



# Elecsys $\beta$ -Amyloid (1-42) CSF II

cobas®

REF			SYSTEM
08821941190	08821941500	100	cobas e 402 cobas e 801

## English

### System information

Short name	ACN (application code number)
AB42 2	10097

### Please note

The measured  $\beta$ -amyloid (1-42) value in a given sample, determined with assays from different manufacturers, can vary due to differences in assay methods and reagent. Values determined on samples by different assay methods and on different **cobas e** platforms cannot be used interchangeably.

**Please note that due to the sticky properties of the  $\beta$ -amyloid protein, the Elecsys assay cut-off provided in this document is only valid if the below described pre-analytical handling procedure (see section "Specimen collection and preparation") is strictly followed.**

All performance data were generated using frozen cerebrospinal fluid (CSF) material. A positive  $\beta$ -amyloid (1-42) result in CSF does not establish a diagnosis of Alzheimer's disease (AD) and should always be interpreted in conjunction with clinical information.

### Intended use

Elecsys  $\beta$ -Amyloid (1-42) CSF II is an in vitro diagnostic immunoassay intended for the quantitative determination of the  $\beta$ -amyloid (1-42) protein concentration in human cerebrospinal fluid (CSF).

1. The Elecsys  $\beta$ -Amyloid (1-42) CSF II assay is intended to be used in adult subjects with cognitive impairment being evaluated for Alzheimer disease (AD) and other causes of cognitive impairment. Result above the cutoff is consistent with a negative amyloid positron emission tomography (PET) scan. Negative  $\beta$ -amyloid PET scans indicate sparse to no neuritic plaques and are inconsistent with a neuropathological diagnosis of AD at the time of image acquisition; a negative scan result reduces the likelihood that a patient's cognitive impairment is due to AD.
2. The Elecsys  $\beta$ -Amyloid (1-42) CSF II assay is intended to be used in combination with Elecsys Phospho-Tau (181P) CSF or Elecsys Total-Tau CSF assay as a ratio in adult subjects with cognitive impairment being evaluated for AD and other causes of cognitive impairment wherein a positive and negative CSF result are concordant with positive and negative amyloid Positron Emission Tomography (PET) scan result, respectively.
3. Elecsys  $\beta$ -Amyloid (1-42) CSF II assay is intended to be used alone or in combination with Elecsys Phospho-Tau (181P) CSF or Elecsys Total-Tau CSF assay as a ratio in adult subjects with mild cognitive impairment (MCI) as an aid to identify subjects who are at lower vs. higher risk of cognitive decline as defined by change in a clinical score within a 2 year period.

### Limitations of use

- Elecsys  $\beta$ -Amyloid (1-42) CSF II assay is an adjunct to other clinical diagnostic evaluations.
- A positive Elecsys  $\beta$ -Amyloid (1-42) CSF II assay result and/or a positive Elecsys Phospho-Tau (181P) CSF or Elecsys Total-Tau CSF to Elecsys  $\beta$ -Amyloid (1-42) CSF II ratio result does not establish a diagnosis of AD or other cognitive disorder.
- The safety and effectiveness of the Elecsys  $\beta$ -Amyloid (1-42) CSF II assay have not been established for monitoring responses to therapies. The electrochemiluminescence immunoassay "ECLIA" is intended for use on **cobas e** immunoassay analyzers.

### Summary

The Elecsys  $\beta$ -Amyloid (1-42) CSF II assay is designed to detect the  $\beta$ -amyloid (1-42) peptide, a small, 4 kDa protein of about 40 amino acids that is formed following proteolytic cleavage of a transmembrane protein

known as amyloid precursor protein (APP). Cleavage of APP occurs via 2 events: cleavage by  $\beta$ -secretase within the extracellular domain and cleavage by  $\gamma$ -secretase in the transmembrane region. Due to its hydrophobic nature, the  $\beta$ -amyloid (1-42) peptide has the property to form aggregates and oligomers. Oligomers of higher order form fibrils that accumulate into  $\beta$ -amyloid plaques.<sup>1</sup> A clinical relevance of  $\beta$ -amyloid (1-42) peptide deposition in the brain as 1 of the 2 hallmarks of AD, besides neurofibrillary tangles, can be detected by several methods: (a) histopathological staining of  $\beta$ -amyloid (1-42) deposits in post mortem brain tissue; (b) use of radiolabeled tracers that bind to  $\beta$ -amyloid deposits in the brain and can then be detected in vivo using PET scan; (c) measuring the  $\beta$ -amyloid 42 level in CSF because lower titers in CSF are believed to reflect accumulation of this molecule in the brain.<sup>2,3</sup>

Pathological changes in the  $\beta$ -amyloid metabolism are the earliest alterations during AD development known so far that can be utilized diagnostically. They are reflected by the decrease in the CSF concentrations of  $\beta$ -amyloid (1-42) as well as by the increase in the brain uptake of the specific tracers on the  $\beta$ -amyloid PET.<sup>4</sup> Current clinical diagnostic criteria for AD require a patient to have dementia before a diagnosis of AD can be made, and are largely based on the exclusion of other disorders. No clinical method is available for identifying prodromal AD in patients with MCI, as such individuals have only mild disturbances in episodic memory.<sup>5</sup>

Numerous studies show that while CSF  $\beta$ -Amyloid (1-42) levels decrease to around half the level in controls, CSF tTau and CSF pTau 181 levels increase around 2-3 fold in mild-moderate AD patients compared to age-matched controls.<sup>6,7</sup> CSF tTau has been shown to reflect the intensity of the neuronal and axonal damage and degeneration. High CSF tTau is also associated with a faster progression from MCI to AD.<sup>8</sup> CSF pTau 181 levels are also associated with a faster progression from MCI to AD with more rapid cognitive decline in AD patients<sup>9</sup> as well as in very mild AD dementia cases.

CSF pTau and CSF tTau biomarkers have the highest power when used in combination with CSF  $\beta$ -Amyloid (1-42) for detecting the likely progression of subjects with MCI to AD.<sup>10</sup>

The use of AD biomarkers has been included in the new consensus research diagnostic criteria for AD, mild cognitive impairment (MCI), and preclinical AD, proposed by the National Institute on Aging (NIA) and the Alzheimer's Association. These new criteria take into account that AD dementia is part of a continuum of clinical and biological phenomena.<sup>11,12</sup> The new IWG-2 (International Working Group 2) criteria recommend the use of either CSF biomarker or PET imaging for evaluation of AD patients.<sup>13</sup> In Europe, the CHMP (Committee for Medicinal Products for Human Use) published a number of positive opinions on the use of biomarkers in the context of AD for enrichment of clinical trials in pre-dementia and mild- to moderate AD.<sup>14,15</sup>

### Test principle

Sandwich principle. Total duration of assay: 18 minutes.

- 1st incubation: 30  $\mu$ L of sample, a biotinylated monoclonal  $\beta$ -amyloid (1-42)-specific antibody (21F12), and a monoclonal  $\beta$ -amyloid (1-42)-specific antibody (3D6) 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 II 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 **cobas** link.

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

# Elecsys $\beta$ -Amyloid (1-42) CSF II

**cobas®**

## Reagents - working solutions

The **cobas e** pack is labeled as AB42 2.

- M Streptavidin-coated microparticles, 1 bottle, 6.1 mL:  
Streptavidin-coated microparticles 0.72 mg/mL; preservative.
- R1 Anti- $\beta$ -amyloid (1-42)-Ab~biotin, 1 bottle, 6.8 mL:  
Biotinylated monoclonal anti- $\beta$ -amyloid (1-42) antibody 21F12  
(mouse) 2.0 mg/L; phosphate buffer approx. 100 mmol/L, pH 7.2;  
preservative.
- R2 Anti- $\beta$ -amyloid (1-42)-Ab~Ru(bpy)<sub>3</sub><sup>2+</sup>, 1 bottle, 6.8 mL:  
Monoclonal anti- $\beta$ -amyloid antibody 3D6 (mouse) labeled with  
ruthenium complex 1.75 mg/L; phosphate buffer approx. 100 mmol/L,  
pH 7.2; preservative.

## Precautions and warnings

For in vitro diagnostic use for health care professionals. Exercise the normal precautions required for handling all laboratory reagents.

Infectious or microbial waste:

Warning: handle waste as potentially biohazardous material. Dispose of waste according to accepted laboratory instructions and procedures.

Environmental hazards:

Apply all relevant local disposal regulations to determine the safe disposal.

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:



## Warning

H317 May cause an allergic skin reaction.

## Prevention:

P261 Avoid breathing mist or vapours.

P272 Contaminated work clothing should not be allowed out of the workplace.

P280 Wear protective gloves.

## Response:

P333 + P313 If skin irritation or rash occurs: Get medical advice/attention.

P362 + P364 Take off contaminated clothing and wash it before reuse.

## Disposal:

P501 Dispose of contents/container to an approved waste disposal plant.

Product safety labeling follows EU GHS guidance.

Contact phone: all countries: +49-621-7590

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 available via the **cobas** link.

## Storage and stability

Store at 2-8 °C.

Do not freeze.

Store the **cobas e** pack **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

on the analyzers

16 weeks

## Specimen collection and preparation

Please follow the steps listed below for CSF sample collection and measurement.

**The technical notes are an essential part of the instructions and must be read thoroughly before completing each step.**

Steps	Technical notes
1. <b>Perform lumbar puncture (LP)</b> using gravity drip collection method.	Avoid the use of syringes or tubings. Perform LP before noon.
2. <b>Do not use the first 2 mL of CSF for Elecsys AD Biomarker measurement.</b>	None
3. <b>Subsequently collect at least 2.5 mL of CSF directly into the</b> CSF tube [REF] 63.614.625 (Sarstedt) for AD biomarker measurements (Note: 2.5 mL filling volume corresponds to filling up to the mark on the tube).	Each sample should be visually inspected for hemolysis. Do not use CSF samples which appear reddish for measurement of Elecsys AD biomarkers. Instead, collect additional clear (non-hemolytic) CSF in a new CSF tube. Collection of CSF for other purposes can follow thereafter, if required.
4. Do not process the CSF sample before transport to the measuring site (i.e. no mixing/inverting, no tube transfers, no aliquoting, and normally no centrifugation) until measurement.	It is strongly recommended that the sample be kept at 2-8 °C or -15 to -25 °C during transport and storage up to the time of measurement. Samples can be stored at -15 to -25 °C for up to 8 weeks or at 2-8 °C for up to 14 days. If transport and storage at -15 to -25 °C or 2-8 °C is not feasible, the sample can be transported/stored at room temperature (20-25 °C). If this is the case, measurement is to be performed within 5 days after sample draw. Note that samples cannot be frozen at -80 °C.
5. For samples stored at -15 to -25 °C, thaw samples for 30 minutes at room temperature on a roller mixer.	Only one freeze/thaw is acceptable.
6. Measurement on the <b>cobas e</b> systems: Directly place the CSF sample tube on the analyzer for measurement. To prevent evaporation, only open the sample tube immediately before measurement.	-

Stability of CSF samples: Stable for 8 weeks at -15 to -25 °C (one freeze/thaw cycle), 14 days at 2-8 °C and 5 days at 20-25 °C.

Do not use hemolyzed CSF samples that are visibly colored red.

Centrifuge samples containing precipitates before performing the assay.

Do not use samples and controls stabilized with azide.

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

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

# Elecsys $\beta$ -Amyloid (1-42) CSF II

cobas®

Please always keep them capped if not in use.

## Materials provided

See "Reagents – working solutions" section for reagents.

## Materials required (but not provided)

- [REF] 08821976190, CalSet  $\beta$ -Amyloid (1-42) II, for 4 x 1.0 mL
  - [REF] 08821968190, PreciControl  $\beta$ -Amyloid (1-42) II, for 6 x 1.0 mL
  - [REF] 63.614.625, 2.5 mL Low bind False bottom tube, Sarstedt (for CSF collection)
  - General laboratory equipment
  - **cobas e** analyzer
- Additional materials for **cobas e** 402 and **cobas e** 801 analyzers:
- [REF] 06908799190, ProCell II M, 2 x 2 L system solution
  - [REF] 04880293190, CleanCell M, 2 x 2 L measuring cell cleaning solution
  - [REF] 07485409001, Reservoir Cup, 8 cups to supply ProCell II M and CleanCell M
  - [REF] 06908853190, PreClean II M, 2 x 2 L wash solution
  - [REF] 05694302001, Assay Tip/Assay Cup tray, 6 magazines x 6 magazine stacks x 105 assay tips and 105 assay cups, 3 wasteliners
  - [REF] 07485425001, Liquid Flow Cleaning Cup, 2 adaptor cups to supply ISE Cleaning Solution/Elecsys SysClean for Liquid Flow Cleaning Detection Unit
  - [REF] 07485433001, PreWash Liquid Flow Cleaning Cup, 1 adaptor cup to supply ISE Cleaning Solution/Elecsys SysClean for Liquid Flow Cleaning PreWash Unit
  - [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.

Place the cooled (stored at 2-8 °C) **cobas e** pack on the reagent manager. Avoid foam formation. The system automatically regulates the temperature of the reagents and the opening/closing of the **cobas e** pack.

## Calibration

Traceability: This method has been standardized against the 3 certified reference materials (CRMs), ERM®-DA480/IFCC, ERM®-DA481/IFCC and ERM®-DA482/IFCC.

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 **cobas e** pack 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 12 weeks when using the same reagent lot
- after 28 days when using the same **cobas e** pack on the analyzer
- as required: e.g. quality control findings outside the defined limits

## Quality control

For quality control, use PreciControl  $\beta$ -Amyloid (1-42) II.

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

Special care needs to be taken to ensure that the accuracy and precision of the testing stays within acceptable limits. Besides meeting the PreciControl  $\beta$ -Amyloid (1-42) II target ranges provided, the user needs to ensure that the systematic bias with respect to the assigned target value is within  $\pm 10\%$ , the intermediate precision CV is  $\leq 10\%$  and the maximal total error is within  $\pm 26.5\%$  ( $TE = |bias| + 1.65 \cdot CV$ ). It is recommended to use quality control rule software.

For those users who are not familiar with the special QC setup and application, detailed information is available in the brochure "**Guidance: Statistical Quality Control Rule Implementation**" in English language, which is available via [navifyportal.roche.com](http://navifyportal.roche.com). This brochure explains e.g. how to check if the maximal total error is within the allowed range based on the local QC results, besides other useful information.

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.

If necessary, repeat the measurement of the samples concerned.

## Calculation

The analyzer automatically calculates the analyte concentration of each sample in pg/mL.

## Limitations - interference

The effect of the following endogenous substances and pharmaceutical compounds on assay performance was tested. Interferences were tested up to the listed concentrations and no impact on results was observed.

### Endogenous substances

Compound	Concentration tested
Bilirubin	$\leq 0.51 \mu\text{mol/L}$ or $\leq 0.03 \text{ mg/dL}$
Hemoglobin	$\leq 0.0031 \text{ mmol/L}$ or $\leq 5 \text{ mg/dL}$
Intralipid	$\leq 10 \text{ mg/dL}$
Biotin	$\leq 4912 \text{ nmol/L}$ or $\leq 1200 \text{ ng/mL}$
Rheumatoid factors	$\leq 4 \text{ IU/mL}$
IgG	$\leq 0.02 \text{ g/dL}$
IgA	$\leq 0.002 \text{ g/dL}$
IgM	$\leq 0.0005 \text{ g/dL}$
Albumin	$\leq 0.05 \text{ g/dL}$

Criterion: Recovery within  $\pm 48 \text{ pg/mL}$  of initial value  $\leq 480 \text{ pg/mL}$  and within  $\pm 10\%$  of initial value  $> 480 \text{ pg/mL}$ .

There is no high-dose hook effect at  $\beta$ -amyloid (1-42) concentrations up to  $6000 \text{ pg/mL}$ .

### Pharmaceutical substances

In vitro tests were performed on 17 commonly used pharmaceuticals. No interference with the assay was found.

### Commonly used pharmaceuticals

Pharmaceutical	Concentration tested mg/L
Acetaminophen	156
Acetylcysteine	150
Acetylsalicylic acid	30
Ampicillin-Na	75
Ascorbic acid	52.5
Cefoxitin	750
Cyclosporine	1.8
Doxycycline	18
Heparin	1100 IU/L
Ibuprofen	219
Itraconazole	0.06
Levodopa	7.5
Methyldopa	22.5
Metronidazole	123

# Elecsys $\beta$ -Amyloid (1-42) CSF II



Pharmaceutical	Concentration tested mg/L
Phenylbutazone	107
Rifampicin	48
Theophylline	60

In addition, the following 15 special drugs were tested. No interference with the assay was found.

## Special drugs

Drug	Concentration tested mg/L
Atorvastatin	0.75
Clopidogrel	0.3
Digoxin	0.039
Donepezil	30
Escitalopram	0.192
Esomeprazole	6.9
Furosemide	15.9
Galantamine	250
Hydrochlorothiazide	1.13
Lisinopril	0.246
Memantine	0.117
Metformin	12
Metoprolol	1.5
Rivastigmine	45
Simvastatin	1.68

Criterion: Recovery within  $\pm 48$  pg/mL of initial value  $\leq 480$  pg/mL and within  $\pm 10$  % of initial value  $> 480$  pg/mL.

Drug interferences are measured based on recommendations given in CLSI guidelines EP07 and EP37 and other published literature. Effects of concentrations exceeding these recommendations have not been characterized.

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

150-2500 pg/mL (defined by the Limit of Quantitation and the maximum of the master curve). Values below the Limit of Quantitation are reported as  $< 150$  pg/mL. Values above the measuring range are reported as  $> 2500$  pg/mL.

### Lower limits of measurement

*Limit of Blank, Limit of Detection and Limit of Quantitation*

Limit of Blank = 50 pg/mL

Limit of Detection = 100 pg/mL

Limit of Quantitation = 150 pg/mL

The Limit of Blank, Limit of Detection and Limit of Quantitation were determined in accordance with the CLSI (Clinical and Laboratory Standards Institute) EP17-A2 requirements.

The Limit of Blank is the 95<sup>th</sup> percentile value from  $n \geq 60$  measurements of analyte-free samples over several independent series. The Limit of Blank corresponds to the concentration below which analyte-free samples are found with a probability of 95 %.

The Limit of Detection is determined based on the Limit of Blank and the standard deviation of low concentration samples. The Limit of Detection

corresponds to the lowest analyte concentration which can be detected (value above the Limit of Blank with a probability of 95 %).

The Limit of Quantitation is the lowest analyte concentration that can be reproducibly measured with an intermediate precision CV of  $\leq 30$  %.

### 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, samples and controls in a protocol (EP05-A3) of the CLSI (Clinical and Laboratory Standards Institute): 2 runs per day in duplicate each for 21 days ( $n = 84$ ). The following results were obtained:

cobas e 402 and cobas e 801 analyzers					
		Repeatability		Intermediate precision	
Sample	Mean pg/mL	SD pg/mL	CV %	SD pg/mL	CV %
Human CSF 1	157	1.53	1.0	2.44	1.6
Human CSF 2	200	1.83	0.9	3.17	1.6
Human CSF 3	764	15.2	2.0	21.3	2.8
Human CSF 4	973	20.9	2.1	27.2	2.8
Human CSF 5	1042	21.2	2.0	30.1	2.9
Human CSF 6	1186	22.5	1.9	32.6	2.7
Human CSF 7	1243	27.7	2.2	37.3	3.0
Human CSF 8	2124	84.3	4.0	126	5.9
Human CSF 9	2290	21.6	0.9	28.6	1.2
PC <sup>b)</sup> $\beta$ -Amyloid (1-42) II 1	616	4.86	0.8	6.76	1.1
PC $\beta$ -Amyloid (1-42) II 2	1689	12.6	0.7	18.2	1.1

b) PC = PreciControl

### Analytical specificity

The test is highly specific for human  $\beta$ -amyloid (1-42). The following potential cross-reactivity was found.<sup>16</sup>

Cross-reactant	Concentration tested pg/mL	Cross-reactivity %
$\beta$ -Amyloid (1-38)	10000	$< 0.9$
$\beta$ -Amyloid (1-40)	10000	$< 1.6$

### Method comparison

A comparison of the Elecsys  $\beta$ -Amyloid (1-42) CSF II assay, [REF] 08821941190 (cobas e 402 analyzer; y) with the Elecsys  $\beta$ -Amyloid (1-42) CSF II assay, [REF] 08821941190 (cobas e 801 analyzer; x) gave the following correlations (pg/mL):

Number of samples measured: 133

Passing/Bablok<sup>17</sup> Linear regression

$y = 1.04x - 6.70$

$y = 1.03x - 1.85$

$r = 0.982$

$r = 0.999$

The sample concentrations were between 168 and 2464 pg/mL.

### Clinical performance

Each laboratory should investigate the transferability of the expected values to its own patient population.

**Note:** Clinical performance data were generated using the first generation Elecsys  $\beta$ -Amyloid (1-42) CSF ([REF] 06986811190) that highly correlate with Elecsys  $\beta$ -Amyloid (1-42) CSF II. In an internal method comparison study ( $N = 103$ ) the observed Pearson's correlation coefficient was 0.999. The Elecsys  $\beta$ -Amyloid (1-42) CSF II was re-standardized leading to systematic



# Elecsys $\beta$ -Amyloid (1-42) CSF II

cobas®

differences between the first and second version. These differences were taken into account by definition of the clinical decision thresholds.

## Concordance with amyloid PET visual read

Concordance with PET visual read was assessed in a retrospective study (Roche study RD002145) based on samples from the BioFINDER cohort.<sup>18</sup> The primary analysis population consisted of 277 mild cognitive symptoms (MCS) patients for whom banked CSF samples and PET scan results were available (PET tracer: [18F]-Flutemetamol). Of the 277 patients, 120 had subjective cognitive decline (SCD), 153 MCI and for 4 patients no assignment was available. The average age was 70 years (range 59-80 years), 42 %/ 58 % of patients were female/male and 45 %/ 54 % of patients were ApoE4 carriers/non-carriers. The median (1.48\*Median absolute deviation) of the Elecsys markers at baseline was as follows: Abeta42, 1048 (593) pg/mL measured with the first generation Elecsys  $\beta$ -Amyloid (1-42) CSF; pTau, 20.0 (9.4) pg/mL; tTau 240 (100) pg/mL. The amyloid PET scans were read independently by 3 trained readers and majority voting was used to rate an image as positive or negative, resulting in 110 (40 %) positive, and 167 (60 %) negative amyloid PET reads. The cut-offs for Abeta42 and the ratios pTau/Abeta42 and tTau/Abeta42 were established based on the amyloid PET visual read.

The agreement rates for the Elecsys CSF markers with amyloid PET visual read were as follows:

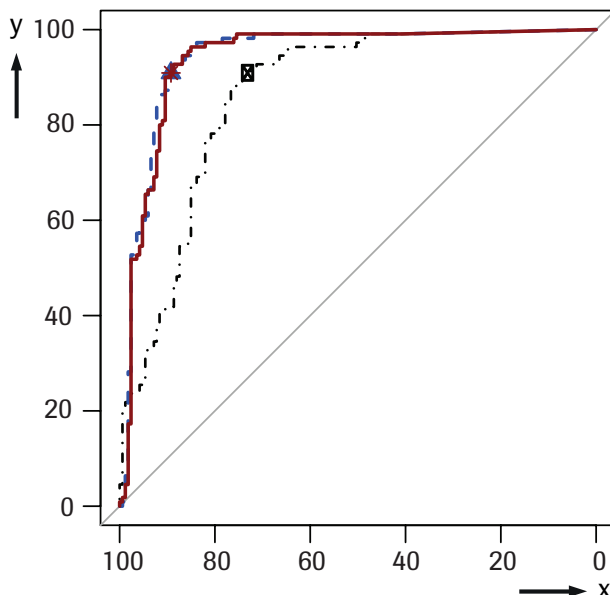
Agreement rates [%] (95 % CI) <sup>c)</sup>			
	Abeta42	pTau/Abeta42	tTau/Abeta42
PPA <sup>d)</sup>	90.9 (83.9, 95.6)	90.9 (83.9, 95.6)	90.9 (83.9, 95.6)
NPA <sup>e)</sup>	72.5 (65.0, 79.1)	89.2 (83.5, 93.5)	89.2 (83.5, 93.5)
OPA <sup>f)</sup>	79.8 (74.6, 84.4)	89.9 (85.7, 93.2)	89.9 (85.7, 93.2)

c) Confidence interval

d) PPA = Positive percentage agreement (sensitivity)

e) NPA = Negative percentage agreement (specificity)

f) OPA = Overall percentage agreement



x: NPA (Specificity) (%) y: PPA (Sensitivity) (%)

—○— Abeta42 —\*— ratio tTau/Abeta42 —▲— ratio pTau/Abeta42

Figure: Receiver-operating characteristic curves for Abeta42 and ratios pTau/Abeta42 and tTau/Abeta42 with outcome amyloid PET. The Circle/Triangle/asterisk denotes PPA and NPA at the cut-offs for the 3 biomarkers, respectively; Abeta42, AUC: 86.5 % (82.3 %, 90.7 %); pTau/Abeta42, AUC: 94.4 % (91.5 %, 97.3 %); tTau/Abeta42, AUC: 94.0 % (91.0 %, 97.0 %).

## Identification of patients at risk of cognitive decline

The ability of the single marker Abeta42 as well as the biomarker ratios pTau/Abeta42 or tTau/Abeta42 to identify patients at higher vs. lower risk of cognitive decline as defined by change in a clinical score within a 2-year period was assessed in a retrospective study (Roche study RD002530) based on samples from the ADNI1/GO/2 studies.<sup>19</sup> The primary analysis population included a total of 619 patients from the early (EMCI, 277) and late mild cognitive impairment (LMCI, 342) cohorts with baseline Elecsys CSF measurements available. For each of these patients also baseline assessments of the clinical scores Clinical Dementia Rating – Sum of Boxes (CDR-SB) and Mini-Mental State Examination (MMSE) were available. The average age of the 619 subjects was 72 years (range 54-91 years), 41 %/59 % were female/male, the average education time was 16 years (range 6-20 years) and 51 %/39 %/11 % carried 0/1/2 ApoE4 alleles. The averages (standard deviation, SD) of clinical scores were as follows: CDR-SB, 1.5 (0.9) at baseline, 2.3 (2.1) at 2-year follow-up; MMSE, 27.7 (1.8) at baseline, 26.6 (3.3) at 2-year follow-up. The median (1.48\*Median absolute deviation) of the Elecsys CSF marker concentrations at baseline were as follows: Abeta42, 838 (410) pg/mL; pTau, 24.0 (12.0) pg/mL; tTau, 257 (107) pg/mL.

The ability of the biomarkers to separate patients at lower vs. higher risk of cognitive decline (as measured by change in CDR-SB or MMSE) within 2 years was assessed using linear mixed-effects models. The models were adjusted for age, sex, education time and baseline value of the respective clinical score.

Due to different preanalytic handling procedures between BIOFINDER and ADNI, a bridging study RD002475 was used to adjust the cut offs from Biofinder to ADNI based on optimization for concordance with amyloid PET.

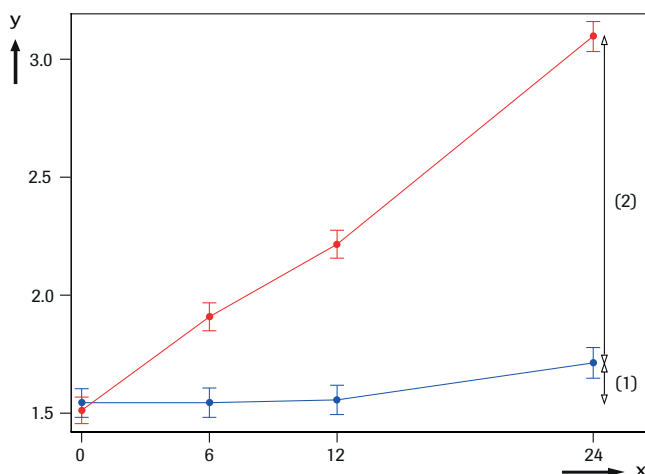
Using these cut-offs for cognitive decline analysis, the model-based average change in clinical scores (CDR-SB; MMSE) between baseline and 2 years in the biomarker-negative group (effect (1)) and the difference in change in clinical scores between biomarker-positive and -negative groups (effect (2)) were as follows:

Clinical score	Biomarker	Effect (1)	Effect (2)
		Estimate (95 % CI)	Estimate (95 % CI)
CDR-SB	Abeta42	0.31 (0.16, 0.46)	1.10 (0.89, 1.31)
	pTau/Abeta42	0.17 (0.02, 0.32)	1.42 (1.21, 1.62)
	tTau/Abeta42	0.21 (0.07, 0.35)	1.41 (1.20, 1.62)
MMSE	Abeta42	-0.25 (-0.53, 0.04)	-1.79 (-2.19, -1.40)
	pTau/Abeta42	-0.08 (-0.36, 0.20)	-2.17 (-2.56, -1.77)
	tTau/Abeta42	-0.13 (-0.40, 0.14)	-2.19 (-2.58, -1.79)

All 3 biomarkers separated patients at lower vs. higher risk of cognitive decline within 2 years. The ratios showed superior performance compared to the single marker Abeta42. For instance, change in CDR-SB and MMSE over 2 years between the biomarker-positive and -negative groups according to pTau/Abeta42 or tTau/Abeta42 ratio differed by more than 1 and -2.5 units (lower confidence limit of effect (2)), respectively. Biomarker ratio-negative patients did not show a change in CDR-SB and MMSE over 2 years more than 0.5 and -0.5 (upper confidence limit of effect (1)), respectively. These results did not change after additional adjustment for ApoE4 genotype (number of E4 alleles).

Model-based time course plot for change in CDR-SB over 2 years for pTau/Abeta42 ratio-based classification (without adjustment for ApoE4 genotype):

# Elecsys $\beta$ -Amyloid (1-42) CSF II

**cobas®**


x: Visit y: CDR-SB

Figure: Model-derived average and standard error of CDR-SB in pTau/Abeta42 ratio-positive (red) and -negative (blue) groups over follow-up time (x-axis; visit time point in months). Effects (1) and (2) as described above are symbolized by arrows.

## Cut-offs for PET concordance and cognitive decline

As the BioFINDER study used a different pre-analytical handling procedure compared to that described in the section "Specimen collection and preparation", an adjustment factor was determined in study RD002842 to adjust the cut offs for the new preanalytical protocol measured with the Elecsys  $\beta$ -Amyloid (1-42) CSF II assay. The adjustment factor was generated by bridging between the Biofinder preanalytical handling procedure, measured with Elecsys  $\beta$ -Amyloid (1-42) CSF first generation and the new preanalytical procedure measured with the Elecsys  $\beta$ -Amyloid (1-42) CSF II assay.

The new derived cut-offs for PET concordance and cognitive decline using the pre-analytical procedure described in the section "Specimen collection and preparation" are shown below:

If Abeta42  $\leq$  1030 pg/mL  $\Rightarrow$  test result positive.

If Abeta42  $>$  1030 pg/mL  $\Rightarrow$  test result negative.

If pTau/Abeta42 ratio\*  $>$  0.023  $\Rightarrow$  test result positive.

If pTau/Abeta42 ratio\*  $\leq$  0.023  $\Rightarrow$  test result negative.

\*The ratio should be rounded to 4 decimal places before comparing against 0.023. If the concentration of one of the analytes is outside the measuring range, the following rules apply:

In cases Abeta42  $<$  150 pg/mL, Abeta42  $>$  2500 pg/mL, pTau  $>$  120 pg/mL, pTau  $<$  8 pg/mL, the value should be set to the respective limit of the measuring range and the ratio should be calculated.

If tTau/Abeta42 ratio\*  $>$  0.28  $\Rightarrow$  test result positive.

If tTau/Abeta42 ratio\*  $\leq$  0.28  $\Rightarrow$  test result negative.

\*The ratio should be rounded to 3 decimal places before comparing against 0.28. If the concentration of one of the analytes is outside the measuring range, the following rules apply:

In cases Abeta42  $<$  150 pg/mL, Abeta42  $>$  2500 pg/mL, tTau  $>$  1300 pg/mL, tTau  $<$  80 pg/mL, the value should be set to the respective limit of the measuring range and the ratio should be calculated.

## References

- Vandenberghe R, Adamczuk K, Dupont P, et al. Amyloid PET in clinical practice: Its place in the multidimensional space of Alzheimer's disease. *Neuroimage Clinical* 2013;2:497-511.
- Blennow K, Zetterberg H, Anne M. Fluid Biomarkers in Alzheimer Disease. *Cold Spring Harb Perspect* 2012;2:a006221:1-23.

- Bates KA, Verdile G, Li QX, et al. Clearance mechanisms of Alzheimer's amyloid- $\beta$  peptide: implications for therapeutic design and diagnostic tests. *Molecular Psychiatry* 2009;14:469-486.
- Lewczuk P, Mroczko B, Fagan A, et al. Biomarkers of Alzheimer's disease and mild cognitive impairment: a current perspective. *Advances in Medical Sciences* 2015;60:76-82.
- Blennow K, Hampel H, Weiner M, et al. Cerebrospinal fluid and plasma biomarkers in Alzheimer disease. *Nat. Rev. Neurol.* 2010;6:131-144.
- Mattsson N, Zetterberg H, Hansson O, et al. CSF biomarkers and incipient Alzheimer disease in patients with mild cognitive impairment. *JAMA.* 2009;302(4):385-393.
- Hampel H, Blennow K. CSF tau and  $\beta$ -amyloid as biomarkers for mild cognitive impairment. *Dialogues Clin Neurosci.* 2004;6(4):379-390.
- Blom ES, Giedraitis V, Zetterberg H, et al. Rapid progression from mild cognitive impairment to Alzheimer's disease in subjects with elevated levels of tau in cerebrospinal fluid and the APOE epsilon4/epsilon4 genotype. *Dement Geriatr Cogn Disord.* 2009;27(5):458-464.
- Snider BJ, Fagan AM, Roe C, et al. Cerebrospinal fluid biomarkers and rate of cognitive decline in very mild dementia of the Alzheimer type. *Arch Neurol.* 2009;66(5):638-645.
- Li J-Q, Lan T, Hui-Fu W, et al. Risk factors for predicting progression from mild cognitive impairment to Alzheimer's disease: a systematic review and meta-analysis of cohort studies. *J Neurol Neurosurg Psychiatry* 2016; 87:476-484.
- Jack CR, Albert MS, Knopman DS, et al. Introduction to the recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimers Dement* 2011;7:257-62.
- Albert MS, DeKosky ST, Dickson D, et al. The diagnosis of mild cognitive impairment due to Alzheimer's disease. *Alzheimers & Dement* 2011;7:270-279.
- Dubois B, Feldman HH, Jacova C, et al. Advancing research diagnostic criteria for Alzheimer's disease: the IWG-2 criteria. *Lancet Neurol* 2014;13:614-629.
- EMA/CHMP/SAWP/893622/2011; Committee for Medicinal Products for Human Use (CHMP) ; 17 November 2011; Qualification opinion of Alzheimer's disease novel methodologies/biomarkers for the use of CSF AB 1-42 and t-tau signature and/or PET-amyloid imaging (positive/negative) as a biomarkers for enrichment, for use in regulatory clinical trials – in mild and moderate of Alzheimer's.
- EMA/CHMP/539931/2014 2; Committee for Medicinal Products for Human Use (CHMP); 28 January 2016; Draft guideline on the clinical investigation of medicines for the treatment of Alzheimer's disease and other dementias.
- Bittner T, Zetterberg H, Teunissen CE, et al. Technical performance of a novel, fully automated electrochemiluminescence immunoassay for the quantitation of  $\beta$ -amyloid (1-42) in human cerebrospinal fluid. *Alzheimers Dement* 2016;12:517-526.
- 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.
- [http://biofinder.se/the\\_biofinder\\_study\\_group/](http://biofinder.se/the_biofinder_study_group/)
- <http://www.adni-info.org/>

For further information, please refer to the appropriate user guide or operator's manual for the analyzer concerned, the respective application sheets 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.







Any serious incident that has occurred in relation to the device shall be reported to the manufacturer and the competent authority of the Member State in which the user and/or the patient is established.

# Elecsys $\beta$ -Amyloid (1-42) CSF II

**cobas<sup>®</sup>**

## Symbols

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

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

Rx only      For USA: Caution: Federal law restricts this device to sale by or on the order of a physician.

COBAS, NAVIFY, ELECSYS and PRECICONTROL are trademarks of Roche. INTRALIPID is a trademark of Fresenius Kabi AB.

All other product names and trademarks are the property of their respective owners.

Additions, deletions or changes are indicated by a change bar in the margin.

© 2023, Roche Diagnostics



Roche Diagnostics GmbH, Sandhofer Strasse 116, D-68305 Mannheim  
[www.roche.com](http://www.roche.com)

+800 5505 6606

