

## Summary of Safety and Effectiveness

### 1. General Information

1.1. Device Generic Name: Immunoassay for hepatitis Be antigen

1.2. Device Trade Name: ETI-EBK PLUS

1.3. Applicant's Name and Address:

DiaSorin  
Via Crescentino  
Saluggia (VC) 13040, Italy

1.4. U.S. Representative:

Sienna Partners, LLC  
P.O. Box 103  
Baldwin, MD 21013

1.5. PMA Number: P990043

1.6. Date of Panel Recommendation: January 20, 2000

1.7. Date of Notice of Approval to the Applicant: February 5, 2001

### 2. Indications For Use

ETI-EBK PLUS is an *in vitro* enzyme immunoassay (EIA) intended for use in the qualitative detection of hepatitis Be antigen (HBeAg) in human serum or plasma (EDTA, citrate or heparin). The ETI-EBK PLUS is intended for manual use and with the Biochem Immunosystems Labotech/ETI-Lab automated instrument.

The detection of HBeAg is indicative of a laboratory diagnosis for active HBV replication, usually correlating with viremia. A reactive test is presumptive laboratory evidence for infection with hepatitis B virus (HBV). Further HBV serological marker testing is required to define the specific disease-state. The ETI-EBK PLUS assay's performance has not been established for the monitoring of HBV disease or therapy.

### 3. Device Description

3.1. Principle of The Assay

ETI-EBK PLUS uses monoclonal antibodies to hepatitis Be antigen as the basis for this enzyme immunoassay. The assay is a direct, non-competitive test based on the use of polystyrene microwells coated with mouse monoclonal antibodies to HBeAg and an enzyme tracer containing horseradish-peroxidase-labeled mouse monoclonal antibodies to HBeAg. The monoclonal antibodies are of the IgG1-k class and are directed to p16, the secreted form of HBeAg.

In the assay procedure, patient specimens and controls are incubated with an incubation buffer in antibody-coated microwells. If HBeAg is present in a specimen or control, it binds to the antibody. Excess sample is removed by a wash step, and the enzyme tracer is then added to the microwells and allowed to incubate. The enzyme tracer binds to any antigen-antibody complexes present in the microwells. Excess enzyme tracer is removed by a wash step, and a chromogen/substrate solution is added to the microwells and allowed to incubate. If a sample contains HBeAg, the bound enzyme (horseradish peroxidase) chemically reduces the substrate peroxide, which concurrently oxidizes the chromogen tetramethylbenzidine (TMB) to a blue color. The blue color turns to yellow after addition of the stop solution. If a sample does not contain HBeAg, the microwell will be colorless after the chromogen/substrate solution is added and will remain colorless after the stop solution is added. Color intensity, which is measured spectrophotometrically, is directly related to the presence of HBeAg. Absorbance value readings for patient specimens are compared to a cutoff value determined from the mean absorbance value of the calibrator.

### 3.2. Kit Configuration and Components

For detection of HBeAg, the ETI-EBK PLUS system is comprised of the following:

#### Coated Strips

Microwells coated with mouse monoclonal antibodies to HBeAg.

#### Enzyme Tracer

Horseradish peroxidase-labeled mouse monoclonal antibody to HBeAg, buffer, protein stabilizers.

Preservative: 0.2% ProClin 300.

#### Tracer Diluent

Buffer, protein stabilizers.

Preservative: 0.2% ProClin 300.

#### Calibrator (Human)

Human serum/plasma non-reactive for all known HBV markers.

Preservative: 0.2% ProClin 300.

#### Negative Control (Human)

Human serum/plasma non-reactive for all known HBV markers.

Preservative: 0.2% ProClin 300.

#### Positive Control

HBeAg (recombinant DNA), protein stabilizers.

Preservative: 0.2% ProClin 300.

#### Incubation Buffer

Buffer, protein stabilizers, an inert blue dye.

Preservative: 0.2% ProClin 300.

#### Wash Buffer (concentrate)

Buffer, detergents, preservatives.

#### Chromogen/Substrate

Tetramethylbenzidine/hydrogen peroxide system.

#### Stop Solution

1N sulfuric acid.

Strip Sealers

Plate Sealers

Pouch Sealer

#### **4. Contraindications**

None

#### **5. Warnings and Precautions**

For *in vitro* diagnostic use only.

Warnings and precautions for users of the ETI-EBK PLUS assay are stated in the product labeling.

#### **6. Alternative Practices and Procedures**

Several methods are available for detecting HBeAg in human serum or plasma. Methods commonly used include immunodiffusion, electrophoresis, counter immunoelectrophoresis, reverse passive hemagglutination, radioimmunoassay, and enzyme immunoassay.

#### **7. Marketing History**

The ETI-EBK-PLUS assay has never been marketed in the US or outside the US.

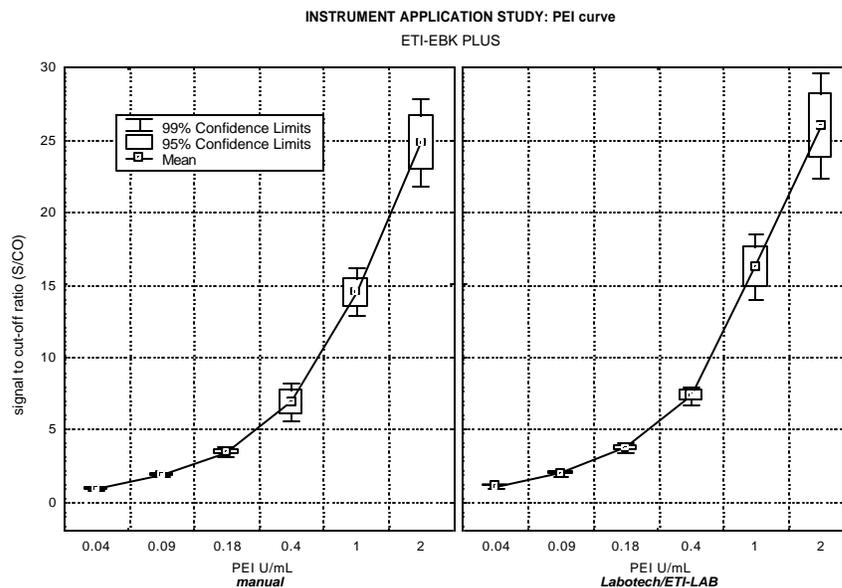
#### **8. Potential Adverse Effects of the Device on Health**

Failure of the product to perform as indicated or human error in use of the product may lead to a false result. A false negative result may be considered a patient or public health concern because the patient may be considered in early recovery and proceeding to HBV clearance. In this case, the risk may be that the patient's treatment may be altered or that they might not be considered infectious. This could lead to possible infection of uninfected individuals.

## 9. Summary of Preclinical Studies

### 9.1. Comparison of Labotech Instrumentation with the Manual Assay

An instrument application study was conducted at DiaSorin, Saluggia Italy, to evaluate the performance of the ETI-EBK PLUS assay on the Biochem Immunosystems Labotech/ETI-LAB, an automated microplate processing instrument, compared to the manual analysis. The Paul-Ehrlich-Institut (PEI) Standard, 12 serum samples near the ETI-EBK PLUS cutoff and samples from the clinical trials (29 suspected hepatitis B patients and 11 apparently healthy adults) were tested in parallel manually and on the Labotech. Serial dilutions of the PEI Standard were prepared in fetal calf serum to obtain a panel ranging from high concentration to below the analytical sensitivity of the assay. The diluted Standard samples were tested in duplicate, one run per day for three days both manually and on the Labotech. Due to the requirement that assay cutoff be established for each plate, reproducibility was evaluated based on specimen absorbance-to-cutoff ratios (S/CO) rather than absolute absorbance values. The 95% confidence intervals were established for the S/CO values of each point of the Standard-referenced curve and therefore the analytical endpoint sensitivity was defined (first dilution with S/CO > 1.1). A graph summarising these results is presented below.



The 12 samples near the cutoff were tested in triplicate, one run per day for three days, both manually and on the Labotech. The samples from the clinical trials were tested in singlet in one run on one day, both manually and on Labotech. The mean, the standard deviation and the coefficient of variation (CV%) of the S/CO values were computed by the different components of variability for each of the tested specimens. A summary of the data is presented in the following table.

Analytical Endpoint Sensitivity (0.18 PEI U/mL)  S/CO [95% CI] <sup>b</sup>	Manual			Labotech/ETI-LAB		
	Mean	W/R %CV <sup>a</sup>	D/D %CV	Mean	W/R %CV	D/D %CV
	1.87 [1.75 – 1.99]	4.2	5.8	1.97 [1.82 – 2.13]	4.0	7.2
12 Cutoff Samples S/CO Range of S/CO	0.96 0.74 – 1.11	7.1	5.8	1.09 0.84 – 1.27	5.0	3.7
Clinical Samples:						
Suspected Hepatitis B Range of S/CO	Negative: 0.00 – 0.50 (8/29) Equivocal: 0.94 (1/29) Positive: 6.46 – >51 (20/29)			Negative: 0.06 – 0.71 (8/29) Equivocal: N/A (0/29) Positive: 1.15 – >45 (21/29)		
Healthy Adults Range of S/CO	Negative: -0.05 – 0.43 (11/11) Equivocal: N/A (0/11) Positive: N/A (0/11)			Negative: 0.09 – 0.44 (11/11) Equivocal: N/A (0/11) Positive: N/A (0/11)		

<sup>a</sup> %CVs were calculated using specimen absorbance-to-cutoff ratios (S/CO) which normalized the data plate-to-plate

<sup>b</sup> 95% CI = 95% Confidence Interval; W/R = within-run; D/D = day-to-day

No reproducibility testing with the Labotech instrument was conducted. As part of the conditions of approval agreement, DiaSorin will provide FDA results from a reproducibility study using the Labotech instrument. Until that condition is met, the following statement will be placed in the labeling:

“Assay reproducibility using the Labotech has not been established. If the Labotech is used, the user should establish appropriate assay reproducibility in accordance with NCCLS EP5-A, Evaluation of Precision Performance of Clinical Chemistry Devices.”

## 9.2. Analytical Sensitivity

The analytical sensitivity of the assay was evaluated using single point serial dilutions of a standard preparation from the Paul-Ehrlich-Institut(PEI), Germany. The analytical sensitivity of the assay was determined to be 0.2 PEI U/mL.

## 9.3. Potential Cross-Reacting Substances

Serum samples were obtained from patients belonging to a number of different disease categories listed below. Of the 525 potential interfering samples, 513 (98%) were negative and 12 (2%) were positive by ETI-EBK PLUS. Among the 12 positive samples, 4 were negative for HBsAg and IgM anti-HBc and negative for HBeAg on repeat testing; 7 were positive by reference testing or review of hepatitis B marker patterns for those samples. Disease was determined by serological testing, there is no guarantee that the associated antigen was present in the tested material. Interference testing with antigen in the described specimens was not performed.

The following table shows the summary of cross-reactivity tests:

DISEASE CATERGORY	N	ETI-EBK PLUS Negative Samples	ETI-EBK PLUS Positive Samples	% Confirmed Positive By Additional Testing
Acute EBV infection	16	16	0	-
Acute CMV infection	20	20	0	-
Acute HSV infection	10	10	0	-
Acute Toxoplasma infection	18	18	0	-
Acute Parvovirus B19 infection	5	5	0	-
HTLV-I/II infection	50	48	2*	-
Syphilis	26	26	0	-
HCV infection	50	50	0	-
HDV infection	20	17	3	100% (3/3)
HIV infection	50	49	1*	-
Acute HAV infection	50	49	1	0% (0/1)
Past HAV infection	50	48	2	100% (2/2)
Rheumatoid factor (RF) +	40	40	0	-
Autoimmune disease	19	19	0	-
Systemic lupus erythrematosus (SLE)	11	11	0	-
Autoimmune hepatitis	5	5	0	-
Myeloma	20	19	1*	-
Hypergammaglobulinemia	20	20	0	-
Influenza vaccine	5	5	0	-
Elevated liver enzymes	10	10	0	-
Non-viral liver disease	30	28	2	100% (2/2)
<b>TOTAL</b>	525	513 (98%)	12 (2%)	88% (7/8)

\*These samples were negative for HBsAg and IgM anti-HBc, and negative on repeat testing on ETI-EBK PLUS.

A BLAST (Basic Local Alignment Search Tool, National Center for Biotechnology Information, National Library of Medicine, National Institutes of Health) analysis was performed to determine if untested viral or bacterial proteins could potentially cross-react with the anti-HBe monoclonal antibodies used in this assay. The only protein that showed

some homology was the HBV core antigen. Additional cross-reactivity studies showed that the HBc antigen cross-reacted with the assay only when the monoclonal anti-HBe was present at approximately 83 times the concentration used in the assay. No notable similarities in protein sequences were identified from the other viral or bacterial proteins, suggesting that they should not cross-react in this assay.

#### 9.4. Interfering Substances

DiaSorin ETI-EBK PLUS assay was evaluated for interference by testing the following substances listed below. Testing was performed using matched pairs of negative donor serum and negative donor serum spiked with a high titer HBeAg samples to obtain a result near the cutoff. None of the compounds at the levels indicated were found to interfere with the clinical interpretation of the assay in serum. No interference was found with bilirubin in plasma (EDTA, heparin or citrate), testing for interference with hemoglobin and triolein was not performed in plasma.

Compound	Concentration	
Bilirubin	0.35 mmol/L	20 mg/dL
Hemoglobin	0.06 mmol/L	100 mg/dL
Triolein	33.9 mmol/L	3000 mg/dL

The ETI-EBK PLUS assay was also evaluated for possible interference from heterophilic anti-mouse antibodies (HAMA). A dilutional panel was used, consisting of 21 samples prepared from a stock pool of high positive human serum. The HAMA concentrations in the samples ranged from 0 to 2975.5 ng/mL, as determined by a HAMA ELISA. In a direct non-competitive assay, such as ETI-EBK PLUS, interference would manifest as false positive results. No interference was seen in that all 21 dilutions were negative by the ETI-EBK PLUS assay, and supported by positive anti-HBe results.

#### 9.5. Stability Studies

##### 9.5.1. Kit Stability

Stability studies were performed on 3 different ETI-EBK PLUS kit lots. At specified intervals from time of kit release, performance of the kits was evaluated testing the Calibrator, Negative and Positive Controls, HBeAg calibration curve (Paul Ehrlich Institut [PEI] referenced), and Q.C. sera panel according to the instructions for use. The kit must meet established acceptance criteria. On the basis of the stability results, a shelf life of 6 months has been established for the kit.

##### 9.5.2. Working Enzyme Tracer Stability

The Enzyme Tracer was diluted with the Tracer Diluent to obtain the working Enzyme Tracer according to the instructions for use. After 7 days from dilution, the performance of the kit was evaluated, according to the instructions for use, testing various specimens with freshly prepared working Enzyme Tracer and the 7-days old working Enzyme Tracer. The kit must meet established acceptance criteria. The tests on the working Enzyme Tracer demonstrate that the performance of the kit is

acceptable when the 7 day-diluted Enzyme Tracer is used. The working Enzyme Tracer can be used for one week if stored at 2-8 °C.

### 9.5.3. Working Wash Buffer Stability

The Wash Buffer concentrate was diluted with deionized water according to the instruction for use to obtain the working Wash buffer. After 7 days from dilution, the performance of the kit was evaluated by testing various specimens with a freshly prepared working Wash buffer and the 7-days-old working Wash buffer, according to the instructions for use. The kit must meet established acceptance criteria. The tests on the working Wash Buffer demonstrate that the performance of the kit is acceptable when the 7 day-old working Wash Buffer is used. The working Wash Buffer can be used for one week if stored at 2-8 °C.

### 9.6. Common Reagents interchangeability Study

Studies were performed to demonstrate that the lots of some components included with ETI-EBK PLUS kit and common to all kits of ETI-PLUS line (Wash Buffer, Chromogen/Substrate, Stop Solution), can be exchanged with other lots of the same component produced for the ETI-PLUS line (interchangeability). Three lots of Wash Buffer, Chromogen/Substrate and Stop Solution were combined with one lot of ETI-EBK PLUS; the three combinations were then tested with various samples. Regression analysis was applied to the Optical Densities of the samples. The regression analyses for the three studies gave slopes close to 1.0, with low intercepts and excellent correlation values. These results indicate that the use of different lots of Wash Buffer, Chromogen/Substrate and Stop Solution with the same ETI-EBK PLUS lot gave equivalent results with samples distributed over the range of reactivity, confirming their interchangeability.

### 9.7. Reproducibility

Manual Assay: Intra-assay, inter-assay, inter-lot, and inter-site variability studies were carried out on the ETI-EBK PLUS kit to test the variability within runs, between runs, between days, between kit lots, and between test sites. Variability was measured on a panel of ten sera that included negative, borderline, and positive samples. Three ETI-EBK PLUS kit lots were tested at three independent test sites. Due to the requirement that assay cutoff be established for each plate, reproducibility was evaluated based on specimen absorbance to cutoff ratios (S/CO) rather than absolute absorbance values. The results of that study are tabulated below showing the reproducibility of the assay to be satisfactory.

### Clinical Site Reproducibility Study

ID#		Number of tests per sample	Mean S/CO	Within-run %CV*	Between-runs %CV	Between-lots %CV	Between-days %CV	Between-sites %CV	Total
S01	High	108	20.03	6.37	6.29	10.07	7.30	5.14	14.47
S02	High	108	10.83	4.16	5.07	11.56	7.34	9.44	15.69
S03	High	108	6.83	4.47	7.16	11.78	7.09	6.73	17.18
S04	Low	108	3.84	3.80	8.25	14.42	6.97	5.79	17.12
S05	Equiv	108	0.80	6.08	6.79	8.51	6.38	3.79	13.03
S06	Low	108	2.61	5.35	5.99	9.72	7.92	9.80	14.35
S07	Low	108	2.11	3.55	10.49	10.44	7.47	10.18	17.97
S08	Low	108	1.96	5.08	11.86	10.47	6.86	7.30	16.18
S09	Equiv	108	1.67	6.27	11.85	10.47	4.04	4.04	19.19
S10	Neg	108	0.06	20.20	36.73	36.18	15.26	29.61	89.32

\* %CVs were calculated using specimen absorbance-to-cutoff ratios (S/CO) which normalized the data plate-to-plate

#### 9.8. Plasma Reproducibility

A plasma reproducibility study was conducted at DiaSorin, Saluggia Italy, to evaluate the performance of the manual ETI-EBK PLUS assay on serum versus a variety of plasma types. The plasma types evaluated were citrate, heparin and EDTA. Sample sets of matched serum/multiple plasma were used in the study. A sample set was prepared by spiking the same high positive sample into each of the matrices (serum and plasmas) resulting in a total of four specimens per set around the cutoff. Several high positive samples were used in the preparation of the 12 different near-cutoff sample sets. Six matched serum/multiple plasma samples sets were tested in triplicate in each run; thus there were two runs per day for three days, all tested in a manual mode. Due to the requirement that assay cutoff be established for each plate, reproducibility was evaluated based on specimen absorbance to cutoff ratios (S/CO) rather than absolute absorbance values. The mean, the standard deviation and the coefficient of variation (CV%) of the S/CO values were computed by the different components of variability for each of the tested specimens. The 95% confidence intervals were established for the S/CO values of all serum samples and each plasma type. A summary of the data is presented in the following table. The study supports the use of plasma specimens in the ETI-EBK PLUS assay.

	SERUM	CITRATE	HEPARIN	EDTA
Mean (S/CO)	0.99	0.99	1.02	1.04
95% CI*	[0.95 - 1.03]	[0.95 - 1.03]	[0.98 - 1.06]	[1.00 - 1.08]
W/R %CV**	5.9%	4.8%	5.4%	4.5%
D/D %CV	9.3%	7.7%	7.2%	8.5%
Total %CV	10.4%	8.6%	8.6%	8.9%
Between matrix %CV	7.9%			
Across matrix total %CV	11.7%			

\* CI = 95% Confidence Interval; W/R = within-run; D/D = day-to-day.

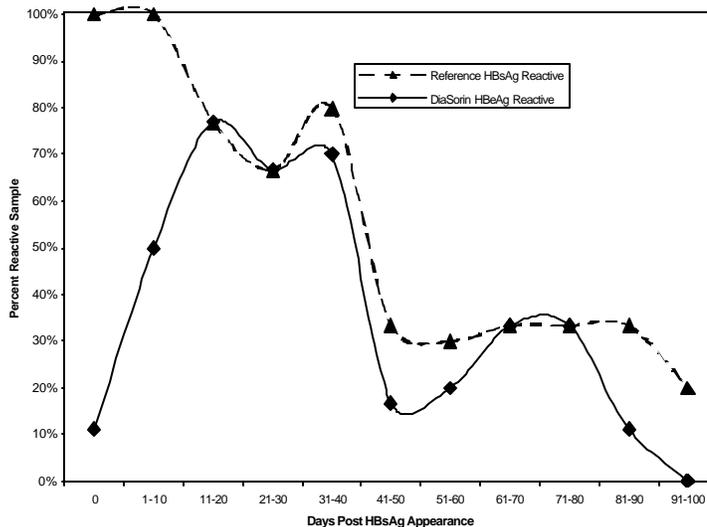
\*\* %CVs were calculated using specimen absorbance-to-cutoff ratios (S/CO) which normalized the data plate-to-plate

## 9.9. Acute Serial Seroconversion Panels

One hundred twenty-four (124) archived serial samples from nine individuals were tested for the appearance of HBeAg. Most (8/9) of these individuals were defined as being acutely infected by the appearance of HBsAg and HBeAg with the subsequent appearance of IgM anti-HBc, total HBc, anti-HBe, and anti-HBs. One individual had detectable HBsAg but did not have detectable HBeAg in any specimen. However, this individual did seroconvert for anti-HBe.

The specimens were collected from individuals undergoing plasmapheresis for further manufacturing purposes. Three individuals were found to be infected with HBV during the first plasmapheresis and others became infected with HBV during subsequent plasmapheresis. It is unknown how long these three initially HBsAg reactives were infected prior to the first plasmapheresis. All nine individuals underwent sequential plasmapheresis after becoming HBV infected. However, the timing of subsequent plasmapheresis varied from individual to individual. The specimens draw times were normalized to represent the day that HBsAg was first detected by a FDA licensed assay as Day 0. For the remaining specimens, draw days ranged from day 0 (HBsAg first detected) through day 355 post day 0. Since all panels did not contain the same draw day, sample results were grouped within day intervals (e.g., days 0, 1-10, 11-20, etc., representing days since first detection of HBsAg). The results are summarized in the following table and graph. No specimen was reactive for HBeAg by the DiaSorin assay after day 90. In the graph below a dashed line for the reference HBsAg percent reactive has been overlaid for reference.

Acute Serial Panel Results



Day Range	Number Specimens	DiaSorin HBeAg Reactive	% Positive
0	9	1	11.1
1-10	10	5	50.0
11-20	13	10	76.9
21-30	9	6	66.7
31-40	10	7	70.0
41-50	6	1	16.7
51-60	10	2	20.0
61-70	9	3	33.3
71-80	6	2	33.3
81-90	9	1	11.1
91-100	10	0	NA
101-110	6	0	NA
111-120	4	0	NA
121-130	4	0	NA
131-140	3	0	NA
141-150	2	0	NA
151-160	0	0	NA
161-170	1	0	NA
171-180	0	0	NA
181-190	1	0	NA
191-200	1	0	NA
355	1	0	NA

#### 9.10. Expected Values Study

The 236 prospective samples used in the expected values study for the DiaSorin ETI-EBK PLUS assay were from patients who were sent to the laboratory for HBV testing. Of those, 100 (42%) were frozen and 136 (58%) were fresh. The patients represented Florida, Georgia, Pennsylvania, California, Utah, and the southeastern US. The group was 69% (162/236) female and 31% (74/236) male; the ethnicity of the patients was unspecified. The ages ranged from 5 to 88 years old. The prevalence rate for HBeAg in patients who were sent to the laboratory for HBV testing was 7%.

The Table below summarizes the percent DiaSorin ETI-EBK PLUS positive and negative results by gender and age range. There were 6 samples for which gender and age were not reported; they were all positive. There were 6 samples for which age was not reported, 2 were from females and 4 were from males; all were negative. These 12 results were not included in the table.

Expected Values Summary

		DiaSorin ETI-EBK PLUS				
		+		-		
Age Range	Gender	n	%	n	%	TOTAL
0-9	F	0	0%	2	100%	2
	M	0	NA	0	NA	0
10-19	F	1	6%	16	94%	17
	M	1	50%	1	50%	2
20-29	F	1	2%	50	98%	51
	M	3	23%	10	77%	13
30-39	F	1	2%	48	98%	49
	M	1	6%	16	94%	17
40-49	F	1	5%	19	95%	20
	M	1	7%	13	93%	14
50-59	F	4	80%	1	20%	5
	M	1	13%	7	88%	8
60-69	F	0	0%	3	100%	3
	M	0	0%	2	100%	2
70-79	F	0	0%	10	100%	10
	M	0	0%	5	100%	5
80-89	F	0	0%	3	100%	3
	M	0	0%	3	100%	3
<b>TOTAL</b>		15	7%	209	93%	224

**10. Summary of Clinical Studies**

10.1. Clinical Sample Testing

10.1.1 Prospective Samples

A study of 136 prospective specimens was conducted. These specimens represented individuals who were sent to the laboratory for hepatitis testing. Specimens were collected at a reference laboratory and assayed at the California clinical trial site. The patients were 86% (117/136) female and 14% (19/136) male. The ages ranged from 5 to 77 years old, with 3 specimens not specified. The study (testing) sites were blinded to the previous specimen categorization. All testing was performed by the manual ETI-EBK PLUS procedure. Specimens were characterized by testing with six HBV serological markers (HBsAg, HBeAg, IgM anti-HBc, total anti-HBc, anti-HBe, anti-HBs) using FDA-licensed or approved assays. Testing with these assays followed the FDA-licensed or approved labeling, including confirmation by neutralization of repeatably reactive HBsAg samples.

### Results by Specimen Classification

After study completion all samples were assigned a specimen classification based on the patterns of the six HBV serological markers established by the reference assays. Based on these serological marker patterns, the samples were categorized into the HBV classifications described in the table below. There were 5 unique HBV marker patterns observed in the DiaSorin ETI-EBK PLUS prospective clinical studies.

Characterization Based On Single Point Specimen	HBsAg	HBeAg	IgM anti-HBc	Total anti-HBc	anti-HBe	anti-HBs	n
Chronic Infection	+	-	-	+	+	-	1
Recovery	-	-	-	+	+	+	2
Past Infection	-	-	-	+	-	+	4
	-	-	-	+	-	-	4
HBV Vaccine Response	-	-	-	-	-	+	38
Not Previously Infected with HBV	-	-	-	-	-	-	87

Based on the above classifications the DiaSorin HBeAg results for the prospective samples were compared to a reference assay's HBeAg results. The following table shows this comparison and percent agreement with 95% confidence intervals with the reference HBeAg assay.

### Prospective Samples Comparison

Reference Serology Classification	-	Reference HBeAg
	-	DiaSorin HBeAg
Chronic infection	1	1
Recovery	2	2
Past Infection	8	8
HBV vaccine response	38	38
Not previously infected with HBV	87	87
Grand Total	136	136

### Prospective Samples Agreement Rates

Chronic Infection	Positive agreement with reference assay results = NA (0/0) 95% CI = NA
	Negative agreement with reference assay results = 100% (1/1) 95% CI = 2.5 to 100%
Recovery	Positive agreement with reference assay results = NA (0/0) 95% CI = NA
	Negative agreement with reference assay results = 100% (2/2) 95% CI = 15.8 to 100%
HBV Vaccine Response	Positive agreement with reference assay results = NA (0/0) 95% CI = NA
	Negative agreement with reference assay results = 100% (38/38) 95% CI = 90.8 to 100%
Past Infection	Positive agreement with reference assay results = NA (0/0) 95% CI = NA
	Negative agreement with reference assay results = 100% (8/8) 95% CI = 63.1 to 100%
Not Previously Infected	Positive agreement with reference assay results = NA (0/0) 95% CI = NA
	Negative agreement with reference assay results = 100% (87/87) 95% CI = 98.5 to 100%

#### 10.1.2 Retrospective Samples

Retrospective studies were carried out at three clinical laboratories in the United States (California, Missouri and Minnesota) and at DiaSorin (Italy) to assess the performance of the ETI-EBK PLUS assay in detecting HBeAg. The study set included 650 frozen repository samples (the majority of which were purchased from commercial vendors) from the following populations:

- patients with chronic hepatitis B infection (diagnosed by a physician as having HBsAg positive for greater than 6 months) – 111 frozen repository samples;
- patients with serologically diagnosed hepatitis B infection (acute, chronic, asymptomatic, convalescent, etc.) – 82 frozen repository samples;
- patients sent to the laboratory for hepatitis B testing – 100 frozen repository samples;
- a general hospital patient population – 357 frozen repository samples.

The specimens represented Midwestern (2%), Southeastern (25%), Western (13%), and Northeastern US (2%), outside of the US (1%), and unspecified (57%). The group was 44% (287/650) female, 42% (270/650) male, and 14% (93/650) unspecified. Approximately 13% (84/650) were Caucasian, 4% (27/650) were African American, < 1% (5/650) were Hispanic, < 1% (3/650) were Asian, and 82% (531/650) were unspecified. The ages ranged from 5 to 98 years old, with 131 specimens not specified.

The study (testing) sites were blinded to the previous specimen categorization. All testing was performed by the manual ETI-EBK PLUS procedure. Specimens were

characterized by testing with six HBV serological markers (HBsAg, HBeAg, IgM anti-HBc, total anti-HBc, anti-HBe, anti-HBs) using FDA-licensed or approved assays. Testing with these assays followed the FDA-licensed or approved procedure with the exception of the HBsAg assay at two of the three sites. At these sites, the majority of specimens that were initially HBsAg-positive were repeated in duplicate, however the repeatedly reactive specimens were not confirmed by the licensed HBsAg confirmation assay at the two sites. Therefore, true HBsAg result was determined in one of three ways: 1) confirmed by reference assay neutralization during clinical trials, 2) based on a statement by the attending physician that HBsAg was positive for greater than 6 months, or 3) information provided by the vendor regarding confirmatory testing performed at their location or by the material source facility.

### Results by Specimen Classification

After study completion all samples were assigned a specimen classification based on the patterns of the six HBV serological markers established by the reference assays. Based on these serological marker patterns, the samples were categorized into the HBV classifications described in the table below. There were 35 unique HBV marker patterns observed in the ETI-EBK PLUS retrospective clinical studies.

Characterization Based On Single Point Specimen	HBsAg	HBeAg	IgM anti-HBc	Total anti-HBc	Anti-HBe	anti-HBs	n
Acute Infection	+	+	+ or I	+	-	-	52
	+	-	+ or I	+	+	-	4
	+	-	-	-	-	-	2
	+	+	-	-	-	-	2
Chronic Infection	+	-	-	+	+	-	82
	+	+	-	+	-	-	21
	+	-	-	+	- or I	-	23
	+	+	+	+	-	+	4
	+	+	- or I	+	-	+	2
	+	-	-	+	+	+	2
	+	+	-	+	+ or I	+	2
	+	+	+	+	+	+	1
	+	+	-	+	+	-	1
Recovery	-	-	-	+	+ or I	+	40
	-	-	-	+	+	-	6
	-	-	+	+	+	-	2
	-	-	+ or I	+	+	+	2
Past Infection	-	- or I	-	+	-	+	12
	-	-	-	+	-	-	9
HBV Vaccine Response	-	-	-	-	-	+	20
Not Previously Infected with HBV	-	-	-	-	-	-	343
Uninterpretable	-	+ or I	-	-	-	-	13
	-	+	-	+	-	+	2
	-	+	-	+	+	+	1
	-	I	-	+	-	-	1

\*I = indeterminate result

Based on the above classifications the ETI-EBK PLUS results for the retrospective samples were compared to a reference assay's HBeAg results as determined by the methods above. The following table shows this comparison and percent agreement with 95% confidence intervals with the reference HBeAg results.

Retrospective Samples Comparison

Reference Serology Classification	-		+		I <sup>‡</sup>	Reference HBeAg
	-	+	-	+	-	DiaSorin HBeAg
Acute infection	5	1	0	54	0	60
Chronic infection	107	1	2	29	0	139
Recovery	50	0	0	0	0	50
HBV vaccine response	20	0	0	0	0	20
Not previously infected with HBV	343	0	0	0	0	343
Past Infection	20	0	0	0	1	21
Uninterpretable	0	0	9	1	7	17
Total	545	2	11	84	8	650

<sup>‡</sup> Indeterminate result

Retrospective Samples Agreement Rate

Acute Infection

Positive agreement with reference assay results = 100% (54/54)  
 95% CI = 93.4 to 100%  
 Negative agreement with reference assay results= 83.3% (5/6)  
 95% CI = 35.9 to 99.6%

Chronic Infection

Positive agreement with reference assay results = 93.5% (29/31)  
 95% CI = 78.6 to 99.2%  
 Negative agreement with reference assay results= 99.1% (107/108)  
 95% CI = 95.0 to 100%

Recovery

Positive agreement with reference assay results = NA (0/0)  
 95% CI = NA  
 Negative agreement with reference assay results= 100% (50/50)  
 95% CI = 92.9 to 100%

HBV Vaccine Response

Positive agreement with reference assay results = NA (0/0)  
 95% CI = NA  
 Negative agreement with reference assay results= 100% (20/20)  
 95% CI = 83.2 to 100%

Not Previously Infected

Positive agreement with reference assay results = NA (0/0)  
 95% CI = NA  
 Negative agreement with reference assay results= 100% (343/343)  
 95% CI = 98.9 to 100%

Past Infection

Positive agreement with reference assay results = NA (0/0)  
 95% CI = NA  
 Negative agreement with reference assay results= 100% (20/20)  
 95% CI = 83.2 to 100%

Uninterpretable

Positive agreement with reference assay results = 10.0% (1/10)

95% CI = 0.3 to 44.5%

Negative agreement with reference assay results= NA (0/0)

95% CI = NA

## 11. Conclusions Drawn from Studies

The study data demonstrates that acceptable performance is obtained with the DiaSorin ETI-EBK PLUS assay when testing specimens collected in serum and plasma. The DiaSorin assay shows acceptable within-run, between-run, between-day, site-to-site, and lot-to-lot reproducibility. The quality control procedures described in the package insert are appropriate to assure accurate assay performance. The data from this study provide reasonable assurance that the DiaSorin ETI-EBK PLUS assay is safe and effective for its stated purpose when used as instructed in the package insert. The DiaSorin ETI-EBK PLUS HBeAg assay can be stored up to 6 months at 2-8°C

## 12. Panel Recommendations

The Microbiology Advisory Panel met on January 20, 2000, to consider the safety and effectiveness of the ETI-EBK PLUS assay. The advisory panel recommended approval subject to the following conditions.

- Conduct additional studies for the immunity claim by testing individuals immediately after receiving the complete series of three vaccinations with the hepatitis B virus vaccines and three to nine months later.
- Provide data on acute/chronic infections in high-risk populations such as those individuals that are infected with HIV, sexually transmitted diseases, and those patients that are immunosuppressed.
- Collect more data on patients meeting the standard definition for chronicity, i.e., > 6 months of infection.

## 13. CDRH Decision

CDRH concurred with the Panel's recommendation. DiaSorin Inc. has provided some additional data to address some of the Panel's issues and those issues not fully resolved were addressed with labeling restrictions and the requirement of postapproval studies. The two postapproval studies were:

- Within 6 months of this approval, DiaSorin should submit a reproducibility study for the Biochem Immunosystems Labotech/ETI-Lab automated instrument.
- To address the concerns made by the Panel regarding the retrospective nature of the clinical studies, within 2 years of this approval, DiaSorin should submit the results of an additional prospective clinical study. We suggest that this study involve individuals that may be considered representative of an U.S. population, i.e., similar prevalence of HBV disease and serotypes.

The applicant's manufacturing facility was found to be in compliance with the Quality Systems Regulation (21 CFR 820).

CDRH issued an approval order on February 5, 2001

#### **14. Approval Specifications**

Directions for use: See Labeling

Conditions of Approval: CDRH Approval of this PMA is subject to full compliance with the conditions described in the approval order.