

# HCG+ $\beta$

Intact human chorionic gonadotropin + the  $\beta$ -subunit

cobas®

REF	$\Sigma$	SYSTEM
03271749 190	100	Elecsys 2010 MODULAR ANALYTICS E170 <b>cobas e 411</b> <b>cobas e 601</b> <b>cobas e 602</b>

## English

### Please note

The measured hCG 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 hCG assay method used. hCG 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 hCG assay procedure used while monitoring therapy, then the hCG 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 the sum of human chorionic gonadotropin (hCG) plus the hCG  $\beta$ -subunit in human serum and plasma.

This assay is intended for use as an aid in:

- Early detection and monitoring of pregnancy. The test is also intended for the use as 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.
- Oncology, to serve the management of patients with trophoblastic diseases. This assay is useful in the detection and monitoring of hCG-producing tumor cells of either ovarian, placental or testicular origin.

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

### Summary

References<sup>1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17</sup>

Similarly to LH, FSH and TSH, human chorionic gonadotropin (hCG) is a member of the glycoprotein family and consists of 2 subunits ( $\alpha$ - and  $\beta$ -chains) which are associated to the intact hormone. The  $\alpha$ -chains in all four of these glycoprotein hormones are virtually identical, whereas the  $\beta$ -chains have greatly differing structures and are responsible for the respective specific hormonal functions.

hCG is produced in the placenta during pregnancy. In non-pregnant women, it can also be produced by tumors of the trophoblast, germ cell tumors with trophoblastic components and some non-trophoblastic tumors. Human chorionic gonadotropin consists of a number of isohormones with differing molecular size. The biological action of hCG serves to maintain the corpus luteum during pregnancy. It also influences steroid production. The serum of pregnant women contains mainly intact hCG.<sup>7</sup>

Elevated values here serve as an indication of chorionic carcinoma, hydatiform mole or multiple pregnancy.

Depressed values indicate threatening or missed abortion, ectopic pregnancy, gestosis or intra-uterine death.

Measurement of hCG+ $\beta$  makes also a contribution to the risk assessment for trisomy 21 (Down syndrome) in the second trimester of pregnancy together with AFP and other parameters, such as exact gestational age and maternal weight. In a trisomy 21 affected pregnancy the maternal serum concentration of AFP is decreased whereas the maternal serum hCG+ $\beta$  concentration is approximately twice the normal median.<sup>8</sup> 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 Wald<sup>10</sup> and the respective assay-specific parameters.<sup>8,9,10,11,12,13,14,15</sup>

Elevated hCG concentrations not associated with pregnancy are found in patients with other diseases such as tumors of the germ cells, ovaries, bladder, pancreas, stomach, lungs, and liver.<sup>5,6</sup>

In the following the prevalence (%) of elevated serum hCG + hCG $\beta$  values in various malignancies is listed: Testicular or placental choriocarcinoma (100), hydatidiform mole (97), nonseminomatous testicular germ cell tumor (48-86), seminoma (10-22), pancreatic cancer (adenocarcinoma (11-80) and islet-cell carcinoma (22-50)), gastric cancer (0-52), ovarian cancer, epithelial (18-41), colon cancer (0-37), lung cancer (0-36), breast cancer (7-25), hepatoma, liver cancer (17-21), tumors of small intestine (13), and renal carcinoma (10).<sup>15,16</sup>

HCG assays detecting the intact hCG plus the free  $\beta$ -subunit are well established markers as an aid in the management of patients with trophoblastic tumors and, together with AFP in patients with non seminomatous testicular tumors.<sup>17</sup>

The combination of the specific monoclonal antibodies used in the Elecsys HCG+ $\beta$  assay recognize the holo-hormone, "nicked" forms of hCG, the  $\beta$ -core fragment and the free  $\beta$ -subunit. The ruthenium-labeled and biotinylated antibodies used are directed against different epitopes of the hCG molecule.

### Test principle

Sandwich principle. Total duration of assay: 18 minutes.

- 1st incubation: 10  $\mu$ L of sample, biotinylated monoclonal hCG-specific antibodies, and a monoclonal hCG-specific antibody labeled with a ruthenium complex<sup>a)</sup> 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.

a) Tris(2,2'-bipyridyl)ruthenium(II)-complex (Ru(bpy)<sub>3</sub><sup>2+</sup>)

### Reagents - working solutions

The reagent rackpack is labeled as HCG-BETA.

- M Streptavidin-coated microparticles (transparent cap), 1 bottle, 6.5 mL: Streptavidin-coated microparticles 0.72 mg/mL; preservative.
- R1 Anti-hCG-Ab~biotin (gray cap), 1 bottle, 9 mL: Biotinylated monoclonal anti-hCG antibodies (mouse) 2.6 mg/L; phosphate buffer 40 mmol/L, pH 7.5; preservative.
- R2 Anti-hCG-Ab~Ru(bpy)<sub>3</sub><sup>2+</sup> (black cap), 1 bottle, 10 mL: Monoclonal anti-hCG antibody (mouse) labeled with ruthenium complex 4.6 mg/L; phosphate buffer 40 mmol/L, pH 6.5; preservative.



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## 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.

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 the analyzers	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<sup>-</sup>, Na<sup>-</sup>, NH<sub>4</sub><sup>+</sup>-heparin, Na<sub>2</sub>-EDTA, K<sub>3</sub>-EDTA, sodium citrate and sodium fluoride/potassium oxalate plasma.

Criterion: Recovery within 90-110 % of serum value or slope 0.9-1.1 + coefficient of correlation > 0.95 (Pearson).

Stable for 3 days at 2-8 °C, 12 months at -20 °C. Freeze only once.<sup>18</sup>

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 03302652190, HCG+β CalSet, for 4 x 1 mL
- REF 11731416190, PreciControl Universal, for 2 x 3 mL each of PreciControl Universal 1 and 2 or  
REF 11776452122, PreciControl Tumor Marker, for 2 x 3 mL each of PreciControl Tumor Marker 1 and 2
- REF 11732277122, Diluent Universal, 2 x 16 mL sample diluent or  
REF 03183971122, Diluent Universal, 2 x 36 mL sample diluent
- General laboratory equipment
- Elecsys 2010, MODULAR ANALYTICS E170 or **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 04481798190, AFP, 100 tests
- REF 04491742190, AFP, 200 tests
- REF 04487761190, AFP CalSet II, for 4 x 1 mL

Accessories for Elecsys 2010 and **cobas e** 411 analyzers:

- 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, Elecsys 2010 AssayCup, 60 x 60 reaction vessels
- REF 11706799001, Elecsys 2010 AssayTip, 30 x 120 pipette tips

Accessories for MODULAR ANALYTICS E170, **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 03004899190, PreClean M, 5 x 600 mL detection cleaning solution
- REF 12102137001, AssayTip/AssayCup Combimagazine M, 48 magazines x 84 reaction vessels or pipette tips, waste bags
- REF 03023150001, WasteLiner, waste bags
- REF 03027651001, SysClean Adapter M

Accessories for all analyzers:

- REF 11298500316, 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.

MODULAR ANALYTICS E170, **cobas e** 601 and **cobas e** 602 analyzers: PreClean M solution is necessary.

Bring the cooled reagents to approx. 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 4th International Standard for Chorionic Gonadotropin from the National Institute for Biological Standards and Control (NIBSC) code 75/589.

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.



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**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). 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 Universal or PreciControl Tumor Marker.

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.

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

## Calculation

The analyzer automatically calculates the analyte concentration of each sample (either in mIU/mL or IU/L).

## Limitations - interference

The assay is unaffected by icterus (bilirubin < 410 μmol/L or < 24 mg/dL), hemolysis (Hb < 0.621 mmol/L or < 1.0 g/dL), lipemia (Intralipid < 1400 mg/dL) and biotin (< 327 nmol/L or < 80 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 3400 IU/mL and samples from dialysis patients.

There is no high-dose hook effect at hCG concentrations up to 750000 mIU/mL.

In vitro tests were performed on 15 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.

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

0.100-10000 mIU/mL (defined by the lower detection limit and the maximum of the master curve). Values below the lower detection limit are reported as < 0.100 mIU/mL. Values above the measuring range are reported as > 10000 mIU/mL (or up to 1000000 mIU/mL for 100-fold diluted samples).

### Lower limits of measurement

#### Lower detection limit of the test

Lower detection limit: < 0.1 mIU/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 hCG concentrations above the measuring range can be diluted with Diluent Universal. The recommended dilution is 1:100 (either

automatically by the MODULAR ANALYTICS E170, Elecsys 2010 or **cobas e** analyzers or manually). The concentration of the diluted sample must be > 100 mIU/mL.

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

After dilution by the analyzers, the MODULAR ANALYTICS E170, Elecsys 2010 and **cobas e** software automatically takes the dilution into account when calculating the sample concentration.

## Expected values

Results from a multicenter study in clinical centers in Belgium, France, and Germany using the HCG+β assay (REF 03271749) are listed below (Study No. BO1P019, status March 2003).

### Serum samples from healthy individuals:

- ≤ 1 mIU/mL hCG for 97.5 % of the values obtained from 181 healthy, non-pregnant premenopausal women. The corresponding upper 95 % confidence limit ranges up to 5.3 mIU/mL.
- ≤ 7 mIU/mL hCG for 97.5 % of the values obtained from 143 healthy, postmenopausal women. The corresponding upper 95 % confidence limit ranges up to 8.3 mIU/mL.
- < 2 mIU/mL hCG for 97.5 % of the values obtained from 290 men. The corresponding upper 95 % confidence limit ranges up to 2.6 mIU/mL.
- During pregnancy (weeks of pregnancy - defined as completed weeks of pregnancy beginning with the start of the last menstruation phase), the following values have been determined.

Data are given only for the weeks of gestation for which the case numbers (n) were greater than 10.

Weeks of gestation	N	HCG mIU/mL	
		Median	5-95 <sup>th</sup> percentile
3	25	17.5	5.8-71.2
4	43	141	9.5-750
5	23	1398	217-7138
6	19	3339	158-31795
7	13	39759	3697-163563
8	23	90084	32065-149571
9	23	106257	63803-151410
10	20	85172	46509-186977
12	17	66676	27832-210612
14*	67	34440	13950-62530
15*	666	28962	12039-70971
16*	766	23930	9040-56451
17*	190	20860	8175-55868
18*	64	19817	8099-58176

\* For the gestational weeks 14 to 18, which are the relevant weeks for the trisomy 21 risk assessment, the values from serum samples of 1753 pregnant women in total were evaluated from measurements with the Elecsys HCG+β assay and the Elecsys AFP assay in the 5 clinical centers. The maternal age and weight and the gestational age in days was given for each sample.

The individual results were analyzed for normal distribution of the log MoM (Multiple of Median) values. The standard deviations of the MoM values are comparable to published data.

Median values and the 5<sup>th</sup> and 95<sup>th</sup> percentile were calculated for the completed gestational weeks - see within the table above.

*Distribution of Elecsys HCG+β results from healthy subjects and patients with benign and malignant diseases:*



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The results from patients with benign and malignant diseases are summarized data from measurements with the HCG+β assay (REF 03271749) and the HCG+β assay (REF 11973193).

Concentration mIU/mL	N	Percent (%)				
		≤ 2	> 2 - ≤ 7	> 7 - ≤ 100	> 100	> 1000
Healthy subjects	614					
Males	290	97.9	2.1	0	0	0
Females premenopause	181	98.9	1.1	0	0	0
Females postmenopause	143	53.1	46.2	0.7	0	0
Malignant diseases	839					
Choriocarcinoma	64	10.9	10.9	21.9	10.9	45.3
Seminoma	29	89.7	3.4	6.9	0	0
Germ cell tumor	109	78.0	3.7	0.9	5.5	11.9
Yolk sac tumor	45	20.0	6.7	22.2	8.9	42.2
Ovarian cancer	38	76.3	18.4	5.3	0	0
Gestational trophoblastic diseases	169	19.5	10.7	29.6	20.1	20.1
Mole	72	1.4	4.2	26.4	27.8	40.3
Others	313	52.7	13.1	8.6	11.8	13.7

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

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

## 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 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:

Elecsys 2010 and cobas e 411 analyzers					
Sample	Mean mIU/mL	Repeatability		Intermediate precision	
		SD mIU/mL	CV %	SD mIU/mL	CV %
Human serum 1	4.81	0.21	4.4	0.22	4.6
Human serum 2	880	11.7	1.3	22.9	2.6
Human serum 3	7949	132	1.7	249	3.1
PreciControl U <sup>b)</sup> 1	9.14	0.19	2.1	0.24	2.6
PreciControl U2	24.0	0.96	4.0	1.11	4.6
PreciControl TM <sup>a)</sup> 1	25.7	0.63	2.4	0.82	3.2
PreciControl TM2	2365	37.0	1.6	62.8	2.7

b) U = Universal

c) TM = Tumor Marker

MODULAR ANALYTICS E170, cobas e 601 and cobas e 602 analyzers						
Sample	Repeatability			Intermediate precision		
	Mean mIU/mL	SD mIU/mL	CV %	Mean mIU/mL	SD mIU/mL	CV %
Human serum 1	8.52	0.24	2.8	4.73	0.35	7.4
Human serum 2	796	13.6	1.7	899	29.4	3.3
Human serum 3	7012	188	2.7	8082	344	4.3
PreciControl U1	7.20	0.18	2.5	8.49	0.29	3.4
PreciControl U2	19.6	0.55	2.8	22.5	1.05	4.6
PreciControl TM1	21.4	0.39	1.8	24.2	1.11	4.6
PreciControl TM2	2012	47.0	2.3	2316	84.2	3.6

## Method comparison

A comparison of the Elecsys HCG+β assay (y) with the Elecsys HCG STAT assay (x) using human sera gave the following correlations:

Number of samples measured: 81

Passing/Bablok<sup>19</sup>

$$y = 1.00x + 7.40$$

$$r = 0.986$$

Linear regression

$$y = 0.95x + 53.4$$

$$r = 0.999$$

The sample concentrations were between approx. 3 and approx. 8550 mIU/mL.

## Analytical specificity

For the monoclonal antibodies used, the following cross-reactivities were found:

TSH: not detectable, LH 0.12 %, FSH < 0.1 %.

## Functional sensitivity

< 0.6 mIU/mL

The functional sensitivity is the lowest analyte concentration that can be reproducibly measured with an intermediate precision CV of 20 %.

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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.

<b>CONTENT</b>	Contents of kit
<b>SYSTEM</b>	Analyzers/Instruments on which reagents can be used
<b>REAGENT</b>	Reagent
<b>CALIBRATOR</b>	Calibrator
	Volume after reconstitution or mixing

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