

Version 3 Last updated 19 November 2021

# ab240688 Human HE4 SimpleStep ELISA<sup>®</sup> Kit

For the quantitative measurement of HE4 in human serum, plasma (citrate), plasma (EDTA), saliva, urine, and cell culture supernatant samples.

This product is for research use only and is not intended for diagnostic use.

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## 1. Overview

HE4 *in vitro* SimpleStep ELISA® (Enzyme-Linked Immunosorbent Assay) kit is designed for the quantitative measurement of HE4 protein in human serum, plasma (citrate), plasma (EDTA), saliva, urine, and cell culture supernatant samples

The SimpleStep ELISA® employs an affinity tag labeled capture antibody and a reporter conjugated detector antibody which immunocapture the sample analyte in solution. This entire complex (capture antibody/analyte/detector antibody) is in turn immobilized via immunoaffinity of an anti-tag antibody coating the well. To perform the assay, samples or standards are added to the wells, followed by the antibody mix. After incubation, the wells are washed to remove unbound material. TMB Development Solution is added and during incubation is catalyzed by HRP, generating blue coloration. This reaction is then stopped by addition of Stop Solution completing any color change from blue to yellow. Signal is generated proportionally to the amount of bound analyte and the intensity is measured at 450 nm. Optionally, instead of the endpoint reading, development of TMB can be recorded kinetically at 600 nm.

HE4 (Human Epididymal Protein 4) is a secreted glycoprotein with anti-microbial and protease inhibitory functions. Overexpression of HE4 is seen in a variety of cancers, including lung adenocarcinomas, endometrial cancer, and breast cancer.

## 2. Protocol Summary

Prepare all reagents, samples, and standards as instructed



Add 50  $\mu$ L standard or sample to appropriate wells



Add 50  $\mu$ L Antibody Cocktail to all wells



Incubate at room temperature for 1 hour



Aspirate and wash each well three times with 350  $\mu$ L 1X Wash Buffer  
PT



Add 100  $\mu$ L TMB Development Solution to each well and incubate  
for 10 minutes.



Add 100  $\mu$ L Stop Solution and read OD at 450 nm

### 3. Precautions

**Please read these instructions carefully prior to beginning the assay.**

- All kit components have been formulated and quality control tested to function successfully as a kit.
- We understand that, occasionally, experimental protocols might need to be modified to meet unique experimental circumstances. However, we cannot guarantee the performance of the product outside the conditions detailed in this protocol booklet.
- Reagents should be treated as possible mutagens and should be handled with care and disposed of properly. Please review the Safety Datasheet (SDS) provided with the product for information on the specific components.
- Observe good laboratory practices. Gloves, lab coat, and protective eyewear should always be worn. Never pipet by mouth. Do not eat, drink or smoke in the laboratory areas.
- All biological materials should be treated as potentially hazardous and handled as such. They should be disposed of in accordance with established safety procedures.

### 4. Storage and Stability

**Store kit at +4°C immediately upon receipt. Kit has a storage time of 1 year from receipt, providing components have not been reconstituted.**

Refer to list of materials supplied for storage conditions of individual components.

## 5. Limitations

- Assay kit intended for research use only. Not for use in diagnostic procedures.
- Do not mix or substitute reagents or materials from other kit lots or vendors. Kits are QC tested as a set of components and performance cannot be guaranteed if utilized separately or substituted.

## 6. Materials Supplied

Item	Quantity	Storage Condition
Human HE4 Capture Antibody 10X	600 µL	+4°C
Human HE4 Detector Antibody 10X	600 µL	+4°C
Human HE4 Lyophilized Recombinant Protein	2 Vials	+4°C
Antibody Diluent 4BI	6 mL	+4°C
Wash Buffer PT 10X	20 mL	+4°C
Cell Extraction Enhancer Solution 50X	1 mL	+4°C
TMB Development Solution	12 mL	+4°C
Stop Solution	12 mL	+4°C
Sample Diluent 25BS	20 mL	+4°C
Sample Diluent NS	12 mL	+4°C
Anti-tag coated microplate (12 x 8 well strips)	96 Wells	+4°C
Plate Seal	1	+4°C

## 7. Materials Required, Not Supplied

These materials are not included in the kit, but will be required to successfully perform this assay:

- Microplate reader capable of measuring absorbance at 450 or 600 nm.
- Method for determining protein concentration (BCA assay recommended).
- Deionized water.
- Multi- and single-channel pipettes.
- Tubes for standard dilution.
- Plate shaker for all incubation steps.
- Optional: Phenylmethylsulfonyl Fluoride (PMSF) (or other protease inhibitors).

## 8. Technical Hints

- Samples generating values higher than the highest standard should be further diluted in the appropriate sample dilution buffers.
- Avoid foaming or bubbles when mixing or reconstituting components.
- Avoid cross contamination of samples or reagents by changing tips between sample, standard and reagent additions.
- Ensure plates are properly sealed or covered during incubation steps.
- Complete removal of all solutions and buffers during wash steps is necessary to minimize background.
- As a guide, typical ranges of sample concentration for commonly used sample types are shown below in Sample Preparation (section 11).
- All samples should be mixed thoroughly and gently.
- Avoid multiple freeze/thaw of samples.
- Incubate ELISA plates on a plate shaker during all incubation steps.
- When generating positive control samples, it is advisable to change pipette tips after each step.

- The provided Cell Extraction Enhancer Solution 50X may precipitate when stored at + 4°C. To dissolve, warm briefly at + 37°C and mix gently. The Cell Extraction Enhancer Solution 50X can be stored at room temperature to avoid precipitation.
- **To avoid high background always add samples or standards to the well before the addition of the antibody cocktail.**
- **This kit is sold based on number of tests. A 'test' simply refers to a single assay well. The number of wells that contain sample, control or standard will vary by product. Review the protocol completely to confirm this kit meets your requirements. Please contact our Technical Support staff with any questions.**

## 9. Reagent Preparation

- Equilibrate all reagents to room temperature (18-25°C) prior to use. The kit contains enough reagents for 96 wells. The sample volumes below are sufficient for 48 wells (6 x 8-well strips); adjust volumes as needed for the number of strips in your experiment.
- Sample Diluent 25BS may contain precipitate, this is normal. If precipitate is not dissolved by gentle mixing, the precipitate may be dissolved by gentle warming and mixing at 37°C for 10 minutes. If precipitate remains, gently spin down and avoid visible precipitates when pipetting.
- Prepare only as much reagent as is needed on the day of the experiment. Capture and Detector Antibodies have only been tested for stability in the provided 10X formulations.

### 9.1 Sample Diluent 25BS + Enhancer:

Prepare Sample Diluent 25BS + Enhancer by diluting 50X Cell Extraction Enhancer Solution to 1X in Sample Diluent 25BS. To make 10 mL Sample Diluent 25BS + Enhancer, combine 9.8 mL Sample Diluent 25BS and 200  $\mu$ L Cell Extraction Enhancer Solution 50X. Mix thoroughly and gently. If required protease inhibitors can be added.

### 9.2 Sample Diluent NS + Enhancer:

Prepare Sample Diluent NS + Enhancer by diluting 50X Cell Extraction Enhancer Solution to 1X in Sample Diluent NS. To make 10 mL Sample Diluent NS + Enhancer, combine 9.8 mL Sample Diluent NS and 200  $\mu$ L Cell Extraction Enhancer Solution 50X. Mix thoroughly and gently. If required protease inhibitors can be added.

### 9.3 1X Wash Buffer PT:

Prepare 1X Wash Buffer PT by diluting Wash Buffer PT 10X with deionized water. To make 50 mL 1X Wash Buffer PT combine 5 mL Wash Buffer PT 10X with 45 mL deionized water. Mix thoroughly and gently.

### 9.4 Antibody Cocktail:

Prepare Antibody Cocktail by diluting the capture and detector antibodies in Antibody Diluent 4BI. To make 3 mL of the Antibody Cocktail combine 300  $\mu$ L 10X Capture Antibody and 300  $\mu$ L 10X Detector Antibody with 2.4 mL Antibody Diluent 4BI. Mix thoroughly and gently.

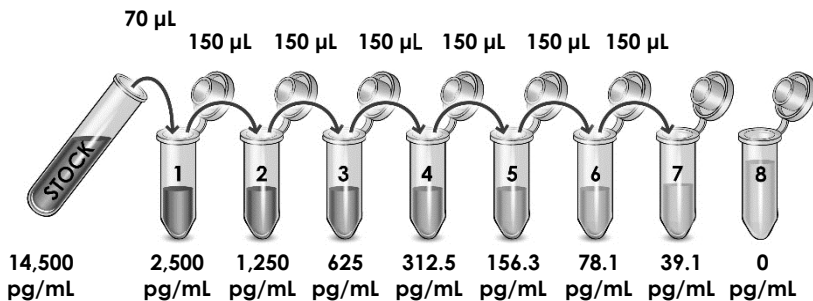
## 10. Standard Preparation

- Always prepare a fresh set of standards for every use.
- Discard working standard dilutions after use as they do not store well.
- The following section describes the preparation of a standard curve for duplicate measurements (recommended).

**IMPORTANT:** If the protein standard vial has a volume identified on the label, reconstitute the HE4 by adding that volume of Diluent indicated on the label. Alternatively, if the vial has a mass identified, reconstitute the HE4 standard by adding 500  $\mu\text{L}$  Diluent.

### 10.1 For serum and plasma samples follow these instructions:

- 10.1.1 Reconstitute the HE4 standard sample by adding Sample Diluent 25BS + Enhancer. Hold at room temperature for 10 minutes and mix thoroughly and gently. This is the 14.5 ng/mL **Stock Standard Solution**.
- 10.1.2 Label eight tubes, Standards 1– 8.
- 10.1.3 Add 336  $\mu\text{L}$  of Sample Diluent 25BS + Enhancer into tube number 1 and 150  $\mu\text{L}$  of Sample Diluent 25BS + Enhancer into numbers 2-8.
- 10.1.4 Use the Stock Standard to prepare the following dilution series. Standard #8 contains no protein and is the Blank control:



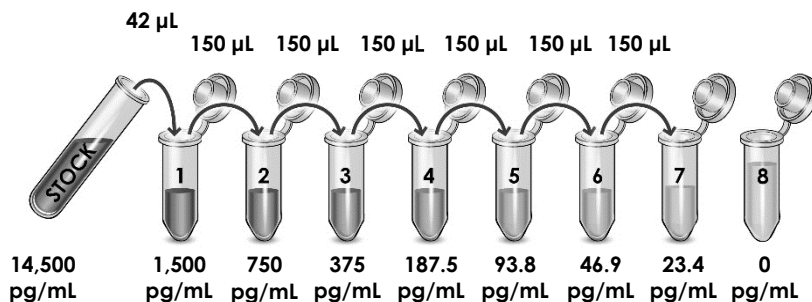
**10.2** For **saliva, urine, and cell culture supernatant samples** follow these instructions:

10.2.1 Reconstitute the HE4 standard sample by adding Sample Diluent NS + Enhancer. Hold at room temperature for 10 minutes and mix thoroughly and gently. This is the 14.5 ng/mL **Stock Standard** Solution.

10.2.2 Label eight tubes, Standards 1– 8.

10.2.3 Add 364  $\mu\text{L}$  of Sample Diluent NS + Enhancer into tube number 1 and 150  $\mu\text{L}$  of Sample Diluent NS + Enhancer into numbers 2-8.

10.2.4 Use the Stock Standard to prepare the following dilution series. Standard #8 contains no protein and is the Blank control:



## 11. Sample Preparation

Typical Sample Dynamic Range	
Sample Type	Range
Serum	0.8 – 25%
Plasma - Citrate	0.8 – 25%
Plasma - EDTA	0.8 – 25%
Saliva	1: 32,000 – 1: 1,000
Urine	1: 32,000 – 1: 1,000
OVCAR-3 cell culture supernatant	1: 16,000 – 1: 1,000

### 11.1 Serum:

Samples should be collected into a serum separator tube. After clot formation, centrifuge samples at 2,000 x g for 10 minutes and collect serum. Add 50X Enhancer to serum to a final concentration of 1X. Then dilute samples at least 1:4 into Sample Diluent 25BS + Enhancer and assay. Any serial dilutions should be made in Sample Diluent 25BS + Enhancer. Store undiluted serum at -20°C or below. Avoid repeated freeze-thaw cycles.

### 11.2 Plasma:

Collect plasma using citrate or EDTA. Centrifuge samples at 2,000 x g for 10 minutes. Add 50X Enhancer to plasma to a final concentration of 1X. Then dilute samples at least 1:4 into Sample Diluent 25BS + Enhancer and assay. Any serial dilutions should be made in Sample Diluent 25BS + Enhancer. Store undiluted plasma samples at -20°C or below for up to 3 months. Avoid repeated freeze-thaw cycles.

### 11.3 Saliva:

Centrifuge saliva at 800 x g for 10 minutes to remove debris. Then dilute samples at least 1:1000 into Sample Diluent NS + Enhancer and assay. Any serial dilutions should be made in Sample Diluent NS + Enhancer. Store un-diluted samples at -20°C or below. Avoid repeated freeze-thaw cycles.

#### **11.4 Urine:**

Centrifuge urine at 2,000 x g for 10 minutes to remove debris. Dilute samples at least 1: 1,000 into Sample Diluent NS + Enhancer and assay. Store un-diluted urine samples at -20°C or below. Avoid repeated freeze-thaw cycles.

#### **11.5 Cell Culture Supernatants:**

Centrifuge cell culture media at 2,000 x g for 10 minutes to remove debris. Collect supernatants and assay. Or dilute samples at least 1: 1,000 into Sample Diluent NS + Enhancer and assay. Store un-diluted samples at -20°C or below. Avoid repeated freeze-thaw cycles.

## 12. Plate Preparation

- The 96 well plate strips included with this kit are supplied ready to use. It is not necessary to rinse the plate prior to adding reagents.
- Unused plate strips should be immediately returned to the foil pouch containing the desiccant pack, resealed and stored at 4°C.
- For each assay performed, a minimum of two wells must be used as the zero control.
- For statistical reasons, we recommend each sample should be assayed with a minimum of two replicates (duplicates).
- Differences in well absorbance or “edge effects” have not been observed with this assay.

## 13. Assay Procedure

- Equilibrate all materials and prepared reagents to room temperature prior to use.
  - We recommend that you assay all standards, controls and samples in duplicate.
- 13.1** Prepare all reagents, working standards, and samples as directed in the previous sections.
  - 13.2** Remove excess microplate strips from the plate frame, return them to the foil pouch containing the desiccant pack, reseal and return to 4°C storage.
  - 13.3** Add 50 µL of all sample or standard to appropriate wells.
  - 13.4** Add 50 µL of the Antibody Cocktail to each well.
  - 13.5** Seal the plate and incubate for 1 hour at room temperature on a plate shaker set to 400 rpm.
  - 13.6** Wash each well with 3 x 350 µL 1X Wash Buffer PT. Wash by aspirating or decanting from wells then dispensing 350 µL 1X Wash Buffer PT into each well. Wash Buffer PT should remain in wells for at least 10 seconds. Complete removal of liquid at each step is essential for good performance. After the last wash invert the plate and tap gently against clean paper towels to remove excess liquid.
  - 13.7** Add 100 µL of TMB Development Solution to each well and incubate for 10 minutes in the dark on a plate shaker set to 400 rpm.

*Given variability in laboratory environmental conditions, optimal incubation time may vary between 5 and 20 minutes.*

*Note: The addition of Stop Solution will change the color from blue to yellow and enhance the signal intensity about 3X. To avoid signal saturation, proceed to the next step before the high concentration of the standard reaches a blue color of O.D.600 equal to 1.0.*
  - 13.8** Add 100 µL of Stop Solution to each well. Shake plate on a plate shaker for 1 minute to mix. Record the OD at 450 nm. This is an endpoint reading.
  - 13.9** Alternative to 13.7 – 13.8: Instead of the endpoint reading at 450 nm, record the development of TMB Substrate kinetically. Immediately after addition of TMB Development Solution begin recording the blue color development with elapsed

time in the microplate reader prepared with the following settings:

<b>Mode</b>	<b>Kinetic</b>
Wavelength:	600 nm
Time:	up to 20 min
Interval:	20 sec - 1 min
Shaking:	Shake between readings

Δ **Note:** that an endpoint reading can also be recorded at the completion of the kinetic read by adding 100 µL Stop Solution to each well and recording the OD at 450 nm.

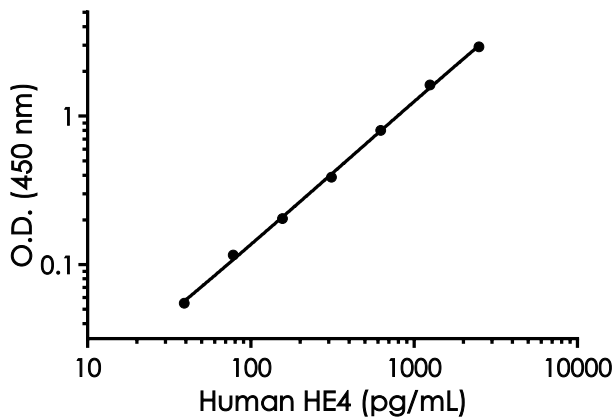
**13.10** Analyze the data as described below.

## 14. Calculations

- 14.1 Calculate the average absorbance value for the blank control (zero) standards. Subtract the average blank control standard absorbance value from all other absorbance values.
- 14.2 **Create a standard curve** by plotting the average blank control subtracted absorbance value for each standard concentration (y-axis) against the target protein concentration (x-axis) of the standard. Use graphing software to draw the best smooth curve through these points to construct the standard curve.
  - Δ **Note:** Most microplate reader software or graphing software will plot these values and fit a curve to the data. A four parameter curve fit (4PL) is often the best choice; however, other algorithms (e.g. linear, semi-log, log/log, 4 parameter logistic) can also be tested to determine if it provides a better curve fit to the standard values.
- 14.3 Determine the concentration of the target protein in the sample by interpolating the blank control subtracted **absorbance values against the standard curve**. Multiply the resulting value by the appropriate sample dilution factor, if used, to obtain the concentration of target protein in the sample.
- 14.4 Samples generating absorbance values greater than that of the highest standard should be further diluted and reanalyzed. Similarly, samples which measure at an absorbance values less than that of the lowest standard should be retested in a less dilute form.

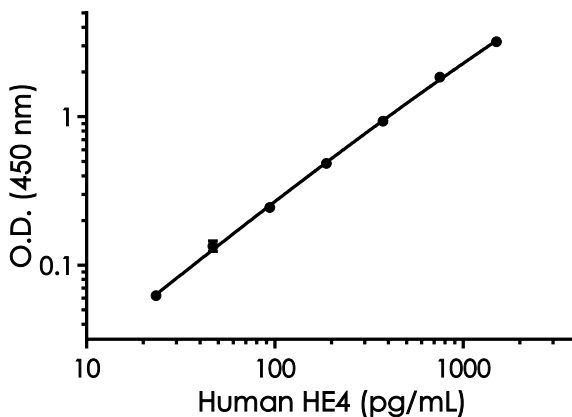
## 15. Typical Data

Typical standard curve – data provided for demonstration purposes only. A new standard curve must be generated for each assay performed.



Standard Curve Measurements			
Concentration (pg/mL)	O.D 450 nm		Mean O.D
	1	2	
0	0.085	0.084	0.084
39.1	0.140	0.139	0.139
78.1	0.198	0.202	0.200
156.3	0.296	0.280	0.288
312.5	0.466	0.479	0.473
625	0.867	0.905	0.886
1250	1.698	1.710	1.704
2500	2.991	3.022	3.006

**Figure 1.** Example of human HE4 standard curve in Sample Diluent 25BS + Enhancer. The HE4 standard curve was prepared as described in Section 10. Raw data values are shown in the table. Background-subtracted data values (mean +/- SD) are graphed.



Standard Curve Measurements			
Concentration (pg/mL)	O.D 450 nm		Mean O.D
	1	2	
0	0.097	0.103	0.100
23.4	0.163	0.166	0.165
46.9	0.229	0.245	0.237
93.8	0.343	0.350	0.347
187.5	0.575	0.600	0.587
375	1.027	1.039	1.033
750	1.939	1.964	1.951
1500	3.277	3.310	3.294

**Figure 2.** Example of human HE4 standard curve in Sample Diluent NS + Enhancer. The HE4 standard curve was prepared as described in Section 10. Raw data values are shown in the table. Background-subtracted data values (mean +/- SD) are graphed.

## 16. Typical Sample Values

### SENSITIVITY –

The calculated minimal detectable dose (MDD) is 5.2 pg/mL in Sample Diluent 25BS + Enhancer and 7.1 pg/mL in Sample Diluent NS + Enhancer. The MDD was determined by calculating the mean of zero standard replicates (n=25) and adding 2 standard deviations then extrapolating the corresponding concentration.

### RECOVERY –

Three concentrations of HE4 recombinant standard protein were spiked in duplicate to the indicated biological matrix to evaluate signal recovery in the working range of the assay.

Sample Type	Average % Recovery	Range (%)
Serum (6.3%)	108	99 – 116
Plasma – Citrate (6.3%)	100	88 – 115
Plasma – EDTA (6.3%)	115	111 – 119
Saliva (1: 4,000)	118	111 – 123
Urine (1: 4,000)	108	106 – 111
OVCAR-3 cell culture supernatant (1: 2,000)	106	98 – 112

## Linearity of Dilution

Linearity of dilution is determined based on interpolated values from the standard curve. Linearity of dilution defines a sample concentration interval in which interpolated target concentrations are directly proportional to sample dilution.

Native HE4 was measured in the following biological samples in a 2-fold dilution series. Sample dilutions are made in Sample Diluent 25BS + Enhancer.

Dilution Factor	Interpolated value	25% Human Serum	25% Human Plasma (Citrate)	25% Human Plasma (EDTA)
Undiluted	pg/mL	1595	1243	1337
	<b>% Expected value</b>	100	100	100
2	pg/mL	747	666	726
	<b>% Expected value</b>	94	107	109
4	pg/mL	359	336	357
	<b>% Expected value</b>	90	108	107
8	pg/mL	164	154	161
	<b>% Expected value</b>	82	99	96
16	pg/mL	79	71	67
	<b>% Expected value</b>	84	91	81

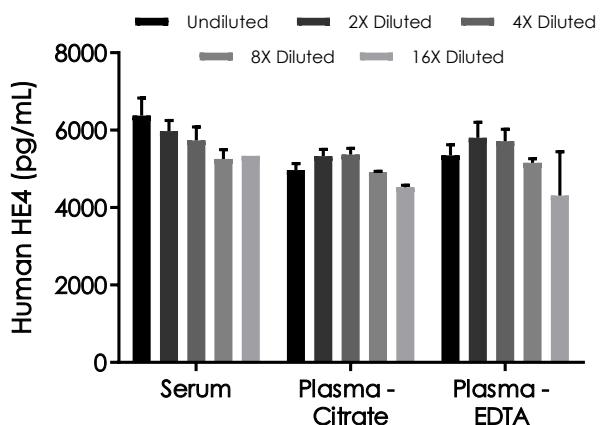
Native HE4 was measured in the following biological samples in a 2-fold dilution series. Sample dilutions are made in Sample Diluent NS + Enhancer.

Dilution Factor	Interpolated value	1: 1,000 Human Saliva	1: 1,000 Human Urine	1: 1,000 OVCAR-3 Supernatant
Undiluted	pg/mL	1463	1288	520
	<b>% Expected value</b>	100	100	100
2	pg/mL	737	623	253
	<b>% Expected value</b>	101	97	97
4	pg/mL	351	303	129
	<b>% Expected value</b>	96	94	99
8	pg/mL	167	152	62
	<b>% Expected value</b>	91	94	95
16	pg/mL	88	78	38
	<b>% Expected value</b>	96	97	117

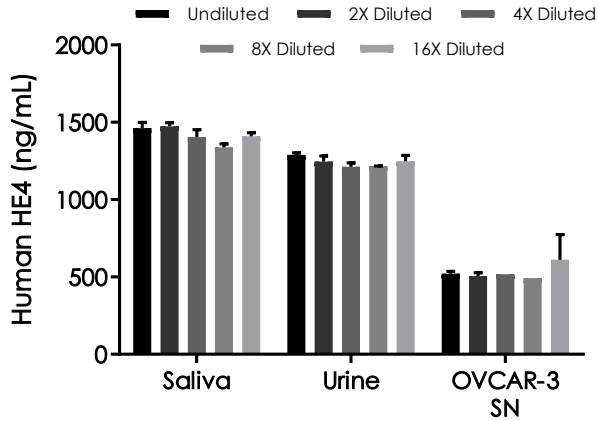
## PRECISION –

Mean coefficient of variations of interpolated values of HE4 from three concentrations of OVCAR-3 cell culture supernatant within the working range of the assay.

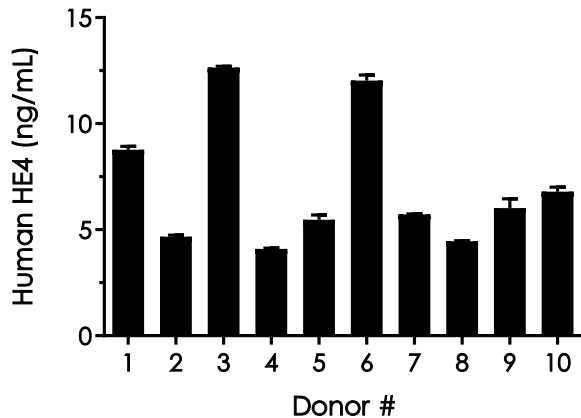
	Intra- Assay	Inter- Assay
n =	5	3
CV(%)	3.9%	6.2%



**Figure 3.** Interpolated concentrations of native HE4 in human serum, plasma (citrate), and plasma (EDTA) samples. The concentrations of HE4 were measured in duplicates, interpolated from the HE4 standard curves and corrected for sample dilution. Undiluted samples are as follows: serum 25%, plasma (citrate) 25%, and plasma (EDTA) 25%. The interpolated dilution factor corrected values are plotted (mean +/- SD, n=2). The mean HE4 concentration was determined to be 5,723 pg/mL in serum, 5,017 pg/mL in plasma (citrate), and 5,396 pg/mL in plasma (EDTA).



**Figure 4.** Interpolated concentrations of native HE4 in human saliva, urine, and cell culture supernatant samples. The concentrations of HE4 were measured in duplicates, interpolated from the HE4 standard curves and corrected for sample dilution. Undiluted samples are as follows: saliva 1: 1,000, urine 1: 1,000, and OVCAR-3 cell culture supernatant 1: 1,000. The interpolated dilution factor corrected values are plotted (mean +/- SD, n=2). The mean HE4 concentration was determined to be 1,405 ng/mL in saliva, 1,237 ng/mL in urine, and 530 ng/mL in OVCAR-3 cell culture supernatant.



**Figure 5.** Serum from ten individual healthy human female donors was measured in duplicate. Interpolated dilution factor corrected values are plotted (mean +/- SD, n=2). The mean HE4 concentration was determined to be 7067 pg/mL with a range of 4099 – 12,026 pg/mL.

## 17. Assay Specificity

This kit recognizes both native and recombinant human HE4 protein in serum, plasma (citrate), plasma (EDTA), saliva, urine, and cell culture supernatant only.

Cell and tissue extract samples have not been tested with this kit. Plasma (heparin) is incompatible with this kit.

## 18. Species Reactivity

This kit recognizes human HE4 protein.

Other species reactivity was determined by measuring 25% mouse, rat, and bovine serum samples, interpolating the HE4 protein concentrations from the human standard curve, and expressing the interpolated concentrations as a percentage of the HE4 protein concentration in human serum assayed at the same dilution.

Reactivity < 3% was determined for the following species:

- Mouse
- Rat
- Cow

Please contact our Technical Support team for more information.

## 19. Troubleshooting

Problem	Reason	Solution
<b>Poor standard curve</b>	Inaccurate Pipetting	Check pipettes
	Improper standard dilution	Prior to opening, briefly spin the stock standard tube and dissolve the powder thoroughly by gentle mixing
<b>Low Signal</b>	Incubation times too brief	Ensure sufficient incubation times; increase to 2 or 3 hour standard/sample incubation
	Inadequate reagent volumes or improper dilution	Check pipettes and ensure correct preparation
	Incubation times with TMB too brief	Ensure sufficient incubation time until blue color develops prior addition of Stop solution
<b>Large CV</b>	Plate is insufficiently washed	Review manual for proper wash technique. If using a plate washer, check all ports for obstructions.
	Contaminated wash buffer	Prepare fresh wash buffer
<b>Low sensitivity</b>	Improper storage of the ELISA kit	Store your reconstituted standards at -80°C, all other assay components 4°C. Keep TMB Development Solution protected from light.
<b>Precipitate in Diluent</b>	Precipitation and/or coagulation of components within the Diluent.	Precipitate can be removed by gently warming the Diluent to 37°C.

# 20. Notes

## Technical Support

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