44-4.80)
F	Lung cancer	24	1.01/5.18 (1.22/6.27)	2.50±0.978 (3.02±1.18)	2.40 (2.90)	1.90-3.03 (2.30-3.67)
G	Breast cancer	27	0.859/7.67 (1.04/9.27)	3.06±1.60 (3.70±1.93)	2.59 (3.13)	1.85-4.01 (2.24-4.85)
H	Renal cancer	10	0.58/6.43 (0.702/7.78)	2.73±1.96 (3.30±2.37)	2.21 (2.67)	-
I	Cholangio-carcinoma	27	1.06/83.8 (1.28/101)	7.48±15.9 (9.05±19.3)	3.51 (4.25)	2.15-4.82 (2.60-5.84)

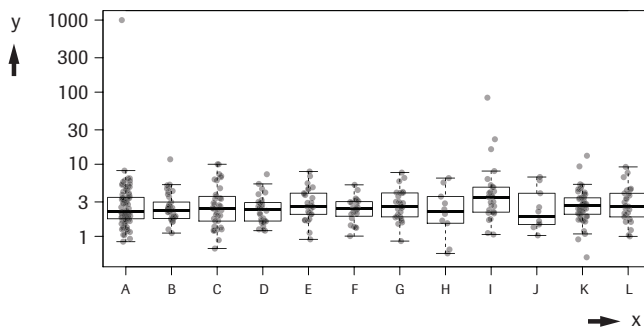
Label	Etiology	N	Min/Max	Mean ± (SD)	Median	25 th -75 th perc.
J	Pancreatic cancer	10	1.03/6.65 (1.25/8.05)	2.83±2.02 (3.43±2.45)	1.92 (2.32)	-
K	Other gastrointestinal cancers ^{l)}	55	0.512/13.1 (0.62/15.9)	3.00±1.95 (3.63 ±2.35)	2.68 (3.24)	2.02-3.43 (2.44-4.15)
L	Gynecological cancers ^{m)}	26	0.999/9.19 (1.21/11.1)	3.24±2.02 (3.92±2.44)	2.62 (3.16)	1.86-3.96 (2.25-4.79)

j) polycystic liver disease, simple cysts, focal nodular hyperplasia, hemangioma, hepatocellular adenoma, non-cirrhotic alcohol liver disease

k) systemic lupus erythematosus, autoimmune thyroiditis

l) colorectal, gastric and esophageal cancer

m) ovarian, endometrial and cervical cancer



y ----> AFP (ng/mL)

Specific performance data

Representative performance data on the analyzers are given below. Results obtained in individual laboratories may differ.

Precision

Precision was determined using Elecsys reagents, pooled human sera and controls in accordance with a modified protocol (EP5-A) of the CLSI (Clinical and Laboratory Standards Institute): 6 times daily for 10 days (n = 60); repeatability on MODULAR ANALYTICS E170 analyzer, n = 21. The following results were obtained:

cobas e 411 analyzer								
Sample	Median		Repeatability			Intermediate precision		
			SD		CV	SD		CV
	IU/mL	ng/mL	IU/mL	ng/mL	%	IU/mL	ng/mL	%
HS ⁿ⁾ 1	12.8	15.5	0.26	0.31	2.0	0.39	0.47	3.1
HS 2	42.6	51.5	0.63	0.76	1.5	1.02	1.24	2.4
HS 3	566	685	11.2	13.5	2.0	15.6	18.9	2.8
PC TM ^{o)} 1	8.01	9.69	0.22	0.27	2.8	0.28	0.33	3.4
PC TM2	86.8	105.0	1.92	2.33	2.2	2.33	2.82	2.7

n) HS = human serum

o) PC TM = PreciControl Tumor Marker

cobas e 601 and cobas e 602 analyzers										
Sample	Repeatability					Intermediate precision				
	Mean		SD		CV	Mean		SD		CV
	IU/mL	ng/mL	IU/mL	ng/mL	%	IU/mL	ng/mL	IU/mL	ng/mL	%
HS 1	14.8	17.8	0.27	0.33	1.8	14.1	17.0	0.53	0.64	3.8
HS 2	46.7	56.5	0.65	0.79	1.4	44.6	53.9	1.14	1.38	2.6

cobas e 601 and cobas e 602 analyzers										
Sample	Repeatability					Intermediate precision				
	Mean		SD		CV	Mean		SD		CV
	IU/mL	ng/mL	IU/mL	ng/mL	%	IU/mL	ng/mL	IU/mL	ng/mL	%
HS 3	745	901	11.7	14.2	1.6	711	860	23.4	28.3	3.3
PC TM1	9.35	11.3	0.21	0.25	2.2	9.1	11.0	0.26	0.31	2.8
PC TM2	104	126	2.49	3.01	2.4	103	125	2.54	3.07	2.5

Method comparison

A comparison of the Elecsys AFP assay, [REF] 07026706190 (cobas e 801 analyzer; y) with the Elecsys AFP assay, [REF] 04481798190 (cobas e 601 analyzer; x) gave the following correlations (IU/mL):

Number of serum samples measured: 165

Passing/Bablok²⁴

$$y = 0.961x - 0.106$$

$$\tau = 0.980$$

Linear regression

$$y = 0.964x - 0.589$$

$$r = 0.999$$

The sample concentrations were between 0.783 and 954 IU/mL.

References

- 1 Taketa K. Alpha-Fetoprotein in the 1990s. In: Sell SS. Serological cancer markers. Humana Press 1992;31-46, ISBN: 0-89603-209-4
- 2 Terentiev AA., Moldogazieva NT. Alpha-fetoprotein: a renaissance. Tumor Biology 2013;34:2075-2091.
- 3 Wald NJ, Kennard A, Densem JW, et al. Antenatal maternal serum screening for Down's syndrome: results of a demonstration project. BMJ 1992;305:391-394.
- 4 Klepp O. Serum tumor markers in testicular and extragonadal germ cell malignancies. Scand J Clin Lab Invest Suppl 1991;206:28-41.
- 5 Sturgeon CM, Duffy MJ, Stenman UH, et al. National Academy of Clinical Biochemistry Laboratory Medicine Practice Guidelines for Use of Tumor Markers in Testicular, Prostate, Colorectal, Breast, and Ovarian Cancers. Clin Chem 2008;54:12:e11-e79.
- 6 Llovet JM, Zucman-Rossi J, Pikarsky E, et al. Hepatocellular carcinoma. Nature Reviews Disease Primers. 2016;14:2:16018.
- 7 Toro A, Ardiri A, Mannino M, et al. Effect of pre- and post-treatment alpha-fetoprotein levels and tumor size on survival of patients with hepatocellular carcinoma treated by resection, transarterial chemoembolization or radiofrequency ablation: a retrospective study. BMC surgery 2014;14:40.
- 8 Gonzalez SA and Keffe EB. Diagnosis of Hepatocellular Carcinoma: Role of Tumor Markers and Liver Biopsy. Clin Liver Dis 2011;15:297-306.
- 9 Gupta S, Bent S, Kohlwes J. Test characteristics of alpha-fetoprotein for detecting hepatocellular carcinoma in patients with hepatitis C. A systematic review and critical analysis. Ann. Intern. Med. 2003;139(1):46-50.
- 10 Chen J, Röcken C, Treiber G, et al. Clinical implications of alpha-fetoprotein expression in gastric adenocarcinoma. Dig Dis 2003;21(4):357-362.
- 11 Daniele B, Bencivenga A, Megna AS, et al. Alpha-fetoprotein and ultrasonography screening for hepatocellular carcinoma. Gastroenterology 2004;127:108-112.
- 12 Stuart KE, Anand AJ, Jenkins RL. Hepatocellular Carcinoma in the United States. Prognostic features, treatment outcome, and survival. Cancer 1996;77,11:2217-2222.
- 13 Heimbach JK, Kulik LM, Finn RS, et al. AASLD Guidelines for the Treatment of Hepatocellular Carcinoma. Hepatology 2018;67(1):358-80.
- 14 Kokudo N, Hasegawa K, Akahane M, et al. Evidence-based Clinical Practice Guidelines for Hepatocellular Carcinoma: The Japan Society of Hepatology 2013 update (3rd JSH-HCC Guidelines). Hepatol Res 2015; 45:123-127.

- 15 Omata M, Cheng AL, Kokudo N, et al. Asia-Pacific clinical practice guidelines on the management of hepatocellular carcinoma: a 2017 update. *Hepatol Int* 2017;11:317-370.
- 16 Schlebush H. Prenatal screening for Down's syndrome. In: Thomas L (ed.). *Clinical Laboratory Diagnosis*, TH-Books, Frankfurt, 1st English edition 1998:1124-1125.
- 17 Cuckle HS, Wald NJ, Thompson SG. Estimating a woman's risk of having a pregnancy associated with Down's syndrome using her age and serum alpha-fetoprotein level. *Br J Obstet Gynaecol* 1987;94:387-402.
- 18 Reynolds TM, Penney MD. The mathematical basis of multivariate risk screening: with special reference to screening for Down's syndrome associated pregnancy. *Ann Clin Biochem* 1989;26:452-458.
- 19 Cuckle HS, Wald NJ, Nanchahal K, et al. Repeat maternal serum alpha-fetoprotein testing in antenatal screening programmes for Down's syndrome. *Br J Obstet Gynaecol* 1989;96:52-60.
- 20 Dunstan FDJ, Gray JC, Nix ABJ, et al. Detection rates and false positive rates for Down's Syndrome screening: How precisely can they be Estimated and what factors influence their value? *Statistics Medicine* 1997;16:1481-1495.
- 21 Lamson SH, Hook B. Comparison of Mathematical Models for the Maternal Age Dependence of Down's Syndrome Rates. *Hum Genet Vol* 1981;59:232-234.
- 22 Cuckle HS. Improved parameters for risk estimation in Down's syndrome screening. *Prenat Diagn* 1995;15:1057-1065.
- 23 Lovet JM, Brú C, Bruix J. Prognosis of hepatocellular carcinoma: the BCLC staging classification. *Semin Liver Dis* 1999;19(3):329-338.
- 24 Bablok W, Passing H, Bender R, et al. A general regression procedure for method transformation. Application of linear regression procedures for method comparison studies in clinical chemistry, Part III. *J Clin Chem Clin Biochem* 1988 Nov;26(11):783-790.
- 25 National Research Council (US) Subcommittee on Reproductive and Neurodevelopmental Toxicology. *Biologic Markers in Reproductive Toxicology*. Washington (DC): National Academies Press (US); 1989. Appendix, Assessing the Validity of Biologic Markers: Alpha-Fetoprotein. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK218948/>

For further information, please refer to the appropriate operator's manual for the analyzer concerned, the respective application sheets, the product information and the Method Sheets of all necessary components (if available in your country).

A point (period/stop) is always used in this Method Sheet as the decimal separator to mark the border between the integral and the fractional parts of a decimal numeral. Separators for thousands are not used.

Symbols

Roche Diagnostics uses the following symbols and signs in addition to those listed in the ISO 15223-1 standard (for USA: see dialog.roche.com for definition of symbols used):

	Contents of kit
	Analyzers/Instruments on which reagents can be used
	Reagent
	Calibrator
	Volume after reconstitution or mixing
	Global Trade Item Number

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