Access
Immunoassay Systems

hLH
REF 33510

Intended Use

The Access hLH assay is a paramagnetic particle, chemiluminescent immunoassay for the quantitative determination of luteinizing hormone (LH) levels in human serum and plasma using the Access Immunoassay Systems.

Summary and Explanation

Human Luteinizing Hormone (hLH, Lutropin) is made up of two non-identical, non-covalently associated glycoprotein subunits, denoted alpha and beta. It has been reported that the 28,500 dalton molecular weight hLH contains two N-linked carbohydrate chains on the alpha subunit and one asparagine-linked oligosaccharide on the beta subunit. The alpha subunit is similar in structure for the glycoproteins hLH, hCG, hFSH, and hTSH. It is the differences in the beta subunit of these glycoproteins which contributes to immunological and physiological specificity.[1,2,3]

In the female, hLH stimulates the final maturation of the follicle, follicular rupture, and ovulation.[3] Human LH is secreted by the gonadotropic cells of the anterior lobe of the pituitary gland in response to gonadotropin releasing hormone (GnRH) from the medial basal hypothalamus. Both hLH and hFSH are secreted in a pulsatile nature; however, this is less noticeable for hFSH perhaps due to the longer half life in the circulation.[3] In a normal menstrual cycle negative feedback by estradiol suppresses hLH secretion in the follicular phase. As the follicle develops (in response to hFSH) estradiol production increases which triggers an increase in GnRH and an increased sensitivity of the pituitary to GnRH. A GnRH surge results in the preovulatory (mid-cycle) surge of hLH and ovulation. Following this surge, hLH is suppressed during the luteal phase due to negative feedback from progesterone and estradiol.[3,4,5]

Variation in cycle lengths are observed in normally menstruating females due to variations in the length of the follicular phase. In the menopausal female, hLH levels are elevated in response to decreased production of ovarian estrogens and progestogens, which eliminates the negative feedback mechanism on the pituitary gland. As a result, ovulation and menstrual cycles decrease and eventually cease.[6]

In the male, hLH is often referred to as interstitial cell-stimulating hormone and influences the production of testosterone by the Leydig cells of the testes.[7]

Concentrations of hLH and hFSH are commonly determined in investigations of menstrual cycle, fertility, and pubertal developmental abnormalities, such as premature ovarian failure, menopause, ovulatory disorders and pituitary failure.[8] The ratio of hLH/hFSH has been used to assist in the diagnosis of polycystic ovary disease. Low concentrations of hLH and hFSH may indicate pituitary failure while elevated concentrations of hLH and hFSH along with decreased concentrations of gonadal steroids may indicate gonadal failure (menopause, ovariectomy, premature ovarian syndrome, Turners Syndrome).[9] Low concentrations of gonadotropin are usually observed in females taking oral steroid based contraceptives.[10] In the male, elevated hLH and hFSH with low concentrations of gonadal steroids may indicate testicular failure or anorchia. In Klinefelter's syndrome hLH may be elevated due to Sertoli cell failure.[11]

Principles of the Procedure

The Access hLH assay is a sequential two-step immunoenzymatic ("sandwich") assay. Sample is added to a reaction vessel, along with paramagnetic particles coated with goat anti-mouse: mouse anti-hLH complexes and TRIS buffered saline with protein. The hLH binds to the immobilized mouse anti-hLH on the solid phase. Materials bound to the solid phase are held in

a magnetic field while unbound materials are washed away. Alkaline phosphatase conjugated goat anti-hLH is then added, which binds to the previously bound hLH on the particles. A second separation and wash step removes unbound conjugate. Then, the chemiluminescent substrate Lumi-Phos* 530 is added to the vessel and light generated by the reaction is measured with a luminometer. The light production is directly proportional to the concentration of hLH in the sample. The amount of analyte in the sample is determined from a stored, multi-point calibration curve.

Product Information

Access hLH Reagent Pack

Cat. No. 33510: 100 determinations, 2 packs, 50 tests/pack

- Provided ready to use.
- Store upright and refrigerate at 2 to 10°C.
- Refrigerate at 2 to 10°C for a minimum of two hours before use on the instrument.
- Stable until the expiration date stated on the label when stored at 2 to 10°C.
- Stable at 2 to 10°C for 28 days after initial use.
- Signs of possible deterioration are a broken elastomeric layer on the pack or control values out of range.
- If the reagent pack is damaged (i.e., broken elastomer), discard the pack.
- All antisera are polyclonal unless otherwise indicated.

R1a:	Paramagnetic particles coated with goat anti-mouse IgG: mouse monoclonal anti-hLH complexes suspended in TRIS buffered saline with bovine serum albumin (BSA), surfactant, < 0.1% sodium azide, and 0.1% ProClin** 300.
R1b:	TRIS-buffered saline with BSA, protein (mouse, goat), surfactant, < 0.1% sodium azide, and 0.1% ProClin 300.
R1c:	Goat anti-hLH-alkaline phosphatase conjugate in TRIS saline buffer with BSA, protein (goat), surfactant, < 0.1% sodium azide, and 0.1% ProClin 300.

Warnings and Precautions

- For *in vitro* diagnostic use.
- Patient samples and blood-derived products may be routinely processed with minimum risk using the procedure described. However, handle these products as potentially infectious according to universal precautions and good clinical laboratory practices, regardless of their origin, treatment, or prior certification. Use an appropriate disinfectant for decontamination. Store and dispose of these materials and their containers in accordance with local regulations and guidelines.
- Sodium azide may react with lead and copper plumbing to form highly explosive metal azides. On disposal of liquids, flush with a large volume of water to prevent azide build-up.[12]
- Xi. Irritant: 0.1% ProClin 300.

R 43: May cause sensitization by skin contact.

S 28-37: After contact with skin, wash immediately with plenty of soap and water. Wear suitable gloves.

- The Material Safety Data Sheet (MSDS) is available upon request.

Specimen Collection and Preparation

1. Serum and plasma (heparin) are the recommended samples.
2. Observe the following recommendations for handling, processing, and storing blood samples:[13]
   - Collect all blood samples observing routine precautions for venipuncture.

- Allow serum samples to clot completely before centrifugation.
- Keep tubes stoppered at all times.
- Within two hours after centrifugation, transfer at least 500 µL of cell-free sample to a storage tube. Tightly stopper the tube immediately.
- Store samples tightly stoppered at room temperature (15 to 30°C) for no longer than eight hours.
- If the assay will not be completed within eight hours, refrigerate the samples at 2 to 8°C.
- If the assay will not be completed within 48 hours, or for shipment of samples, freeze at -20°C or colder.
- Thaw samples only once.

3. Use the following guidelines when preparing specimens:
   - Ensure residual fibrin and cellular matter has been removed prior to analysis.
   - Follow blood collection tube manufacturer's recommendations for centrifugation.
4. Each laboratory should determine the acceptability of its own blood collection tubes and serum separation products. Variations in these products may exist between manufacturers and, at times, from lot-to-lot.
5. Beckman Coulter, Inc. recommends that frozen specimens can be stored up to six months before testing.

Materials Provided

R1 Access hLH Reagent Packs

Materials Required But Not Provided

1. Access hLH Calibrators
   Provided at zero and approximately 2, 10, 25, 100 and 250 mIU/mL (IU/L)
   Cat. No. 33515
2. Quality Control (QC) materials: commercial control material
3. Access Sample Diluent A
   Vial Cat. No. 81908
   Diluent Pack Cat. No. A79783 (For use with the UniCel DxI system onboard dilution feature.)
4. Access Substrate
   Cat. No. 81906
5. **Access, Access 2, SYNCHRON LXi:**
   Access Wash Buffer II, Cat. No. A16792
   UniCel DxI:
   UniCel DxI Wash Buffer II, Cat. No. A16793

Procedural Comments

1. Refer to the appropriate system manuals and/or Help system for a specific description of installation, start-up, principles of operation, system performance characteristics, operating instructions, calibration procedures, operational limitations and precautions, hazards, maintenance, and troubleshooting.
2. Mix contents of new (unpunctured) reagent packs by gently inverting pack several times before loading on the instrument. Do not invert open (punctured) packs.
3. Use fifty-five (55) µL of sample for each determination in addition to the sample container and system dead volumes. Use one hundred fifty-five (155) µL of sample in addition to the sample container and system dead volumes for each determination run with the DxI system onboard dilution feature. Refer to the appropriate system manuals and/or Help system for the minimum sample volume required.
4. The system default unit of measure for sample results is mIU/mL. To change sample reporting units to the International System of Units (SI units), IU/L, refer to the appropriate system manuals and/or Help system. To manually convert concentrations to the International System, multiply mIU/mL by multiplication factor 1.

Procedure

Refer to the appropriate system manuals and/or Help system for information on managing samples, configuring tests, requesting tests, and reviewing test results.

Calibration Details

An active calibration curve is required for all tests. For the Access hLH assay, calibration is required every 28 days. Refer to the appropriate system manuals and/or Help system for information on calibration theory, configuring calibrators, calibrator test request entry, and reviewing calibration data.

Quality Control

Quality control materials simulate the characteristics of patient samples and are essential for monitoring the system performance of immunochemical assays. Because samples can be processed at any time in a "random access" format rather than a "batch" format, quality control materials should be included in each 24-hour time period.[14] Include commercially available quality control materials that cover at least two levels of analyte. More frequent use of controls or the use of additional controls is left to the discretion of the user based on good laboratory practices or laboratory accreditation requirements and applicable laws. Follow manufacturer's instructions for reconstitution and storage. Each laboratory should establish mean values and acceptable ranges to assure proper performance. Quality control results that do not fall within acceptable ranges may indicate invalid test results. Examine all test results generated since obtaining the last acceptable quality control test point for this analyte. Refer to the appropriate system manuals and/or Help system for information about reviewing quality control results.

Results

Patient test results are determined automatically by the system software using a smoothing spline math model. The amount of analyte in the sample is determined from the measured light production by means of the stored calibration data. Patient test results can be reviewed using the appropriate screen. Refer to the appropriate system manuals and/or Help system for complete instructions on reviewing sample results.

Limitations of the Procedure

1. Samples can be accurately measured within the analytic range of the lower limit of detection and the highest calibrator value (approximately 0.2–250 mIU/mL [IU/L]).
   - If a sample contains less than the lower limit of detection for the assay, report the results as less than that value (i.e., < 0.2 mIU/mL [IU/L]). When the DxI system onboard dilution feature is used, the system will report results as less than 213 mIU/mL (IU/L).
   - If a sample contains more than the stated value of the highest Access hLH Calibrator (S5), report the result as greater than that value (i.e., > 250 mIU/mL [IU/L]). Alternatively, dilute one volume of sample with one volume of Access hLH Calibrator S0 (zero) or Access Sample Diluent A. Refer to the appropriate system manuals and/or Help system for instructions on entering a sample dilution in a test request. The system reports the results adjusted for the dilution.

     The DxI system onboard dilution feature automates the dilution process, using one volume of sample with one volume of Access Sample Diluent A, allowing samples to be quantitated up to approximately 500 mIU/mL (IU/L). The system reports the results adjusted for the dilution.
2. For assays employing antibodies, the possibility exists for interference by heterophile antibodies in the patient sample. Patients who have been regularly exposed to animals or have received immunotherapy or diagnostic procedures utilizing immunoglobulins or immunoglobulin fragments may produce antibodies, e.g. HAMA, that interfere with immunoassays. Additionally, other heterophile antibodies such as human anti-goat antibodies may be present in patient samples.[15,16]

   Such interfering antibodies may cause erroneous results. Carefully evaluate the results of patients suspected of having these antibodies.

3. The Access hLH results should be interpreted in light of the total clinical presentation of the patient, including: symptoms, clinical history, data from additional tests and other appropriate information.

Expected Values

1. Each laboratory should establish its own reference ranges to assure proper representation of specific populations.
2. hLH levels were measured in human serum samples from 50 adult males, 50 postmenopausal females, and 26 normal cycling females. The cycles were synchronized to the mid-cycle hLH peak. The range of hLH levels generated at Beckman Coulter, Inc., are summarized below:

	Males hLH (mIU/mL)	Females hLH (mIU/mL)			
		Mid-Follicular Phase	Mid-Cycle Peak	Mid-Luteal Phase	Postmenopausal
Number	50	29	26	27	50
Mean	3.75	5.88	52.84	4.84	30.55
Range	1.24–8.62	2.12–10.89	19.18–103.03	1.20–12.86	10.87–58.64

Specific Performance Characteristics

Methods Comparison

A comparison of 188 serum values using the Access hLH assay on the Access Immunoassay system and a commercially available enzyme immunoassay kit gave the following statistical data:

n	Range of Observations (mIU/mL)	Intercept (mIU/mL)	Slope	Correlation Coefficient (r)
188	0.7–85.97	1.32	0.99	0.97

A comparison of hLH values obtained by assaying paired serum and plasma samples using the Access hLH assay on the Access Immunoassay System gave the following statistical data:

n	Range of Observations (mIU/mL)	Intercept (mIU/mL)	Slope	Correlation Coefficient (r)
147	0.5–67.94	-0.26	1.03	1.00

Dilution Recovery (Linearity)

Gravimetric dilutions of two samples containing various hLH levels with Access hLH Calibrator S0 (zero) resulted in the following data:

Sample 1	Expected Concentration (mIU/mL)	Determined Concentration (mIU/mL)	Recovery (%)
Neat	N/A	130.91	N/A
1/2	65.46	65.61	100.2
1/5	26.18	25.83	98.7
1/20	6.55	7.05	107.6
		Mean % Recovery	**102.2**

Sample 2	Expected Concentration (mIU/mL)	Determined Concentration (mIU/mL)	Recovery (%)
Neat	N/A	133.67	N/A
1/2	66.84	64.80	96.9
1/5	26.73	26.02	97.3
1/20	6.68	6.87	102.8
		Mean % Recovery	**99.0**

Imprecision

This assay exhibits total imprecision of less than 10% across the assay range. One study, using commercially available human serum based control material generating a total of two assays, two replicates per assay, over 10 days provides the following data, analyzed via analysis of variance (ANOVA).[17,18]

Sample	Grand Mean (n=40) (mIU/mL)	Within Run (%CV)	Total Imprecision (%CV)
Low	4.01	3.8	6.4
Medium	16.37	3.6	4.3
High	55.04	5.4	5.4

Analytical Specificity/Interferences

Interferents were added to samples with hLH concentrations of approximately 25 mg/dL. Significant interference (< 10% bias) was not found for the following interferents at the indicated concentrations:

Interferent Tested	Concentration Added
Bilirubin	10 mg/dL
Hemoglobin	300 mg/dL
Triglycerides (Triolein)	1800 mg/dL
Total protein (human serum albumin)	3 g/dL

Samples containing hLH concentrations of approximately 22 mg/dL were spiked with hCG, hFSH, hTSH and βhLH. Significant cross reactivity (< 10% bias) was not found for the following substances at the indicated concentrations:

Substance Tested	Concentration Added
hCG	500,000 mIU/mL (IU/L)
hFSH	2000 mIU/mL (IU/L)
hTSH	2000 µIU/mL
βhLH	100 mIU/mL (IU/L)

Analytical Sensitivity

The lowest detectable level of hLH distinguishable from zero (Access hLH Calibrator S0) with 95% confidence is 0.2 mIU/mL (IU/L). This value is determined by processing a complete six point calibration curve, controls, and 10 replicates of the zero calibrator in multiple assays. The analytical sensitivity value is interpolated from the curve at the point that is two standard deviations from the fitted zero calibrator signal.

Access
Immunoassay Systems

hLH CALIBRATORS
REF 33515

Intended Use

The Access hLH Calibrators are intended to calibrate the Access hLH assay for the quantitative determination of luteinizing hormone (LH) levels in human serum and plasma using the Access Immunoassay Systems.

Summary and Explanation

Quantitative assay calibration is the process by which samples with known analyte concentrations (i.e., assay calibrators) are tested like patient samples to measure the response. The mathematical relationship between the measured responses and the known analyte concentrations establishes the calibration curve. This mathematical relationship, or calibration curve, is used to convert RLU (Relative Light Unit) measurements of patient samples to specific quantitative analyte concentrations.

Traceability

The measurand (analyte) in the Access hLH Calibrators is traceable to the WHO 2nd International Reference Preparation for hLH (80/552). Traceability process is based on EN ISO 17511.

The assigned values were established using representative samples from this lot of calibrator and are specific to the assay methodologies of the Access reagents. Values assigned by other methodologies may be different. Such differences, if present, may be caused by inter-method bias.

Product Information

Access hLH Calibrators
Cat. No. 33515: S0–S5, 4.0 mL/vial

- Provided ready to use.
- Store upright and refrigerate at 2 to 10°C.
- Mix contents by gently inverting before use. Avoid bubble formation.
- Stable until the expiration date stated on the label when stored at 2 to10°C.
- Signs of possible deterioration are control values out of range.
- Refer to calibration card for exact concentrations.

S0:	Buffered bovine serum albumin (BSA) matrix with surfactant, < 0.1% sodium azide, and 0.5% ProClin** 300. Contains 0 mIU/mL (IU/L) hLH.
S1, S2, S3, S4, S5:	hLH at levels of approximately 2, 10, 25, 100 and 250 mIU/mL (IU/L), respectively, in buffered BSA matrix with surfactant, < 0.1% sodium azide, and 0.5% ProClin 300.
Calibration Card:	1

Warnings and Precautions

- For *in vitro* diagnostic use.
- Human source material used in the preparation of the reagent has been tested and found negative or non-reactive for Hepatitis B, Hepatitis C (HCV), and Human Immunodeficiency Virus (HIV-1 and HIV-2). Because no known test method can offer complete assurance that infectious agents are absent, handle reagents and patient samples as if capable of transmitting infectious disease.[19]

- Sodium azide may react with lead and copper plumbing to form highly explosive metal azides. On disposal of liquids, flush with a large volume of water to prevent azide build-up.[12]
- Xi. Irritant: 0.5% ProClin 300.

R 43: May cause sensitization by skin contact.
S 28-37: After contact with skin, wash immediately with plenty of soap and water. Wear suitable gloves.

- The Material Safety Data Sheet (MSDS) is available upon request.

Procedure

Refer to the appropriate system manuals and/or Help system for information on calibration theory, configuring calibrators, calibrator test request entry, and reviewing calibration data.

Calibration Details

The Access hLH Calibrators are provided at six levels – zero and approximately 2, 10, 25, 100 and 250 mIU/mL prepared gravimetrically from purified hLH and buffered BSA matrix. Assay calibration data are valid up to 28 days.

Calibrators run in duplicate.

Limitations of the Procedure

If there is evidence of microbial contamination or excessive turbidity in a reagent, discard the vial.

Access
Immunoassay Systems

SAMPLE DILUENT A

REF 81908 (Vial)

REF A79783 (Diluent Pack)

Intended Use

The Access Sample Diluent A is intended for use with Access assays to dilute patient samples containing analyte concentrations greater than the analyte specific S5 calibrator.

Summary and Explanation

The analyte level in patient samples may exceed the level of the specific S5 calibrator. If a quantitative value is required, it will be necessary to dilute the samples in order to determine the analyte concentration.

Product Information

Access Sample Diluent A

Cat. No. 81908: 4 mL/vial

- Provided ready to use.
- Allow the contents to stand for 10 minutes at room temperature.
- Mix contents by gently inverting before use. Avoid bubble formation.
- Stable until the expiration date stated on the vial label when stored at 2 to 10°C.

Diluent:	Buffered BSA matrix with surfactant, < 0.1% sodium azide, 0.5% ProClin** 300.

Cat. No. A79783: 2 diluent packs, 32.9 mL/pack

- Provided ready to use.
- Store upright and refrigerate at 2 to 10°C.
- Refrigerate at 2 to 10°C for a minimum of two hours before use on the instrument.
- Stable until the expiration date stated on the label when stored at 2 to 10°C.
- Stable at 2 to 10°C for 56 days after initial use of each well.
- Signs of possible deterioration are a broken elastomeric layer on the pack or control values out of range.
- If the diluent pack is damaged (i.e., broken elastomer), discard the pack.

R1a – R1e:	Buffered BSA matrix with surfactant, < 0.1% sodium azide, 0.5% ProClin 300.

Warnings and Precautions

- For *in vitro* diagnostic use.
- Patient samples and blood-derived products may be routinely processed with minimum risk using the procedure described. However, handle these products as potentially infectious according to universal precautions and good clinical laboratory practices, regardless of their origin, treatment, or prior certification. Use an appropriate disinfectant for decontamination. Store and dispose of these materials and their containers in accordance with local regulations and guidelines.
- Sodium azide may react with lead and copper plumbing to form highly explosive metal azides. On disposal of liquids, flush with a large volume of water to prevent azide build-up.[12]

- Xi. Irritant: 0.5% ProClin 300.

R 43: May cause sensitization by skin contact.
S 28-37: After contact with skin, wash immediately with plenty of soap and water. Wear suitable gloves.

- The Material Safety Data Sheet (MSDS) is available upon request.

Procedure

Samples can be accurately measured within the analytical range of the lower limit of detection and the highest calibrator value of the specific assay. If a sample contains more analyte than the stated value of the S5 calibrator, dilute the sample following dilution instructions in the specific assay labeling under "Limitations of the Procedure" in the reagent pack section. Refer to the appropriate system manuals and/or Help system for instructions on how to enter a sample dilution in a test request.

Limitations of the Procedure

If there is evidence of microbial contamination or excessive turbidity in a reagent, discard the vial.

References

1 Vaitukaitis JL, Ross GT. Antigenic similarities among the human glycoprotein hormones and their subunits. In Gonadotropins. Edited by Saxena BB, Gandy HM, Beling CG. 1972; New York: John Wiley and Sons, 435-443.

2 Pierce JG, Parsons TF. Glycoprotein hormones: structure and function. In Annual Review of Biochemistry 1981; 50: 465-95.

3 South SA, Yankov VI, Evans WS. Normal reproductive neuroendocrinology in the female. In Endocrinology and Metabolism Clinics of North America 1993; Edited by Veldhuis JD, Philadelphia, PA: W.B. Saunders Co. 22: 1-28.

4 Adashi EY. The ovarian life cycle. In Reproductive Endocrinology. Edited by Yen, S.S.C., Jaffe, R.B., Philadelphia, W.B. Saunders Co. 1991; 181-237.

5 Yen SSC. The human menstrual cycle: neuroendocrine regulation. In Reproductive Endocrinology 1991; Edited by Yen, S.S.C., Jaffe, RB, Philadelphia, PA: W.B. Saunders Co., 273-308.

6 Richardson SJ. The biological basis of menopause. Baillières Clinical Endocrinology and Metabolism 1993; 7:1-16.

7 Reyes-Fuentes A, Veldhuis JD. Neuroendocrine physiology of the normal male gonadal axis. In Endocrinology and Metabolism Clinics of North America 1993; Edited by Veldhuis, JD. Philadelphia, PA: W.B. Saunders Co., 22: 93-124.

8 Carr BR, Disorders of the ovary and female reproductive tract. In Williams Textbook of Endocrinology 8th edition 1992; Edited by Wilson JD and Foster DW, Philadelphia, PA: W. B. Saunders Co., 733-798.

9 Hall JE. Polycystic ovarian disease as a neuroendocrine disorder of the female reproductive axis. In Endocrinology and Metabolism Clinics of North America 1993; Edited by Veldhuis JD, Philadelphia, PA: W.B. Saunders Co. 22 (1): 75-92.

10 Bonnar J. The hypothalmus and reproductive function. In The Medical Annual 1973; Edited by Scott RB and Walker RM, Bristol, England, J. Wright and Sons, 251-258.

11 Tietz Textbook of Clinical Chemistry. 1994. Second edition. Edited by Burtis CA and Ashwood ER, Philadelphia, PA: W. B. Saunders Co. 1846-1850.

12 DHHS (NIOSH) Publication No. 78-127, August 1976. Current Intelligence Bulletin 13 - Explosive Azide Hazard. Available http://www.cdc.gov/niosh.

13 Approved Guideline – Procedures for the Handling and Processing of Blood Specimens, H18-A3. 2004. Clinical and Laboratory Standards Institute.

14 Cembrowski GS, Carey RN. Laboratory quality management: QC⇌QA. ASCP Press, Chicago, IL, 1989.

15 Kricka L. Interferences in immunoassays – still a threat. Clin Chem 2000; 46: 1037–1038.

16 Bjerner J, et al. Immunometric assay interference: incidence and prevention. Clin Chem 2002; 48: 613–621.

17 Krouwer JS, Rabinowitz R. How to improve estimates of imprecision. Clinical Chemistry 1984; 30: 290-292.

18 Approved Guideline - Evaluation of precision performance of clinical chemistry devices, EP5-A. 1999. National Committee for Clinical Laboratory Standards.

19 HHS Publication, 4th ed., April 1999. Biosafety in Microbiological and Biomedical Laboratories. Available http://www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4toc.htm

Manufactured by:
Beckman Coulter, Inc.
250 S. Kraemer Blvd.
Brea, CA 92821 U.S.A.

EC REP
Beckman Coulter Ireland Inc.
Mervue Business Park,
Mervue, Galway,
Ireland 353 91 774068

Printed in U.S.A.
Made in U.S.A. or Ireland
Revised February 2010