sebia

MINICAP HEMOGLOBIN(E)

Ref. 2207

Ref. 2227*

MINICAP FLEX-PIERCING

PHORESIS VS ≥ 9.15

IVD

CE

2020/07

MINICAP HEMOGLOBIN(E) USING THE MINICAP FLEX-PIERCING INSTRUMENT

INTENDED USE

The MINICAP HEMOGLOBIN(E) kit is designed for the separation of the normal hemoglobins (A, A2 and F) in human blood samples, and for the detection of the major hemoglobin variants (S, C, E and D), by capillary electrophoresis in alkaline buffer (pH 9.4) with the SEBIA MINICAP FLEX-PIERCING instrument. The MINICAP HEMOGLOBIN(E) kit is designed for laboratory use.
The MINICAP FLEX-PIERCING instrument is an automated analyzer which performs a complete hemoglobin profile for the quantitative analysis of the normal hemoglobin fractions A, A2 and F and for the detection of major hemoglobin variants S, C, E and D. The assay is performed on the hemolysate of whole blood samples collected in tubes containing K_2EDTA or K_3EDTA as anticoagulant.

For *In Vitro* Diagnostic Use.

PRINCIPLE OF THE TEST [1-20]

Hemoglobin is a complex molecule composed of two pairs of polypeptide chains. Each chain is linked to the heme, a tetrapyrrolic nucleus (porphyrin) which chelates an iron atom. The heme part is common to all hemoglobins and their variants. The type of hemoglobin is determined by the protein part called globin. Polypeptide chains α, ß, δ and γ constitute the normal human hemoglobins:

- hemoglobin A .....= α 2 ß 2
- hemoglobin A2 .....= α 2 δ 2
- fetal hemoglobin F .....= α 2 γ 2

The α-chain is common to these three hemoglobins.

The hemoglobin spatial structure and other molecular properties (like that of all proteins) depend on the nature and the sequence of the amino acids constituting the chains. Substitution of amino acids by mutation is responsible for formation of hemoglobin variants which have different surface charge and consequently different electrophoretic mobilities, which also depend on the pH and ionic strength of the buffer.
The resulting qualitative (or structural) abnormalities are called hemoglobinopathies [9, 10, 13]. Decreased synthesis of one of the hemoglobin chains leads to quantitative (or regulation) abnormalities, called thalassemias.

Hemoglobin electrophoresis is a well established technique routinely used in clinical laboratories for screening samples for hemoglobin abnormalities [1, 2, 3, 4, 12]. The MINICAP FLEX-PIERCING instrument has been developed to provide complete automation of this testing with fast separation and good resolution. In many aspects, the methodology can be considered as an intermediary type of technique between classical zone electrophoresis and liquid chromatography [8, 11].
The MINICAP FLEX-PIERCING instrument uses the principle of capillary electrophoresis in free solution. With this technique, charged molecules are separated by their electrophoretic mobility in an alkaline buffer with a specific pH. Separation also occurs according to the electrolyte pH and electroosmotic flow [5].
The MINICAP FLEX-PIERCING instrument has capillaries functioning in parallel allowing 2 simultaneous analyses for hemoglobin quantification. A sample dilution with hemolysing solution is prepared and injected by aspiration at the anodic end of the capillary. A high voltage protein separation is then performed and direct detection of the hemoglobins is made at 415 nm at the cathodic end of the capillary. Before each run, the capillaries are washed with a Wash Solution and prepared for the next analysis with buffer.
The hemoglobins, separated in silica capillaries, are directly and specifically detected at an absorbance wave length of 415 nm which is specific to hemoglobins. The resulting electrophoregrams are evaluated visually for pattern abnormalities.
Direct detection provides accurate relative quantification of individual hemoglobin fraction, with particular interest, such as A2 hemoglobin for thalassemia diagnostic. In addition, the high resolution of this procedure allows the identification of hemoglobin variants, in particular, differentiation of hemoglobins S from D, and E from C.
The hemoglobin A2 quantification can also be performed when hemoglobin E is present.
By using alkaline pH buffer, normal and abnormal (or variant) hemoglobins are detected in the following order, from cathode to anode: δA'2 (A2 variant), C, A2/O-Arab, E, S, D, G-Philadelphia, F, A, Hope, Bart's, J, N-Baltimore and H.
The carbonic anhydrase is not visualized on the hemoglobin electrophoretic patterns, this permits to identify hemoglobin A2 variants in this migration zone.

REAGENTS AND MATERIALS SUPPLIED IN THE MINICAP HEMOGLOBIN(E) KITS

WARNING: See the safety data sheets.

ITEMS	PN 2207	PN 2227*
Buffer (ready to use)	2 vials, 250 mL each	6 vials, 250 mL each
Hemolysing solution (ready to use)	1 vial, 225 mL	3 vials, 225 mL each
Wash solution (stock solution)	1 vial, 25 mL	3 vials, 25 mL each
Reagent cups	1 pack of 125	3 packs of 125 each
Filters	3 filters	3 filters
Bins for used cups	4 bins	12 bins
Hemolysing solution bar code labels	5 sheets of 4 labels	15 sheets of 4 labels

** MINICAP HEMOGLOBIN(E) MAXI-KIT*

During transportation, the kit can be kept without refrigeration (15 to 30 °C) for 15 days without any adverse effects on performance.

FOR OPTIMAL MANAGEMENT OF TRACEABILITY : All reagents from the same kit must be used together.
TO OBTAIN THE EXPECTED PERFORMANCES : The package insert instructions must be observed.

WARNING : Do not use marketed deionized water, such as water for ironing for example (risk of important capillaries damage). Use only water with ultrapure quality, such as injection grade water.

1. BUFFER

Preparation
The buffer is ready to use. It contains : buffer solution pH 9.4 ± 0.5 ; additives, nonhazardous at concentrations used, necessary for optimum performance.

Use
Buffer for analysis of hemoglobins in MINICAP FLEX-PIERCING instrument.

Storage, stability and signs of deterioration
Store the buffer refrigerated (2 to 8 °C). It is stable until the expiration date indicated on the kit package or buffer vial labels. Avoid storage at room temperature for a long time or close to a window or to a heat source.
DO NOT FREEZE.

IMPORTANT : When stored at 2 – 8 °C and prior to use, it is necessary for the buffer to reach room temperature ; when it is full, let the buffer vial at room temperature for at least 3 hours prior to use. If this precaution is not respected, the performances of the procedure may be affected.

WARNING : Do not pre-heat the buffer in hot water.

Once the buffer vial has been opened and positioned on the MINICAP FLEX-PIERCING instrument, it is stable for a maximum of 1 month (accumulated) at room temperature (15 to 30 °C). After each use, the buffer must imperatively be stored refrigerated (between 2 and 8 °C) without any delay, it is then stable until the expiration date indicated on the buffer vial label.

IMPORTANT : The accumulated time of the buffer stored at room temperature must not exceed 1 month. This time of 1 month storage takes account of the time for the buffer to come to room temperature.

Discard buffer if it changes its appearance, e.g., becomes cloudy due to microbial contamination.

2. HEMOLYSING SOLUTION

Preparation
Hemolyzing solution is ready to use. It contains buffer solution pH 8.7 ± 0.5 ; additives, nonhazardous at concentrations used, necessary for optimum performance.

Use
To dilute and hemolyze red blood cells.

Storage, stability and signs of deterioration
Store Hemolysing Solution refrigerated (2 to 8 °C). It is stable until the expiration date indicated on the kit package or Hemolysing Solution vial label. Avoid storage at room temperature or close to a window or to a heat source. DO NOT FREEZE.
Discard Hemolysing Solution if it changes its appearance, e.g., becomes cloudy due to microbial contamination.

IMPORTANT : After each use, close immediately and tightly the hemolysing solution vial and store it refrigerated.

NOTE : Hemolysing solution may show a more or less marked yellow-orange colour without any adverse effects on its performance.

3. WASH SOLUTION

Preparation
The vial of the stock wash solution should be diluted up to 250 mL with distilled or deionized water.
After dilution, the wash solution contains an alkaline solution pH ≈ 12.

Use
For washing the capillaries before hemoglobin electrophoresis.

IMPORTANT : Before filling the wash solution container, it is recommended to wash the opening of the container, the connector and the tube with plenty of distilled or deionized water to avoid salts deposit.

Storage, stability and signs of deterioration
Store the stock and working wash solutions in closed containers at room temperature or refrigerated. The stock wash solution is stable until the expiration date indicated on the kit or wash solution vial label.
Working wash solution is stable for 3 months.
Discard working wash solution if it changes its appearance, e.g., becomes cloudy due to microbial contamination.

4. REAGENT CUPS

Use
Single use cups for the preparation of biological samples to analyze with the automated instrument. To be placed on the automated loading system for cups of MINICAP FLEX-PIERCING. One reagent cup is intended for the analysis of 2 samples.

WARNING : After use, reagent cups with biological samples have to be handled with care. When the analysis is completed, reagent cups must be discarded with biological waste products and they must NEVER be reused.

Storage
Before use, store the reagent cups in their sealed package in a clean and dry place and at a temperature comprised between 2 and 30 °C.

5. FILTERS

Use
Disposable filters for filtration of analysis buffer, working wash solution and distilled water (used for capillaries rinsing).

IMPORTANT : When kit replacement, change systematically all the filters. Wear clean gloves for handling and installation of filters.

Screw one filter at the connector situated at the extremity of each tube that plunges in the vials of buffer, wash solution and distilled or deionized water. When setting filters on MINICAP FLEX-PIERCING instrument, rinse the connectors and the tubes with distilled or deionized water.

Storage
Before use, store the filters in their sealed package in a dry place at room temperature or refrigerated.

6. BINS FOR USED CUPS

Use

Bins intended for automated collection of used reagent cups in MINICAP FLEX-PIERCING. To place in MINICAP FLEX-PIERCING at the location intended for this purpose.

WARNING : Bins containing used reagent cups with biological samples have to be handled with care.

7. HEMOLYSING SOLUTION BAR CODE LABELS

Use

Labels to identify the tube containing the hemolysing solution (HEMOGLOBIN(E) HEMOLYSING SOLUTION).

REAGENTS REQUIRED BUT NOT SUPPLIED

WARNING : See the safety data sheets.

1. NORMAL Hb A2 CONTROL

Composition

The Normal Hb A2 Control (SEBIA, PN 4778) is obtained from a pool of normal human blood samples. The Normal Hb A2 Control is in a stabilized lyophilised form.

Intended use

The Normal Hb A2 Control is designed for the migration control **before starting a new analysis sequence and after the analysis of a complete rotating sampler**, and for the quality control of human hemoglobin A2 quantification with the MINICAP HEMOGLOBIN(E) electrophoresis procedure performed with the MINICAP FLEX-PIERCING instrument.

Reconstitute each Normal Hb A2 Control vial with the volume of distilled or deionized water, as indicated in the package insert of the Normal Hb A2 Control. Allow to stand for 30 minutes and mix gently (avoid formation of foam).

NOTE : The precision of the reconstitution volume to be maintained is ± 1.0 %.

Migration control :

IMPORTANT : For optimal use of the Normal Hb A2 Control with the MINICAP FLEX-PIERCING instrument, it is necessary to use one specific tube designed for blood controls and its corresponding cap (see "EQUIPMENT AND ACCESSORIES REQUIRED", Tubes and caps for Controls) and to identify this tube with one Normal Hb A2 Control bar code label.

The Normal Hb A2 Control should be used as follows :

- Apply the reconstituted Normal Hb A2 Control in a tube designed for blood control.
- Close the tube with its cap.
- Place the tube (identified with the Normal Hb A2 Control bar code label), in position No. 28 on a MINICAP FLEX-PIERCING rotating sampler ("Control" position with centering ring).
- Pour 5 mL of MINICAP HEMOGLOBIN(E) hemolysing solution in a hemolysing tube (identified with the hemolysing solution bar code label) without introducing air bubbles and place it in position No. 27 on the rotating sampler ("Diluent / Solution" position without any centering ring) (A message will be displayed if the tube or the hemolysing solution is missing).

IMPORTANT : Ensure the absence of foam in the tube before placing it on the rotating sampler.

- Slide the rotating sampler into the MINICAP FLEX-PIERCING instrument.
- Close the doors of the MINICAP FLEX-PIERCING instrument, the analysis starts automatically.
- In the window which appears on the screen, select the number of analyses of the Normal Hb A2 Control to perform, according to the following indications, and validate :
    - 1 analysis of the Normal Hb A2 Control before starting a new analysis sequence,
    - 2 analyses after having changed the analysis buffer vial (even if the lot number is identical) or the technique, after a cleaning sequence with CAPICLEAN, after a software upgrade or after capillaries activation,
    - 3 analyses for the first use of the "HEMOGLOBIN(E)" analysis program with the MINICAP FLEX-PIERCING instrument or after a prolonged stoppage (over 1 week).

The results are then automatically considered by the software for the data analysis.

IMPORTANT : The hemoglobin A fraction of the Normal Hb A2 Control must show a minimal optical density (OD) of 0.10. Under this value, the recentering of the electrophoretic pattern will not occur correctly. When analysing samples, the identification of hemoglobin fractions, Hb A, Hb F, Hb A2 and Hb C and also the determination of the migration zone of other variants, may be impossible or wrong (see the paragraph RESULT ANALYSIS).

IMPORTANT : For optimal use of the Normal Hb A2 Control, it is necessary to use one bar code label intended to identify the tube for control which contains the Hb A2 Control (close the tube with its specific cap before using it).

After the installation of MINICAP FLEX-PIERCING instrument, during the first sequence of blood sample analysis, a red warning signal will appear if hemoglobin A is absent in one of the samples (and the recentering of the electrophoretic pattern will not be possible, see the paragraph « Result analysis »).
It is then recommended to analyze a blood sample with hemoglobin A on the concerned capillary and to analyze again the sample without hemoglobin A by placing it in a position corresponding to a capillary which has already detected hemoglobin A.

Quality control :
The Normal Hb A2 Control should be used as a normal human blood. After reconstitution, use directly the Normal Hb A2 Control as a blood sample to analyze or as a migration control (in position No. 28 on the rotating sampler, see paragraph before). It will be automatically diluted with hemolysing solution.
It is recommended to include one analysis of Normal Hb A2 Control. The values obtained must fall within the range provided with each batch of Hb A2 Control.

IMPORTANT : For optimal use of the Normal Hb A2 Control placed on the rotating sampler in positions No. 1 to 26, it is necessary to use one bar code label intended to identify the tube for control which contains the Hb A2 Control (close the tube with its specific cap before using it).

Storage, stability and signs of deterioration

See the Normal Hb A2 Control package insert.

IMPORTANT : After the analysis of the Normal Hb A2 Control with the MINICAP FLEX-PIERCING instrument (for migration control or for quality control), store the control at 2 - 8 °C or at - 18 / - 30 °C without any delay, according to the Normal Hb A2 Control package insert.

WARNING : No test method can provide an absolute assurance of the absence of HIV, hepatitis B and C or other infectious agents. Therefore, handle the Normal Hb A2 Control as a hazardous biological material.

This control was found negative on assays approved by FDA or EU equivalent regulatory agency :
- against hepatitis B surface antigen ;
- for antibody to HCV ;
- for antibody to HIV1 and HIV2.

2. DISTILLED OR DEIONIZED WATER

Use

For rinsing capillaries in the SEBIA MINICAP FLEX-PIERCING automated instrument, for capillary electrophoresis.
It is recommended to use filtered distilled or deionized water (on a filter with a porosity ≤ 0.45 µm) and with a conductivity lower than 3 µS/cm, which corresponds to a resistivity higher than 0.33 MΩ.cm.
To prevent microbial proliferation, change the water every day.
For optimal operation, add CLEAN PROTECT (SEBIA, PN 2059, 1 vial of 5 mL) in distilled or deionized water (see the instructions for use of CLEAN PROTECT) or use directly the ready to use CAPIprotect* solution (SEBIA, PN 2061 : 2 containers of 5 L of distilled water with CLEAN PROTECT).

IMPORTANT : Before filling the rinse container, it is recommended to wash it with plenty of distilled or deionized water.

** NOTE : The CAPIprotect solution can also be used to dilute the stock wash solution. Then, in that case, the diluted wash solution may show a transient more or less marked yellow colour without any adverse effects on its performance.*

3. MINICAP FLEX-PIERCING CAPICLEAN

Composition

The vial of CAPICLEAN concentrated solution (MINICAP FLEX-PIERCING CAPICLEAN, SEBIA, PN 2251, 25 mL) contains : proteolytic enzymes, surfactants and additives nonhazardous at concentrations used, necessary for optimum performances.

Use

For sample probe cleaning in the SEBIA MINICAP FLEX-PIERCING automated instrument, for capillary electrophoresis, during the CAPICLEAN cleaning sequence.

IMPORTANT : Launch a CAPICLEAN cleaning sequence at least once a week and at maximum once a day, or after every 500 analyses when performed within less than one week.

See the instruction sheets of MINICAP FLEX-PIERCING CAPICLEAN, SEBIA.

WARNING : Do not use a capped tube.

IMPORTANT : For optimal use of the CAPICLEAN solution with the MINICAP FLEX-PIERCING instrument, it is necessary to use one bar code label intended to identify the 100 mm tube which contains the diluted CAPICLEAN solution.

Storage, stability and signs of deterioration

Store CAPICLEAN refrigerated (2 - 8 °C). It is stable until the expiration date indicated on the vial label. DO NOT FREEZE.
Precipitate or combined particles in suspension (floccules) may be observed in the CAPICLEAN vial without any adverse effects on its utilization.
Do not dissolve this precipitate or these particles. It is recommended to collect only the supernatant.
For later use, store the tube containing the diluted solution at 2 - 8 °C. It must be used within the day.

4. SODIUM HYPOCHLORITE SOLUTION (for sample probe cleaning)

Preparation

Prepare a sodium hypochlorite solution (2 % to 3 % chloride) by diluting 250 mL 9.6 % chloride concentrated solution to 1 liter with cold distilled or deionized water.

Use

For the sample probe cleaning in the MINICAP FLEX-PIERCING instrument (weekly maintenance in order to eliminate adsorbed proteins from the probe).

See the SEBIA MINICAP FLEX-PIERCING instruction manual.

WARNING : Do not use a capped tube.

- Apply in a 100 mm tube 2 mL of diluted chlorinated solution previously prepared.
- Place the 100 mm tube (identified with one bar code label specific to the sodium hypochlorite solution) on the rotating sampler of MINICAP FLEX-PIERCING.
- Position a new reagent cup on the automated loading system for cups of MINICAP FLEX-PIERCING (a message will be displayed if the reagent cup is missing).
- Slide the rotating sampler into the MINICAP FLEX-PIERCING instrument.
- Close the doors of the MINICAP FLEX-PIERCING instrument, the cleaning sequence starts automatically.

IMPORTANT : For optimal use of the sodium hypochlorite solution with the MINICAP FLEX-PIERCING instrument, it is necessary to use one bar code label intended to identify the 100 mm tube which contains the solution.

Storage, stability and signs of deterioration

Store the working chlorinated solution at room temperature in a closed container, it is stable for 3 months. Avoid storage in sunlight, close to heat and ignition source, and to acids and ammonia.

5. CAPILLARYS / MINICAP WASH SOLUTION

Preparation

Each vial of the stock CAPILLARYS / MINICAP Wash solution (SEBIA, PN 2052, 2 vials, 75 mL) should be diluted up to 750 mL with distilled or deionized water.
After dilution, the wash solution contains an alkaline solution pH ≈ 12.
For MINICAP FLEX-PIERCING, it is convenient to dilute only 25 mL of the stock solution to 250 mL with distilled or deionized water.

Use

For washing the MINICAP FLEX-PIERCING capillaries.

IMPORTANT : Before filling the wash solution container, it is recommended to wash the opening of the container, the connector and the tube with plenty of distilled or deionized water to avoid salts deposit.

Storage, stability and signs of deterioration

Store the stock and working wash solutions in closed containers at room temperature or refrigerated. The stock wash solution is stable until the expiration date indicated on the kit or wash solution vial label.
Working wash solution is stable for 3 months.
Discard working wash solution if it changes its appearance, e.g., becomes cloudy due to microbial contamination.

6. SALINE

Preparation

Make 0.15 M (0.9 g/dL) NaCl solution in distilled or deionized water.

Use

To wash red blood cells before storage at - 70 / - 80 °C, if necessary.

Storage, stability and signs of deterioration

Store saline at room temperature or refrigerated.
Discard after 3 months or if it changes its appearance, e.g., becomes cloudy due to microbial contamination. For longer storage periods, add sodium azide, 0.1 g/dL.

OPTIONAL REAGENT BUT NOT SUPPLIED

WARNING: See the safety data sheet.

PATHOLOGICAL Hb A2 CONTROL

The Pathological Hb A2 Control, SEBIA, PN 4779, can be used for the migration control, in addition or as a replacement of the Normal Hb A2 Control. For its utilization for the migration control or quality control, the Pathological Hb A2 Control should be used like the Normal Hb A2 Control, see the previous paragraph "NORMAL Hb A2 CONTROL".

See the instructions for use of the Pathological Hb A2 Control for additional information.

NOTES :

The assays that were performed for the validation of reagents demonstrated that, for the different solutions and using an adapted equipment for the reconstitution volume, a variation of ± 5 % on the final volume has no adverse effect on the analysis.
The distilled or deionized water used to reconstitute solutions, must be free of bacterial proliferation and mold (use a filter ≤ 0.45 µm) and have a conductivity lower than 3 µS/cm, which corresponds to a resistivity higher than 0.33 MΩ.cm.

EQUIPMENT AND ACCESSORIES REQUIRED

1. MINICAP FLEX-PIERCING instrument, SEBIA, PN 1232.
2. Rotating sampler supplied with MINICAP FLEX-PIERCING, equipped with centering rings for MINICAP FLEX-PIERCING (specific for the MINICAP HEMOGLOBIN(E) procedure) for 13 mm diameter tubes.
3. MINICAP FLEX-PIERCING centering rings for 11 mm diameter tubes, SEBIA (PN 1612) for 11 mm diameter tubes.
4. Container Kit supplied with MINICAP FLEX-PIERCING : Rinse container (to fill with distilled or deionized water) and waste container.
5. Collection tubes with 13 mm diameter and their corresponding caps (maximal length of tube with cap : 100 mm, maximal diameter of cap : 17 mm) : for example, BD Vacutainer, Terumo Venosafe 5 mL, Greiner Bio-one Vacuette 1, 2, 3 or 4 mL or Sarstedt S-Monovette 4 mL tubes (13 x 75 mm), or
   collection tubes with 11 mm diameter and their corresponding caps (maximal length of tube with cap : 100 mm, maximal diameter of cap : 17 mm) : for example, Sarstedt S-Monovette 2,7 mL or Kabe Labortechnik Primavette S 2,6 mL tubes (11 x 66 mm),
   or collection tubes with equivalent dimensions approved for clinical assays.
6. Tubes and caps for Controls, SEBIA, PN 9205 : 500 conical tubes and their caps to analyze blood controls and particular samples with the MINICAP FLEX-PIERCING instrument.
7. Hemolysing tubes (with 8 to 16 mm diameter and 50 to 100 mm length).

8. "AUTOMATIC LOW VOLUME" bar code labels, SEBIA (20 units), PN 9208 : labels intended to identify samples with volume less than 1 mL for an analysis using the "automatic dilution" mode (VS ≥ 8.61).
9. "MANUAL LOW VOLUME" bar code labels, SEBIA (20 units), PN 9209 : labels intended to identify samples with volume less than 1 mL for an analysis using the "manual dilution" mode (VS ≥ 8.61).
10. MINICAP Reagent cups / 125 (3), SEBIA, PN 2281.
11. Lids for bins for used reagent cups, SEBIA (12 units), PN 2286 : lids to close the bins containing used cups.
12. Pump filter for MINICAP FLEX-PIERCING, SEBIA (2 units), PN 1620.

SAMPLES FOR ANALYSIS

Sample collection and storage

Fresh anticoagulated whole blood samples collected in tubes containing K_2EDTA or K_3EDTA as anticoagulant are recommended for analysis. Avoid anticoagulants containing iodoacetate. Blood must be collected according to established procedures used in clinical laboratory testing.
Samples may be stored for up to 7 days between 2 and 8 °C.

NOTE : Samples should not be stored at room temperature.

Progressive hemoglobins (Hb) degradation may occur for samples stored between 2 to 8 °C.
When the blood sample is stored for more than 7 days at 2 - 8 °C :

- a weak fraction, corresponding to methemoglobin, appears in the Hb S migration zone,
- when Hb C is present, a fraction corresponding to degraded Hb C appears more anodic than Hb A2 which does not interfere with it (Z(E) zone, see the table in paragraph "Interpretation"),
- when Hb O-Arab is present, a fraction corresponding to degraded Hb O-Arab appears in the Hb S migration zone (Z(S) zone, see the table in paragraph "Interpretation"),
- when Hb E is present, a fraction corresponding to degraded Hb E appears in the Z(D) zone (see the table in paragraph "Interpretation"),
- when Hb S is present, a fraction corresponding to degraded Hb S appears in the Hb F migration zone (Z(F) zone, see the table in paragraph "Interpretation"),
- when Hb A is present, a fraction corresponding to degraded Hb A ("aging fraction" of Hb A) appears more anodic (Z11 zone, see the table in paragraph "Interpretation"),
- when Hb F is present (in blood samples from newborn babies), a fraction appears in the Hb A migration zone (Z(A) zone, see the table in paragraph "Interpretation") due to the sample degradation.

When stored for more than 10 days, viscous aggregates in red blood cells are observed ; it is necessary to discard them before the analysis.

For longer storage, whole blood samples (without any preparation) or washed red blood cells can be frozen at - 70 / - 80 °C within 8 hours of collection. Frozen whole blood samples and red blood cells are stable for 3 months maximum at - 70 / - 80 °C.

IMPORTANT : For optimal storage of samples, store them at - 70 / - 80 °C. Do not store at - 20 °C (see BIBLIOGRAPHY, J. Bardakdjian-Michau *et al*, 2003).

Preparation of red blood cells for storage at - 70 / - 80 °C :
Wash red blood cells according to the following procedure: Centrifuge anticoagulated blood to obtain a red blood cells pellet ; discard the plasma ; wash the red blood cells (RBC) 2 times with 10 volumes of saline (centrifuge after each washing step) ; discard the excess of saline over the red blood cells pellet and vortex them before freezing.

Sample preparation

- Use directly whole blood samples.
- Check that all the tubes contain at least 1 mL of blood and are perfectly closed.
- **Vortex for 5 seconds blood samples stored at 2 - 8 °C for one week or stored at - 70 / - 80 °C.**

WARNING : The tubes must be closed with their corresponding caps designed for the MINICAP HEMOGLOBIN(E) procedure with the MINICAP FLEX-PIERCING instrument (see EQUIPMENT AND ACCESSORIES REQUIRED).

Particular cases:

IMPORTANT : The following samples must be identified with the "LOW VOLUME AUTO" or "LOW VOLUME MANUAL" bar code label ; these labels allow the instrument to apply respectively the automatic or manual dilution mode according to the sample preparation procedure. These samples must be placed on the rotating sampler at the beginning of an analysis series and the bar code of each tube must be visible in the opening of the rotating sampler. Without any bar code label, the analysis should be affected.

Analysis of samples without any Hb A and with Hb F < 3 % or without any Hb A2 (these samples are perfectly quantified but not identified by zones).
To identify hemoglobin fractions in a sample without any Hb A and with Hb F < 3 % or without any Hb A2, it is recommended to prepare this sample according to one of the two following procedures:

- Vortex for 5 seconds the whole blood sample.
- In a conical tube for control (identified with a "LOW VOLUME AUTO" bar code label), mix one volume (100 µL) of whole blood to analyze with one volume (100 µL) of Normal Hb A2 Control and cap the tube.
- Vortex for 5 seconds.
- Place the tube on the rotating sampler of the MINICAP FLEX-PIERCING instrument at the beginning of an analysis series and slide the rotating sampler into the instrument to run the analysis without any delay.
- Close the doors of the MINICAP FLEX-PIERCING instrument, the analysis starts automatically.

The results are then automatically considered by the software for the data analysis.

IMPORTANT : For a sample without any Hb A, Hb F or Hb A2 prepared according to this procedure, the result obtained with the mixed sample will enable presumptive variant identification due to the positioning of the hemoglobins fractions in the appropriate identification zones. Do not report the relative quantification from the mixed sample result.

The relative quantification of hemoglobins should be reported utilizing the initial, unmixed sample result (without any dilution in the blood control).

Analysis of samples stored at -70 / - 80 °C :

Whole blood :

Vortex for 5 seconds the tube with thawed whole blood and perform the analysis according to the standard procedure.

Red blood cells :

To analyze a red blood cells sample stored at -70 / - 80 °C, prepare it according to the following procedure :

- Vortex for 5 seconds the tube with thawed red blood cells.
- In a conical tube for control (identified with a "LOW VOLUME MANUAL" bar code label), mix one volume (50 µL) of red blood cells with 8 volumes (400 µL) of MINICAP HEMOGLOBIN(E) hemolysing solution and cap the tube.
- Vortex for 5 seconds.
- Place the tube on the rotating sampler of the MINICAP FLEX-PIERCING instrument at the beginning of an analysis series and slide the rotating sampler into the instrument to run the analysis without any delay.
- Close the doors of the MINICAP FLEX-PIERCING instrument, the analysis starts automatically.

The results are then automatically considered by the software for the data analysis.

Analysis of samples with volume below 1 mL :

- Vortex for 5 seconds the whole blood sample and prepare the sample according to its volume following one of the 2 protocols.

1. Volume of sample comprised between 200 µL and 1 mL :
   - Apply at least 200 µL of whole blood to analyze in a conical tube for control (identified with a "LOW VOLUME AUTO" bar code label) and cap the tube.
   - Place the tube on the rotating sampler of the MINICAP FLEX-PIERCING instrument at the beginning of an analysis series and slide the rotating sampler into the instrument to run the analysis without any delay.
   - Close the doors of the MINICAP FLEX-PIERCING instrument, the analysis starts automatically.

or

2. Volume of sample below 200 µL :
   - Apply 50 µL of whole blood to analyze in a conical tube for control (identified with a "LOW VOLUME MANUAL" bar code label) and 250 µL of MINICAP HEMOGLOBIN(E) hemolysing solution and cap the tube.
   - Vortex for 5 seconds.
   - Place the tube on the rotating sampler of the MINICAP FLEX-PIERCING instrument at the beginning of an analysis series and slide the rotating sampler into the instrument to run the analysis without any delay.
   - Close the doors of the MINICAP FLEX-PIERCING instrument, the analysis starts automatically.

The results are then automatically considered by the software for the data analysis.

NOTES : The minimal volume of sample to analyze in a conical tube is 200 µL. Without any bar code label on the conical tube, the sample cannot be identified and the dilution mode (automatic or manual according to the sample preparation procedure) cannot be applied.

Samples to avoid

- Avoid coagulated blood samples.
- Avoid aged, improperly stored blood samples ; the automated hemolysis of samples may be disturbed by viscous aggregates in red blood cells. Then, degradation products (as artefacts) may affect the electrophoretic pattern.

In these 2 cases, aggregates in red blood cells may affect the collection of the sample by the probe.

- Do not analyze directly tubes containing less than 1 mL of blood sample, the analysis should be affected (see particular cases).

NOTE : Collection tubes and centrifugation parameters for biological samples are described in the available documentation on pre-analytical phase for bio-medical analysis (data provided by the tube manufacturers, guides and recommendations on biological sample collection…). Without any indication in the instructions for use on the type of tube to use or on the centrifugation, please refer to this documentation and for the dimensions of tube to use, refer to the SEBIA document "Characteristics of tubes to use according to the instrument". The pre-analytical phase must be performed according to the state of art, the different recommendations, including those provided by the tube manufacturers, and applicable regulations.

PROCEDURE

The MINICAP FLEX-PIERCING instrument is a multiparameter instrument for hemoglobins analysis on parallel capillaries. The hemoglobins assay uses 2 capillaries to run the samples.

The sequence of automated steps is as follows :

- Bar code reading of rotating sampler and sample tubes (for up to 26 tubes) ;
- Mixing of blood samples before analysis ;
- Sample hemolysis and dilution from primary tubes into reagent cups ;
- Capillary washing ;
- Injection of hemolyzed samples ;
- Hemoglobin separation and direct detection of the separated hemoglobins on capillaries.

The manual steps include :
- Placement of sample tubes (with caps) in rotating sampler in positions 1 to 26 ;
- Placement of the uncapped hemolysing solution tube in rotating sampler in position 27 ;
- Set up the Normal Hb A2 Control or the Pathological Hb A2 Control in rotating sampler in position 28;
- Placement of the rotating sampler in the MINICAP FLEX-PIERCING instrument ;
- Removal of the sample tubes after analysis ;
- Removal and closing of the bins for used cups.

PLEASE CAREFULLY READ THE MINICAP FLEX-PIERCING INSTRUCTION MANUAL.

I. PREPARATION OF MINICAP ANALYSIS

1. Switch on MINICAP FLEX-PIERCING instrument and computer.
2. In order to start the instrument, position at least one new reagent cup on the automated loading system for cups of MINICAP FLEX-PIERCING (a message will be displayed if a reagent cup is missing).
3. Set up the software, the instrument automatically starts.
4. The MINICAP HEMOGLOBIN(E) kit is intended to run with "HEMOGLOBIN(E)" analysis program from the MINICAP FLEX-PIERCING instrument. To select "HEMOGLOBIN(E)" analysis program and place the MINICAP HEMOGLOBIN(E) buffer vial in position "B2" in the instrument, please read carefully the MINICAP FLEX-PIERCING instruction manual and follow the instructions displayed on the screen.
5. Position new reagent cups on the automated loading system for cups of MINICAP FLEX-PIERCING (a message will be displayed if the reagent cups are missing).
6. **Position a bin for used cups in MINICAP FLEX-PIERCING at the location intended for this purpose.**
7. Check the fill level of the reagent vials, add reagent if necessary and empty the waste container. In the window "Check reagent levels", update the software by moving the cursor buttons. Replace the filter of the rinsing system, if necessary.
8. The rotating sampler contains 28 positions for sample tubes:
   - Place up to 26 capped sample tubes with whole blood on the rotating sampler with specific centering rings (**positions No. 1 to 26**), the bar code of each tube must be visible in the opening of the rotating sampler.
   - Pour the MINICAP HEMOGLOBIN(E) hemolysing solution in an uncapped hemolysing tube, identified with the hemolysing solution bar code label, without introducing air bubbles: 2 mL for the analysis of 1 or 2 samples, 5 mL for the analysis of 12 samples. Place this tube in **position No. 27** without any centering ring on the rotating sampler ("Diluent / Solution" position).

   NOTE : 5 mL of hemolysing solution applied in a 13 x 75 mm tube will allow to perform 12 analyses ; 10 mL of hemolysing solution applied in a 16 x 100 mm tube will allow to perform 24 analyses.

   IMPORTANT : Ensure the absence of foam in the tube before placing it on the rotating sampler.
   - Position the Normal Hb A2 Control or the Pathological Hb A2 Control in position No. 28 on the rotating sampler ("Control" position) and select the number of analyses of the control to perform according to the indications previously described, see "Normal Hb A2 Control" paragraph, part "Migration control".

   IMPORTANT : If a tube is missing in position No. 1 (sample tube), in position No. 27 (hemolysing solution tube) and in position No. 28 (blood control tube), the analysis can not start and a message will be displayed.

   NOTE : When using a control blood, it is necessary to use the specific bar code label.
9. Slide the rotating sampler into the MINICAP FLEX-PIERCING instrument.
10. Close the doors of the MINICAP FLEX-PIERCING instrument, the analysis starts automatically.
11. After the analysis, remove the rotating sampler with analyzed sample tubes.
12. If necessary, take off carefully the bin containing used reagent cups, close it tightly with the corresponding lid and discard it.
    WARNING : Bins containing used reagent cups with biological samples have to be handled with care.

DILUTION - MIGRATION - DESCRIPTION OF THE AUTOMATED STEPS

1. Bar codes are read on both rotating sampler and sample tubes.
2. Mixing of tubes.
3. Samples are diluted in hemolysing solution and the sample probe is rinsed after each sample.
4. Capillaries are washed.
5. Diluted samples are injected into capillaries.
6. Migration is carried out under constant voltage for about 8 minutes and the temperature is controlled by Peltier effect.
7. Hemoglobins are detected directly by scanning at 415 nm and an electrophoretic profile appears on the screen of the system.

NOTE : These automated steps are described for the two first analyzed sample tubes. The electrophoretic patterns appear after about 20 minutes from the start of the analysis. For the following sample tubes, the first three steps (bar code reading, mixing and hemolysis of blood samples) are performed during the analysis of the 2 previous samples.

II. RESULT ANALYSIS

At the end of the analysis, relative quantification of individual hemoglobin fractions is automatically performed and profiles can be analyzed. The hemoglobin fractions Hb A, Hb F, Hb A2 and Hb C are automatically identified. The Hb A fraction is centered in the middle of the review window and Hb A2 is adjusted at a fixed position against that of Hb A. In the absence of Hb A and when Hb F is present (≥ 3 %), the recentering of the pattern is made with Hb F and Hb A2 peaks that are placed at fixed positions.
The resulting electrophoregrams are evaluated visually for pattern abnormalities.
The electrophoretic patterns are colored :
- in Cyan when the number of fractions / peaks is that which is configured by default for the procedure (2 fractions for HEMOGLOBIN(E) procedure, for example),
- in Magenta when the number of fractions / peaks is not that which is configured by default for the procedure.

With HEMOGLOBIN(E) procedure, the Hb F peak is orange (identified by «Hb F or variant») when the age of the patient is unknown and blue (identified by «Hb F») when the age of the patient is known and the fraction / peak is lower than 2 %.

The potential positions of the different hemoglobin variants (identified in zones called Z1 to Z15) are shown on the screen of the system and indicated on the result ticket. The table in paragraph "Interpretation" shows known variants which may be present in each corresponding zone.
When the software identifies a hemoglobin fraction in a defined zone, the name of this zone is framed.

Patterns are automatically adjusted with regard to Hb A and Hb A2 fractions, or with regard to Hb F and Hb A2 fractions as the case may be, to facilitate their interpretation:

- when Hb A and / or Hb A2 fractions are not detected on an electrophoretic pattern and / or when Hb F (with no Hb A) is not detected or is at a level < 3 %,
  - a yellow warning signal appears,
  - the adjustment of the pattern is performed using the position of the Hb A fraction on the two previous patterns obtained with the same capillary,
  - no fraction is identified (except when Hb C is detected: in this case, Hb A2 and Hb C fractions are identified),
  - the different migration zones (Z1 to Z15) do not appear neither on the screen of the system, nor on the ticket result.
- when Hb F is detected at a level ≥ 3.0 %, without any detection of Hb A (no Hb A or Hb A at a low level) on an electrophoretic pattern,
  - the adjustment of the pattern is performed using the position of the Hb F and Hb A2 fractions,
  - Hb F and Hb A2 fractions are placed at fixed positions,
  - Hb F and Hb A2 fractions are identified,
  - the different migration zones (Z1 to Z15) are indicated on the screen of the system and on the ticket result by the same way of patterns with Hb A,
  - abnormal fractions are grey-dashed and identified using their migration zone (a fraction detected in Z(D) zone is called "Z(D) zone" for example),
  - when a rare variant migrates in the Hb A2 migration zone, the different migration zones (Z1 to Z15) do not appear neither on the screen of the system, nor on the ticket result.
- when the adjustment is not possible,
  - a red warning signal appears,
  - no fraction is identified,
  - the different migration zones (Z1 to Z15) do not appear neither on the screen of the system, nor on the ticket result.

  Call SEBIA.
- when optical density (OD) is insufficient on a migration control electrophoretic pattern (obtained with the Normal Hb A2 Control or the Pathological Hb A2 Control, identified with its bar code label and analyzed in position No. 28 in the rotating sampler),
  - a warning message is displayed in order to consider or remove this analysis for the determination of Hb A fraction position,
  - a purple warning signal appears on the review window,
  - Hb A and Hb A2 fractions are not identified (except when the analysis is considered by the operator),
  - the different migration zones (Z1 to Z15) do not appear neither on the screen of the system, nor on the ticket result (except when the analysis is considered by the operator).

In all these cases, the different migration zones (Z1 to Z15) do not appear neither on the screen of the system, nor on the ticket result.
On the electrophoretic pattern, the curves of Hb A2 and Hb C fractions, are calculated and redrawn by fitting with adjustment (or fitted) and are overlaid with the native curve. This display allows the Hb A2 fraction quantification if Hb C is present in the sample.

WARNING : In some cases of hemoglobin C (homozygous) or after a technical problem, the hemoglobins A2 and C are not fitted ; these fractions are then under-quantified. It is then recommended to quantify the Hb A2 fraction by using another technique.

PLEASE CAREFULLY READ THE MINICAP FLEX-PIERCING INSTRUCTION MANUAL.

III. END OF ANALYSIS SEQUENCE

At the end of each analysis sequence, the operator must initiate the "shut down" procedure of the MINICAP FLEX-PIERCING in order to store capillaries in optimal conditions.

IMPORTANT : Position at least one new reagent cup on the automated loading system for cups of MINICAP FLEX-PIERCING (a message will be displayed if a reagent cup is missing).

IV. FILLING OF REAGENT CONTAINERS

The MINICAP FLEX-PIERCING instrument has a reagent automatic control.

IMPORTANT :

- Please refer to the instructions for replacement of reagent containers respecting color code for vials and connectors.
- Replace the filter of the rinsing system **every 500 analyses**, with a pump filter for MINICAP FLEX-PIERCING (see paragraph "EQUIPMENT AND ACCESSORIES REQUIRED").

A message will be displayed when it is necessary to perform one of the following tasks :

- Place a new buffer vial and / or ;
- Fill the container with working wash solution and / or ;
- Fill the container with filtered distilled or deionized water for rinsing capillaries and / or ;
- Empty the waste container and / or ;
- Replace the filter of the rinsing system.

WARNING: Do not use marketed deionized water, such as water for ironing for example (risk of important capillaries damage). Use only water with ultrapure quality, such as injection grade water.

IMPORTANT : Before filling the rinse container, it is recommended to wash it with plenty of distilled or deionized water.

PLEASE CAREFULLY READ THE MINICAP FLEX-PIERCING INSTRUCTION MANUAL.

QUALITY CONTROL

It is advised to include into each run of samples, an assayed control blood (for example, a blood sample containing hemoglobins A, F, C and S, such as Hb AFSC Control, SEBIA, PN 4792, or a normal blood sample, the Normal Hb A2 Control, SEBIA, PN 4778 or the Pathological Hb A2 Control, SEBIA, PN 4779).

RESULTS

Values

Direct detection at 415 nm in capillaries yields relative concentrations (percentages) of individual hemoglobin zones.
Reference values for individual major electrophoretic hemoglobin zones in the MINICAP FLEX-PIERCING system have been established from a healthy population of 113 adults (men and women), whose hemoglobin values (as established by HPLC) were normal :

Hemoglobin A : comprised between 96.8 and 97.8 %
Hemoglobin F : < 0.5 % (*)
Hemoglobin A2 : comprised between 2.2 and 3.2 %

(*) See Interference and limitations

It is recommended that each laboratory establish its own threshold values.

NOTE : Normal values have been established using the standard parameters of the PHORESIS software (smoothing 0 and hemoglobin fractions automatic quantification with HEMOGLOBIN(E) analysis program).

WARNING : Normal (reference) values must be considered only when hemoglobin variants are absent.

Interpretation

See ELECTROPHORETIC PATTERNS, figures 1 – 15.

The different migration zones of hemoglobin variants (called Z1 to Z15) are shown on the screen of the system and on the result ticket. Passing the mouse cursor over a zone name displays icon information containing possible hemoglobin variants that could be seen in this zone.
For each fraction, the position of the top of the peak (position of the maximum) defines the migration zone.
See the table showing the potential variants located in each zone.
With PHORESIS VS ≥ 9.15, this table lists 525 different hemoglobin variants. Due to the history of their discovery, some variants may have many names. A second name is added between brackets close to the main name (for example, in zone Z(D), Hb Korle-Bu (G-Accra)). Other names are not listed in this table.
In zone Z(A), variants are listed in alphabetical order.
For other zones, variants are sorted in main fractions and minor fractions and presented by migration order from most cathodic variants to most anodic variants.
For variants with a main fraction that migrates in zone Z(A), their minor fractions which migrate in zone Z(A2) are not indicated.

- The symbol "*" indicates a hidden or partially hidden peak due to similar migration to normal Hb A or Hb A2 fraction. A partially hidden fraction corresponds to a more or less important shoulder of the normal fraction.
- The symbol "#" indicates the display in icon information of several visible fractions from the same variant, generally present in different zones (for example, alpha-chain variant with a second visible peak as Hb Q-India, or unstable variant as Hb Sabine and Hb Köln). Not concerned: beta chain variants except unstable variants, gamma and delta chain variants and delta-beta hybrids, alpha chain variants without second peak visible on the electrophoretic pattern.
- The symbol "!!" alerts the potential risk of a migration zone shift for a rare variant located in a zone boundary. Additionally, the migration variation of a variant (± 1 point) depends on its percentage. For example, Hb Willamette, located on the far right of zone Z(F), may migrate in zone Z(D) when its percentage has decreased in case of an associated thalassemia.

These symbols are explained in the "Captions" icon information located in the upper left side of the review window.

1. Qualitative abnormalities: Hemoglobinopathies

Most hemoglobinopathies are due to substitution by mutation of a single amino acid in one of the four types of polypeptide chains [1, 2, 4, 9, 12]. The clinical significance of such a change depends on the type of amino acid and the site involved [13]. In clinically significant disease, either the α-chain or the ß-chain is affected.
More than 1400 variants of adult hemoglobin have been described [6, 14]. The first abnormal hemoglobins studied and the most frequent have an altered net electric charge, leading to an easy detection by electrophoresis.
There are five main abnormal hemoglobins which present a particular clinical interest: S, C, E, O-Arab and D.
The MINICAP HEMOGLOBIN(E) kit is intended for the identification of hemoglobinopathies and thalassemias.

Hemoglobin S

Hemoglobin S is the most frequent hemoglobinopathy. It is due to the replacement of one glutamic acid (an acidic amino acid No. 6) of the ß-chain by valine (a neutral amino acid): when compared to Hb A, its isoelectric point is elevated and its total negative charge decreased with the analysis pH. Its electrophoretic mobility is therefore increased in the capillary and this hemoglobin migrates faster than A fraction.
With alkaline buffered MINICAP HEMOGLOBIN(E) procedure, hemoglobin S migrates between A and A2 fractions, next to Hb A2.

Hemoglobin C
One glutamic acid of the ß-chain is replaced by lysine (a basic amino acid No. 6): its mobility is strongly reduced. When compared to Hb A, its isoelectric point is highly elevated and its total negative charge decreased with the analysis pH. Its electrophoretic mobility is therefore increased in the capillary and this hemoglobin is faster than A fraction which allows its differenciation. Hemoglobins C, E and O-Arab are not superimposed on the electrophoretic pattern and are easily identified.

Hemoglobin E
One glutamic acid of the ß-chain (No. 26) is replaced by lysine. With MINICAP HEMOGLOBIN(E) procedure, hemoglobin E migrates just anodically behind hemoglobin A2 and is totally separated from it. Then, when hemoglobin E is present, A2 fraction can be measured to detect ß thalassemia.

Hemoglobin O-Arab
One glutamic acid of the ß-chain (No. 121) is replaced by lysine. With MINICAP HEMOGLOBIN(E) procedure, hemoglobin O-Arab migrates exactly like hemoglobin A2. In such a case, hemoglobin A2 can not be quantified. When this fraction is > 10.5 %, hemoglobin O-Arab must be suspected. Note that Hb O-Arab migrates separately from hemoglobins C and E.

Hemoglobin D (-Los Angeles)
One glutamic acid of the ß-chain (No. 121) is replaced by glutamine. With MINICAP HEMOGLOBIN(E) procedure, hemoglobin D (called D-Punjab, D-Los Angeles, D-Chicago or D-Portugal) migrates more anodically than hemoglobin S, this property allows to differenciate hemoglobins S and D.

2. Quantitative abnormalities : Thalassemias
Thalassemias constitute a quite heterogeneous group of genetic disorders characterized by decreased synthesis of one type of the globin chains. The molecular mechanism of this decrease has not been fully described.
There are two types of thalassemia syndromes :

Alpha-thalassemias
They are characterized by the decrease of synthesis of the α-chains, consequently affecting the synthesis of all normal hemoglobins.
The excess of synthesis of the ß- and γ-chains in relation to α-chains induces the formation of tetramers without any α-chain:
- hemoglobin Bart's = γ 4,
- hemoglobin H = ß 4.

Hemoglobin H presents a low isoelectric point ; with MINICAP HEMOGLOBIN(E) procedure, it migrates more anodically than hemoglobin A (and may appear as one or several fractions).

Beta-thalassemias
They are characterized by the decrease of synthesis of the ß-chains. Only hemoglobin A synthesis is affected.
Therefore hemoglobin F and hemoglobin A2 percentages are increased with respect to hemoglobin A.
With MINICAP HEMOGLOBIN(E) procedure, values obtained for different normal hemoglobin fractions allow the detection of beta-thalassemias.

3. Particular cases
- When there is no hemoglobin A in the sample, a small fraction may be observed in anodic position compared with Hb F (in the Z8 zone when migration zones are diplayed on the electrophoretic pattern) ; this fraction may be acetylated hemoglobin F which represents about 15 to 25 % of hemoglobin F. The MINICAP FLEX-PIERCING instrument can identify this acetylated hemoglobin separately from the hemoglobin A without any confusion.
- When a small fraction (about 0.5 to 3 %) migrates between hemoglobins F and δA'2 (A2 variant), a hemoglobin A2 variant may be suspected. The percentages of the normal hemoglobin A2 and of the variant are approximately identical for heterozygous patients.
- When a hemoglobin A2 variant is detected (δA'2 or any other A2 variant), it is recommended to add its percentage to hemoglobin A2 for a better beta-thalassemia diagnostic.
- Some hemoglobin variants (such as Hb Camperdown and Hb Okayama) migrate close to Hb A and may not be separated from this hemoglobin.
- Some hemoglobin variants (such as Hb Pôrto-Alegre or degraded Hb S, for example) including homozygous variants such as Hb Q-Thailand, migrate close to Hb F. In the absence of Hb A, the adjustment of the pattern using Hb F and Hb A2 peaks and the display of migration zones prevents any confusion of these variants with Hb F.
- PHORESIS VS < 9.15: Weak hemoglobin fractions which migrate in zone Z12 are sometimes quantified with imprecision (too asymmetric Hb Bart's, for example). In such case, it is necessary to delete automatic quantification and then to quantify the fraction manually.
  PHORESIS VS ≥ 9.15: In zone Z12, the curve of Hb Bart is calculated and redrawn by fitting with adjustment (or fitted). Fitted fractions are then called "Hb Bart suspected". Narrow fractions with low percentage are not Hb Bart's, they are identified "Z12 zone". Wide fractions with elevated percentage, suspected to be hemoglobin variants, are identified "Hb Bart zone".
- In the MINICAP HEMOGLOBIN(E) technique, for diabetic patients with elevated HbA_{1c} (over 10 %), a small fraction is observed and eventually identified as a peak in Z10 zone.
- The software version (≥ 9.15) allows a specific identification of Hb H in Z15 zone. Fractions with a width over 10 points and a percentage between 0.3 and 32 % are called "Hb H suspected". Fractions with a width below 10 points are not Hb H and are identified "Z15 zone". Wide fractions with a percentage between 10 and 58 %, suspected to be hemoglobin variants, are identified "Abnormal Hb".
- When analysing blood samples from newborn babies, Hb A from samples containing Hb F at high concentrations may be disturbed, especially due to the presence of degraded Hb F in its migration zone. The Hb A percentage indicated by the software may be overestimated. In addition, when hemoglobin variants (> 4 %, such as Hb S, Hb C, Hb E or Hb D-Punjab) are present in blood samples containing high Hb F levels (> 60 %), it is necessary to perform complementary analyses in order to confirm the presence of Hb A.
- For newborn babies until 6 – 9 months old, it is recommended to analyze different blood samples (collected monthly, for example) in order to check the Hb F concentration. It will allow to verify the decrease of Hb F concentration and the potential presence of a variant. In case of uncertainty, it is advised to confirm by using complementary studies and to analyze parents' blood samples.
- When analyzing blood samples from patients with sickle cell disease before transfusion, a variation of Hb S fraction may be observed for the analyses of the same patient due to the inhomogeneity of this type of sample. It is therefore recommended to homogenize this type of blood sample before the analysis.
- Hb S fraction may appear in a very anodic position in Z(S) zone (in far left of this zone) for the following cases:
  - blood sample with low Hb A level (< 10 %) and high Hb S level (for example, blood sample from transfused patient with sickle cell disease, or from patient with S beta-thalassemia) for which the pattern is adjusted with Hb A and Hb A2 peaks, and,
  - blood sample without any Hb A and with high Hb S level for which the pattern is adjusted with Hb F and Hb A2 peaks.

This migration zone, which corresponds to an intermediary zone comprised within Z(S) zone, allows to automatically detect Hb S fractions with modified migration. It is called "Shifted Hb S area" and is indicated by a dash located on the left side of the name Z(S) in the upper section of the Z(S) migration zone. A variant which migrates in this position is identified as "Borderline variant" but not "Z(S) zone" like any other peak which migrates in the rest of the Z(S) zone.
Mix the sample with the Normal Hb A2 Control according to the procedure described in paragraph "SAMPLES FOR ANALYSIS", section "Particular cases", in order to confirm the position of the variant in the Z(S) migration zone. It is necessary to analyze the hematologic state and to perform complementary studies to check the presence of Hb S.

- Examples with increased hemoglobin F (Hb F) (except for newborn babies):
  - pregnancy ;
  - patients with sickle cell disease, more than 2 years old, with a Hydrea® (hydroxyurea) treatment and/or transfused and/or producing naturally Hb F increased by compensation ;
  - patients, more than 2 years old, with HPFH (hereditary persistence of fetal hemoglobin exhibiting 15 to 35 % Hb F for heterozygous patients) ;
  - patients, more than 2 years old, with leukemia (of any type), hereditary hemolytic anemia, diabetes, thyroid disease, hyperactivity of bone marrow, multiple myeloma, cancer with metastases.

Interference and Limitations

- See SAMPLES FOR ANALYSIS.
- Analyze only blood samples contained in collection tubes indicated in the paragraph "EQUIPMENT AND ACCESSORIES REQUIRED" or tubes with equivalent dimensions approved for clinical assays. Call SEBIA technical service for further information on these devices.
- Do not analyze directly tubes containing less than 1 mL of blood sample.
- Avoid aged, improperly stored blood samples ; degradation products (or artefacts) may affect the electrophoretic pattern after 7 days storage.
- After 10 days storage, viscous aggregates composed in red blood cells may appear, they must be discarded before analysis.
- When an abnormal hemoglobin is detected, use other means of identification (e.g., globin chain electrophoresis), or consult or send sample to a specialized laboratory.

IMPORTANT : The analysis of the hematologic state is also necessary, as complementary results.

- The migration of a hemoglobin variant close to Hb A involves an underestimation of Hb A fraction and that of the variant and consequently, an overestimation of Hb A2 fraction. In order to quantify Hb A2 with precision, it is necessary to delete the separate integration of both variants and Hb A, and to quantify these fractions together.
- Some homozygous "S" subjects receive a "Hydrea"® (hydroxyurea) treatment that can induce synthesis of fetal hemoglobin. With MINICAP HEMOGLOBIN(E) procedure, the mobility of the induced hemoglobin F is not different from the physiological hemoglobin F.
- Due to the resolution and sensitivity limits of zone electrophoresis, it is possible that some hemoglobin variants may not be detected with this method.
- In the case of patients with hyperleukocytosis, the migration speed of the sample may be accelerated causing a shift of the profile that may result in a non-recognition of the zones.

Hemoglobin variants observed with Hb A1c and / or HEMOGLOBIN(E) procedures :
Due to the different composition of Hb A1c and HEMOGLOBIN(E) buffers, the electrophoretic mobility of some hemoglobin variants may be different.

The common interfering factors with the MINICAP HEMOGLOBIN(E) procedure performed with the MINICAP FLEX-PIERCING instrument (triglycerides and bilirubin) for hemoglobin fractions analysis were evaluated in studies based on the Clinical Laboratory Standards Institute (CLSI - USA) EP7-A2 guideline "Interference Testing in Clinical Chemistry".
The results are summarized below:

- No qualitative or quantitative interference with the MINICAP HEMOGLOBIN(E) procedure performed with the MINICAP FLEX-PIERCING instrument was detected if triglycerides concentration is equal to or less than 15.57 g/L.
- No qualitative or quantitative interference with the MINICAP HEMOGLOBIN(E) procedure performed with the MINICAP FLEX-PIERCING instrument was detected if bilirubin concentration is equal to or less than 27.7 mg/dL, or 473 μmol/L.

Troubleshooting

Call SEBIA Technical Service of the supplier when the test fails to perform while the instruction for the preparation and storage of materials, and for the procedure were carefully followed.
Kit reagent Safety Data Sheets and information on cleaning and waste disposal, labeling and safety rules applied by SEBIA, packaging for the transportation of biological samples, and instruments cleaning are available on the SEBIA's extranet website : www.sebia.com.

PERFORMANCE DATA

Precision

The precision of the MINICAP HEMOGLOBIN(E) procedure performed with the MINICAP FLEX-PIERCING instrument was evaluated in a study based on the Clinical Laboratory Standards Institute (CLSI - USA) EP5-A2 guideline "Evaluation of Precision Performance of Quantitative Measurements Methods".
The means, standard deviations and coefficients of variation (CV's %) (n = 80) were calculated for percentages (%) of hemoglobin fractions for each sample, using statistical tools recommended by CLSI.
The results obtained with the MINICAP HEMOGLOBIN(E) procedure indicate a very good reproducibility for quantitative analysis for each hemoglobin component. All electrophoregrams were also interpreted visually.
The results presented below have been obtained using the standard parameters of the PHORESIS software (smoothing 0 and hemoglobin fractions automatic quantification with HEMOGLOBIN(E) analysis program).

Reproducibility between capillaries from the same instrument

Seven (7) different blood samples were run using the MINICAP HEMOGLOBIN(E) procedure in both capillaries of the same MINICAP FLEX-PIERCING instrument and with 1 lot of MINICAP HEMOGLOBIN(E) kit. The analyzed blood samples included 2 samples with normal Hb A2 level (No. 1 and 5), 1 sample with low Hb A2 level (No. 2), 2 samples with increased Hb A2 level (No. 3 and 6), 1 pathological sample with Hb F and Hb S (No. 4) and 1 pathological sample with Hb F, Hb S and Hb C (No. 7). In this study, each blood sample was analyzed on both capillaries from the same instrument, including 40 runs over 20 working days (at 2 different times of the day). Within each run, samples were analyzed in duplicate.
The results for Hb A, Hb A2, Hb F, Hb S and Hb C percentages are summarized in the following tables.

	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7
Mean Hb A %	97.6	98.3	95.4	46.5	97.2	93.3	45.7
Within-run reproducibility (CV %)	0.0	0.1	0.1	0.2	0.0	0.1	0.5
Between-run reproducibility (CV %)	0.0	0.0	0.0	0.1	0.0	0.0	0.1
Between-day reproducibility (CV %)	0.0	0.0	0.0	0.1	0.0	0.0	0.1
Total (CV %)	0.0	0.1	0.1	0.3	0.1	0.1	0.5

	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7
Mean Hb A2 %	2.4	1.8	4.6	2.8	2.8	6.7	2.8
Within-run reproducibility (CV %)	1.8	3.1	1.1	1.8	1.7	1.0	4.0
Between-run reproducibility (CV %)	0.0	0.0	0.0	0.0	0.7	0.2	0.0
Between-day reproducibility (CV %)	0.0	0.7	0.5	0.3	0.0	0.0	1.6
Total (CV %)	1.8	3.1	1.2	1.8	1.8	1.1	4.3

	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7
Mean Hb F %	/	/	/	13.0	/	/	25.6
Within-run reproducibility (CV %)	/	/	/	0.8	/	/	0.4
Between-run reproducibility (CV %)	/	/	/	0.0	/	/	0.0
Between-day reproducibility (CV %)	/	/	/	0.3	/	/	0.1
Total (CV %)	/	/	/	0.9	/	/	0.4

	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7
Mean Hb S %	/	/	/	37.7	/	/	18.9
Within-run reproducibility (CV %)	/	/	/	0.4	/	/	0.7
Between-run reproducibility (CV %)	/	/	/	0.0	/	/	0.0
Between-day reproducibility (CV %)	/	/	/	0.2	/	/	0.2
Total (CV %)	/	/	/	0.5	/	/	0.8

	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7
Mean Hb C %	/	/	/	/	/	/	7.1
Within-run reproducibility (CV %)	/	/	/	/	/	/	1.5
Between-run reproducibility (CV %)	/	/	/	/	/	/	0.0
Between-day reproducibility (CV %)	/	/	/	/	/	/	0.5
Total (CV %)	/	/	/	/	/	/	1.6

In addition, none of the repeats showed false positive or false negative values :
- *Samples with normal Hb A2 level : all values are normal ;*
- *Samples with decreased Hb A2 level : all values are decreased ;*
- *Samples with elevated Hb A2 level : all values are elevated ;*
- *Samples with hemoglobin variants : all hemoglobin variants are detected.*

Linearity

The linearity of the MINICAP HEMOGLOBIN(E) procedure performed with the MINICAP FLEX-PIERCING instrument was evaluated in a study based on the Clinical Laboratory Standards Institute (CLSI - USA) EP6-A guideline "Evaluation of the Linearity of Quantitative Measurement Procedures: A statistical Approach".
The results for percentages (%) of hemoglobin fractions were analyzed using statistical tools recommended by CLSI.

Hb A2 linearity

One Hb A2 enriched blood sample (containing 13.4 g/dL total hemoglobin with 12.2 % of Hb A2) was mixed with a Hb A2 depleted blood sample (containing 12.8 g/dL total hemoglobin with 0.0 % of Hb A2) within different proportions and the dilutions were electrophoresed with MINICAP HEMOGLOBIN(E) procedure performed with MINICAP FLEX-PIERCING instrument.
The MINICAP HEMOGLOBIN(E) procedure performed with MINICAP FLEX-PIERCING instrument gave a good linearity for Hb A and Hb A2 within the entire range studied, with a maximum of about 1.6 g/dL for Hb A2 (between 0.0 and 12.2 % of Hb A2).
In addition, a blood sample (containing 17.9 g/dL total hemoglobin with 97.6 % of Hb A and 2.4 % of Hb A2) was concentrated and serially diluted in MINICAP HEMOGLOBIN(E) hemolysing solution and electrophoresed with the MINICAP HEMOGLOBIN(E) procedure performed with MINICAP FLEX-PIERCING instrument.
The tests were determined to be linear within the entire range studied from 1.79 to 45.90 g/dL total hemoglobin and Hb A and Hb A2 fractions percentages were not affected by the total hemoglobin concentration of the sample.

Hb F linearity

One umbilical cord blood sample (containing 15.8 g/dL total hemoglobin with 82.2 % of Hb F) was mixed with a normal blood sample (containing 11.6 g/dL total hemoglobin with 0.0 % of Hb F) within different proportions and the dilutions were electrophoresed with MINICAP HEMOGLOBIN(E) procedure performed with MINICAP FLEX-PIERCING instrument.
The MINICAP HEMOGLOBIN(E) procedure performed with MINICAP FLEX-PIERCING instrument gave a good linearity for Hb A and Hb F within the entire range studied, with a maximum of about 13.0 g/dL for Hb F (between 0.0 and 82.2 % of Hb F).
In addition, one umbilical cord blood sample (containing 17.9 g/dL total hemoglobin with 14.7 % of Hb A and 85.3 % of Hb F) was concentrated and serially diluted in MINICAP HEMOGLOBIN(E) hemolysing solution and electrophoresed with the MINICAP HEMOGLOBIN(E) procedure performed with MINICAP FLEX-PIERCING instrument.
The tests were determined to be linear within the entire range studied from 1.79 to 28.87 g/dL total hemoglobin and Hb A and Hb F fractions percentages were not affected by the total hemoglobin concentration of the sample.

Hb S linearity

One pathological blood sample with Hb S (containing 9.1 g/dL total hemoglobin with 86.2 % of Hb S and 0.0 % of Hb A) was mixed with a normal blood sample (containing 13.5 g/dL total hemoglobin with 0.0 % of Hb S and 97.4 % of Hb A) within different proportions and the dilutions were electrophoresed with MINICAP HEMOGLOBIN(E) procedure performed with MINICAP FLEX-PIERCING instrument.
The MINICAP HEMOGLOBIN(E) procedure performed with MINICAP FLEX-PIERCING instrument gave a good linearity for Hb S within the entire range studied, with a maximum of about 7.8 g/dL for Hb S (between 0.0 and 86.2 % of Hb S) and a good linearity for Hb A within the entire range studied, with a maximum of about 13.1 g/dL for Hb A (between 0.0 and 97.4 % of Hb A).
In addition, a pathological blood sample (containing 9.2 g/dL total hemoglobin with 79.1 % of Hb S) was concentrated and serially diluted in MINICAP HEMOGLOBIN(E) hemolysing solution and electrophoresed with the MINICAP HEMOGLOBIN(E) procedure performed with MINICAP FLEX-PIERCING instrument.
The tests were determined to be linear within the entire range studied from 0.92 to 31.72 g/dL total hemoglobin and Hb S fraction percentage was not affected by the total hemoglobin concentration of the sample.

Accuracy – Internal correlation

The internal concordance study of the MINICAP HEMOGLOBIN(E) procedure performed with the MINICAP FLEX-PIERCING instrument was evaluated in a study based on the Clinical Laboratory Standards Institute (CLSI - USA) EP09-A2 guideline "Method Comparison and Bias Estimation Using Patient Samples; Approved Guideline – Second Edition (Interim Revision)".
The results for percentages (%) of hemoglobin fractions were analyzed using statistical tools recommended by CLSI.

NOTE : The results presented below have been obtained from 1 internal accuracy study that has been performed in SEBIA facility. The analyzed blood samples were provided by 17 hospital laboratories in France, USA and Asia.

All the samples were exactly treated the same way with both techniques and followed the same guidelines in regards to sample integrity.

The levels of hemoglobin fractions were measured in 116 blood samples, including 54 samples with hemoglobin variants such as hemoglobins S, C, D and E, both by electrophoretic separations obtained with the MINICAP HEMOGLOBIN(E) procedure with the MINICAP FLEX-PIERCING instrument and a commercially available capillary electrophoresis technique for hemoglobins analysis.
The measured values of hemoglobin fractions from both procedures were analyzed by a linear regression statistical procedure. The results of linear regression analysis for Hb A, Hb A2, Hb F, Hb S, Hb C and Hb E are tabulated below (y = MINICAP HEMOGLOBIN(E) procedure with MINICAP FLEX-PIERCING instrument) :

Hb fraction	Number of samples	Correlation coefficient	y-Intercept	Slope	Range of Hb % values MINICAP HEMOGLOBIN(E) with MINICAP FLEX-PIERCING instrument
Hb A	110	1.000	1.175	0.990	12.1 – 98.6
Hb A2	115	0.997	- 0.030	0.980	0.2 – 6.6
Hb F	43	1.000	- 0.013	1.000	0.3 – 80.0
Hb S	27	1.000	- 0.486	0.996	7.8 – 90.8
Hb C	6	1.000	- 0.204	0.979	6.9 – 36.6
Hb E	6	0.991	- 0.408	0.981	21.7 – 25.7

This study demonstrated a perfect correlation between the 2 analysis procedures for the hemoglobin A2 quantitative determination in samples without any hemoglobin variant, with a 100.0 % sensibility and a 92.5 % specificity of MINICAP HEMOGLOBIN(E) procedure compared to the reference procedure, calculated using the recommended method (Wendling, 1986).

Additionnaly, this study demonstrated a perfect correlation between the 2 analysis procedures for the detection of abnormal hemoglobins, with a 100.0 % sensibility and a 100.0 % specificity of MINICAP HEMOGLOBIN(E) procedure compared to the reference procedure, calculated using the recommended method (Wendling, 1986). All abnormal hemoglobins (S, C, D, E and other variants) or abnormal levels of normal hemoglobins detected with the MINICAP HEMOGLOBIN(E) procedure performed with the MINICAP FLEX-PIERCING instrument were in agreement with the comparative capillary electrophoresis technique. There was no case observed of false positive, i.e., detection of an abnormal band or abnormal level of a normal band where no such abnormality existed.

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TABLEAU / TABLE

VARIANTS POTENTIELS PRÉSENTS DANS CHAQUE ZONE - POTENTIAL VARIANTS LOCATED IN EACH ZONE

Zone	Hémoglobines / Hemoglobins (Hb)
Z1	Hb Santa Ana (pic mineur) #, Hb Mizuho (pic mineur) #, Hb delta A'2, Hb A2-Canebière, Hb A2-Lampang, Hb S-Oman, Hb A2-Turkish, Hb T-Cambodia, Hb Poissy (pic mineur) #, variant de Hb A2 "Chad" #, variant de Hb A2 "Savaria" #, variant de Hb A2 "Arya" #, variant de Hb A2 "Hasharon" #, variant de Hb A2 "Fort de France" #, variant de Hb A2 "Ottawa" #, variant de Hb A2 "Shimonoseki" #, variant de Hb A2 "Russ" (alpha 2) #, variant de Hb A2 "Russ" (alpha 1) #, variant de Hb A2 "Matsue-Oki" #, variant de Hb A2 "Reims" #, variant de Hb A2 "Mizushi" #, variant de Hb A2 "Stanleyville-II" #, variant de Hb A2 "O-Indonesia" #, variant de Hb A2 "San Antonio" #, variant de Hb A2 "G-Audhali" #, variant de Hb A2 "Handsworth" #, variant de Hb A2 "G-Philadelphia" #, variant de Hb A2 "Q-India" #, variant de Hb A2 "Memphis" #, variant de Hb A2 "Q-Iran" #, variant de Hb A2 "G-Waimanalo" #, variant de Hb A2 "Watts" #, variant de Hb A2 "Spanish Town" #, variant de Hb A2 "Montgomery" #, variant de Hb A2 "G-Norfolk" #, variant de Hb A2 "Inkster" #, variant de Hb A2 "Ube-4" #, variant de Hb A2 "G-Pest" #, variant de Hb A2 "Winnipeg" #, variant de Hb A2 "Queens" #, variant de Hb A2 "Etobicoke" #, variant de Hb A2 "Chapel Hill" #, variant de Hb A2 "Park Ridge" #, variant de Hb A2 "Q-Thailand" #, variant de Hb A2 "Delfzicht" # !!
	Hb Santa Ana (minor peak) #, Hb Mizuho (minor peak) #, Hb delta A'2, Hb A2-Canebière, Hb A2-Lampang, Hb S-Oman, Hb A2-Turkish, Hb T-Cambodia, Hb Poissy (minor peak) #, "Chad" Hb A2 variant #, "Savaria" Hb A2 variant #, "Arya" Hb A2 variant #, "Hasharon" Hb A2 variant #, "Fort de France" Hb A2 variant #, "Ottawa" Hb A2 variant #, "Shimonoseki" Hb A2 variant #, "Russ" Hb A2 variant (alpha 2) #, "Russ" Hb A2 variant (alpha 1) #, "Matsue-Oki" Hb A2 variant #, "Reims" Hb A2 variant #, "Mizushi" Hb A2 variant #, "Stanleyville-II" Hb A2 variant #, "O-Indonesia" Hb A2 variant #, "San Antonio" Hb A2 variant #, "G-Audhali" Hb A2 variant #, "Handsworth" Hb A2 variant #, "G-Philadelphia" Hb A2 variant #, "Q-India" Hb A2 variant #, "Memphis" Hb A2 variant #, "Q-Iran" Hb A2 variant #, "G-Waimanalo" Hb A2 variant #, "Watts" Hb A2 variant #, "Spanish Town" Hb A2 variant #, "Montgomery" Hb A2 variant #, "G-Norfolk" Hb A2 variant #, "Inkster" Hb A2 variant #, "Ube-4" Hb A2 variant #, "G-Pest" Hb A2 variant #, "Winnipeg" Hb A2 variant #, "Queens" Hb A2 variant #, "Etobicoke" Hb A2 variant #, "Chapel Hill" Hb A2 variant #, "Park Ridge" Hb A2 variant #, "Q-Thailand" Hb A2 variant #, "Delfzicht" Hb A2 variant # !!
Z(C)	Hb C-Ziguinchor !!, Hb F-Hull, Hb F-Texas-I, Hb Constant Spring, Hb Paksé, Hb C, Hb C-Harlem (C-Georgetown), variant de Hb A2 "Les Lilas" #, variant de Hb A2 "Boumerdes" #, variant de Hb A2 "Tarrant" #, variant de Hb A2 "Dunn" #, variant de Hb A2 "Bassett" #, variant de Hb A2 "Sassari" #, variant de Hb A2 "St. Luke's" #, variant de Hb A2 "Verdun" #, variant de Hb A2 "Manitoba-I" #, variant de Hb A2 "Setif" #, variant de Hb A2 "Sunshine Seth" #, variant de Hb A2 "Titusville" #, variant de Hb A2 "Swan River" #, variant de Hb A2 "Manitoba-II" #, variant de Hb A2 "Val de Marne" #
	Hb C-Ziguinchor !!, Hb F-Hull, Hb F-Texas-I, Hb Constant Spring, Hb Paksé, Hb C, Hb C-Harlem (C-Georgetown), "Les Lilas" Hb A2 variant #, "Boumerdes" Hb A2 variant #, "Tarrant" Hb A2 variant #, "Dunn" Hb A2 variant #, "Bassett" Hb A2 variant #, "Sassari" Hb A2 variant #, "St. Luke's" Hb A2 variant #, "Verdun" Hb A2 variant #, "Manitoba-I" Hb A2 variant #, "Setif" Hb A2 variant #, "Sunshine Seth" Hb A2 variant #, "Titusville" Hb A2 variant #, "Swan River" Hb A2 variant #, "Manitoba-II" Hb A2 variant #, "Val de Marne" Hb A2 variant #
Z(A2)	Hb A2, Hb Chad (E-Keelung) #, Hb A2-Madrid *, Hb A2-Saint Denis *, Hb A2-Saint-Etienne *, Hb Hong Kong (cas anti-Lepore), Hb O-Tibesti, Hb Gun Hill, Hb O-Arab, Hb E-Saskatoon, Hb Shuangfeng, variant de Hb A2 "Charolles" #, variant de Hb A2 "Roubaix" #, variant de Hb A2 "El Escorial" * #, variant de Hb A2 "Dallas" * #, variant de Hb A2 "Barika" * #, variant de Hb A2 "Melusine" * #, variant de Hb A2 "Jura" #, variant de Hb A2 "Nouakchott" #, variant de Hb A2 "Pohnpei" #
	*Hb A2, Hb Chad (E-Keelung) #, Hb A2-Madrid *, Hb A2-Saint Denis *, Hb A2-Saint-Etienne *, Hb Hong Kong (anti-Lepore case), Hb O-Tibesti, Hb Gun Hill, Hb O-Arab, Hb E-Saskatoon, Hb Shuangfeng, "Charolles" Hb A2 variant #, "Roubaix" Hb A2 variant #, "El Escorial" Hb A2 variant * #, "Dallas" Hb A2 variant * #, "Barika" Hb A2 variant * #, "Melusine" Hb A2 variant * #, "Jura" Hb A2 variant #, "Nouakchott" Hb A2 variant #, "Pohnpei" Hb A2 variant #*
Z(E)	Hb Hornchurch, Hb Seal Rock, Hb Köln (Ube-1) #, Hb Buenos Aires (pic mineur) #, Hb E, Hb Cleveland, Hb M-Saskatoon (pic mineur) #, Hb G-Siriraj, Hb A2-Babinga, Hb F-Moyen Orient, Hb O-Padova, Hb Agenogi, Hb Sabine #, Hb Santa Ana #, Hb Savaria # !!, Hb Djelfa (pic 3) # !!, variant de Hb A2 "M-Iwate" #, variant de Hb A2 "Saint Claude" #, variant de Hb A2 "Jackson" (alpha 2) #, Hb C dégradée
	Hb Hornchurch, Hb Seal Rock, Hb Köln (Ube-1) #, Hb Buenos Aires (minor peak) #, Hb E, Hb Cleveland, Hb M-Saskatoon (minor peak) #, Hb G-Siriraj, Hb A2-Babinga, Hb F-Moyen Orient, Hb O-Padova, Hb Agenogi, Hb Sabine #, Hb Santa Ana #, Hb Savaria # !!, Hb Djelfa (peak 3) # !!, "M-Iwate" Hb A2 variant #, "Saint Claude" Hb A2 variant #, "Jackson" Hb A2 variant (alpha 2) #, denatured Hb C
Z(S)	Hb Arya # !!, Hb Kenya (HPFH-7), Hb Hasharon (Sinai) #, Hb Dhofar (Yukuhashi), Hb Shimonoseki (Hikoshima) #, Hb O-Indonesia (Buginese-X) #, Hb Machida, Hb Vexin, Hb Corbeil, Hb Ottawa (Siam) #, Hb Fort de France #, Hb S, Hb G-Makassar, Hb Montgomery #, Hb G-Copenhagen, Hb S-Antilles, Hb Handsworth #, Hb Lavagna, Hb Poissy #, Hb Hamadan, Hb Belfast, Hb Russ (alpha 1) #, Hb Russ (alpha 2) #, Hb Evanston, Hb Stanleyville-II # !!, Hb Cocody !!, Hb Reims # !!, variant de Hb A2 "Tokoname" #, variant de Hb A2 "Wayne" (pic 1) #, variant de Hb A2 "Pisa" #, variant de Hb A2 "J-Oxford" #, variant de Hb A2 "Lombard" #, variant de Hb A2 "Tatras" #, variant de Hb A2 "J-Cape Town" (alpha 2) #, variant de Hb A2 "Thionville" #, variant de Hb A2 "J-Cape Town" (alpha 1) #, variant de Hb A2 "Cemenelum" #, variant de Hb A2 "Nikaia" #, variant de Hb A2 "Hopkins-II" (alpha 1) #, variant de Hb A2 "Jackson" (alpha 1) #, variant de Hb A2 "Hopkins-II" (alpha 2) #, variant de Hb A2 "Singapore" # !!, Hb O-Arab dégradée
	Hb Arya # !!, Hb Kenya (HPFH-7), Hb Hasharon (Sinai) #, Hb Dhofar (Yukuhashi), Hb Shimonoseki (Hikoshima) #, Hb O-Indonesia (Buginese-X) #, Hb Machida, Hb Vexin, Hb Corbeil, Hb Ottawa (Siam) #, Hb Fort de France #, Hb S, Hb G-Makassar, Hb Montgomery #, Hb G-Copenhagen, Hb S-Antilles, Hb Handsworth #, Hb Lavagna, Hb Poissy #, Hb Hamadan, Hb Belfast, Hb Russ (alpha 1) #, Hb Russ (alpha 2) #, Hb Evanston, Hb Stanleyville-II # !!, Hb Cocody !!, Hb Reims # !!, "Tokoname" Hb A2 variant #, "Wayne" Hb A2 variant (peak 1) #, "Pisa" Hb A2 variant #, "J-Oxford" Hb A2 variant #, "Lombard" Hb A2 variant #, "Tatras" Hb A2 variant #, "J-Cape Town" Hb A2 variant (alpha 2) #, "Thionville" Hb A2 variant #, "J-Cape Town" Hb A2 variant (alpha 1) #, "Cemenelum" Hb A2 variant #, "Nikaia" Hb A2 variant #, "Hopkins-II" Hb A2 variant (alpha 1) #, "Jackson" Hb A2 variant (alpha 1) #, "Hopkins-II" Hb A2 variant (alpha 2) #, "Singapore" Hb A2 variant # !!, denatured Hb O-Arab

TABLEAU / TABLE

VARIANTS POTENTIELS PRÉSENTS DANS CHAQUE ZONE - POTENTIAL VARIANTS LOCATED IN EACH ZONE

Zone	Hémoglobines / Hemoglobins (Hb)
Z(D)	Hb Memphis # !!, Hb G-Audhali # !!, Hb G-Szuhu (Gifu) !!, Hb Leiden !!, Hb Beograd (D-Camperdown), Hb Muravera, Hb D-Bushman, Hb Gavello, Hb Sogn, Hb Matsue-Oki #, Hb Osu Christiansborg, Hb D-Punjab (D-Los Angeles), Hb Watts #, Hb A2-Coburg, Hb G-Waimanalo (Aida) #, Hb Q-India #, Hb Muskegon, Hb D-Ibadan, Hb Buenos Aires (pic mineur) #, Hb Lepore-BW, Hb Q-Iran #, Hb Akron, Hb Summer Hill, Hb G-Philadelphia #, Hb Karlskoga, Hb D-Ouled Rabah, Hb Aichi, Hb Oleander, Hb Yaizu, Hb Kenitra, Hb San Antonio #, Hb Aalborg, Hb Al-Hammadi Riyadh, Hb Ocho Rios, Hb Rocky Mountain (Paddington), Hb Lepore-Hollandia, Hb Quin-Hai, Hb Fort Worth, Hb Mizushi #, Hb G-Honolulu (G-Chinese), Hb Redondo (Isehara), Hb Lepore-Baltimore, Hb G-Ferrara, Hb Djelfa (pic 2) #, Hb G-Hsi-Tsou, Hb Hackney (Xu Chang), Hb Rothschild, Hb Spanish Town #, Hb Korle-Bu (G-Accra), Hb Khartoum, Hb Moabit, Hb Mobile, Hb Köln (Ube-1) #, Hb G-Norfolk #, Hb Ube-4 #, Hb Maputo, Hb Etobicoke #, Hb D-Iran, Hb Caribbean, Hb Okaloosa, Hb St. Luke's #, Hb G-Taipei, Hb G-Coushatta (G-Saskatoon), Hb Winnipeg #, Hb Canuts [A2], Hb Inkster #, Hb Zürich, Hb G-Pest #, Hb P-Galveston, Hb Queens (Ogi) #, Hb Canuts, Hb Aubenas, Hb Setif #, Hb P-Nilotic, Hb G-Galveston (G-Port Arthur), Hb Sunshine Seth # !!, Hb King's Mill !!, Hb Henri Mondor !!, Hb Titusville # !!, variant de Hb A2 "J-Sardegna" # !!, variant de Hb A2 "Suresnes" # !!, variant de Hb A2 "J-Meerut" (alpha 2) #, variant de Hb A2 "J-Broussais" (alpha 2) #, variant de Hb A2 "J-Rajappen" #, variant de Hb A2 "J-Anatolia" #, variant de Hb A2 "J-Meerut" (alpha 1) #, variant de Hb A2 "Ube-2" #, variant de Hb A2 "J-Broussais" (alpha 1) #, variant de Hb A2 "J-Abidjan" #, variant de Hb A2 "J-Toronto" (alpha 1) #, variant de Hb A2 "Mexico" (alpha 2) #, variant de Hb A2 "Thailand" #, variant de Hb A2 "Mexico" (alpha 1) #, variant de Hb A2 "J-Tongariki" #, variant de Hb A2 "Belliard" #, variant de Hb A2 "Neuilly-sur-Marne" #, variant de Hb A2 "J-Wenchang-Wuming" #, variant de Hb A2 "J-Paris-I" (alpha 2) #, variant de Hb A2 "J-Habana" #, variant de Hb A2 "J-Paris-I" (alpha 1) #, Hb E dégradée
	Hb Memphis # !!, Hb G-Audhali # !!, Hb G-Szuhu (Gifu) !!, Hb Leiden !!, Hb Beograd (D-Camperdown), Hb Muravera, Hb D-Bushman, Hb Gavello, Hb Sogn, Hb Matsue-Oki #, Hb Osu Christiansborg, Hb D-Punjab (D-Los Angeles), Hb Watts #, Hb A2-Coburg, Hb G-Waimanalo (Aida) #, Hb Q-India #, Hb Muskegon, Hb D-Ibadan, Hb Buenos Aires (minor peak) #, Hb Lepore-BW, Hb Q-Iran #, Hb Akron, Hb Summer Hill, Hb G-Philadelphia #, Hb Karlskoga, Hb D-Ouled Rabah, Hb Aichi, Hb Oleander, Hb Yaizu, Hb Kenitra, Hb San Antonio #, Hb Aalborg, Hb Al-Hammadi Riyadh, Hb Ocho Rios, Hb Rocky Mountain (Paddington), Hb Lepore-Hollandia, Hb Quin-Hai, Hb Fort Worth, Hb Mizushi #, Hb G-Honolulu (G-Chinese), Hb Redondo (Isehara), Hb Lepore-Baltimore, Hb G-Ferrara, Hb Djelfa (peak 2) #, Hb G-Hsi-Tsou, Hb Hackney (Xu Chang), Hb Rothschild, Hb Spanish Town #, Hb Korle-Bu (G-Accra), Hb Khartoum, Hb Moabit, Hb Mobile, Hb Köln (Ube-1) #, Hb G-Norfolk #, Hb Ube-4 #, Hb Maputo, Hb Etobicoke #, Hb D-Iran, Hb Caribbean, Hb Okaloosa, Hb St. Luke's #, Hb G-Taipei, Hb G-Coushatta (G-Saskatoon), Hb Winnipeg #, Hb Canuts [A2], Hb Inkster #, Hb Zürich, Hb G-Pest #, Hb P-Galveston, Hb Queens (Ogi) #, Hb Canuts, Hb Aubenas, Hb Setif #, Hb P-Nilotic, Hb G-Galveston (G-Port Arthur), Hb Sunshine Seth # !!, Hb King's Mill !!, Hb Henri Mondor !!, Hb Titusville # !!, "J-Sardegna" Hb A2 variant # !!, "Suresnes" Hb A2 variant # !!, "J-Meerut" Hb A2 variant (alpha 2) #, "J-Broussais" Hb A2 variant (alpha 2) #, "J-Rajappen" Hb A2 variant #, "J-Anatolia" Hb A2 variant #, "J-Meerut" Hb A2 variant (alpha 1) #, "Ube-2" Hb A2 variant #, "J-Broussais" Hb A2 variant (alpha 1) #, "J-Abidjan" Hb A2 variant #, "J-Toronto" Hb A2 variant (alpha 1) #, "Mexico" Hb A2 variant (alpha 2) #, "Thailand" Hb A2 variant #, "Mexico" Hb A2 variant (alpha 1) #, "J-Tongariki" Hb A2 variant #, "Belliard" Hb A2 variant #, "Neuilly-sur-Marne" Hb A2 variant #, "J-Wenchang-Wuming" Hb A2 variant #, "J-Paris-I" Hb A2 variant (alpha 2) #, "J-Habana" Hb A2 variant #, "J-Paris-I" Hb A2 variant (alpha 1) #, denatured Hb E
Z(F)	Hb F, Hb Willamette !!, Hb Hoshida (Chaya) !!, Hb Languidic, Hb Chiapas, Hb P-India, Hb Tamano, Hb Sunnybrook, Hb Park Ridge #, Hb Delfzicht #, Hb Atago, Hb Deer Lodge, Hb Alabama, Hb Chapel Hill #, Hb Bunbury, Hb Tak, Hb Q-Thailand (G-Taichung) #, Hb Sabine #, Hb Bassett #, Hb Boyle Heights, Hb Les Lilas #, Hb Rampa, Hb Haaglanden, Hb G-Georgia, Hb Barcelona, Hb G-San José, Hb Denmark Hill, Hb Pôrto Alegre, Hb F-Sardinia, Hb Geldrop Santa Anna, Hb Ta-Li, Hb Chongqing, Hb Richmond, Hb Hirose, Hb Abruzzo, Hb Boumerdes #, Hb British Columbia, Hb Kansas, Hb Tarrant #, Hb Verdun #, Hb Swan River #, Hb Attleboro, Hb Sawara, Hb Burke, Hb Dunn #, Hb Manitoba-I #, Hb Manitoba-II #, Hb Sassari #, Hb Hazebrouck !!, Hb Port Phillip !!, Hb Vanderbilt !!, variant de Hb A2 "J-Rovigo" # !!, variant de Hb A2 "Wayne" (pic 2) # !!, Hb S dégradée, Hb D-Punjab dégradée
	Hb F, Hb Willamette !!, Hb Hoshida (Chaya) !!, Hb Languidic, Hb Chiapas, Hb P-India, Hb Tamano, Hb Sunnybrook, Hb Park Ridge #, Hb Delfzicht #, Hb Atago, Hb Deer Lodge, Hb Alabama, Hb Chapel Hill #, Hb Bunbury, Hb Tak, Hb Q-Thailand (G-Taichung) #, Hb Sabine #, Hb Bassett #, Hb Boyle Heights, Hb Les Lilas #, Hb Rampa, Hb Haaglanden, Hb G-Georgia, Hb Barcelona, Hb G-San José, Hb Denmark Hill, Hb Pôrto Alegre, Hb F-Sardinia, Hb Geldrop Santa Anna, Hb Ta-Li, Hb Chongqing, Hb Richmond, Hb Hirose, Hb Abruzzo, Hb Boumerdes #, Hb British Columbia, Hb Kansas, Hb Tarrant #, Hb Verdun #, Hb Swan River #, Hb Attleboro, Hb Sawara, Hb Burke, Hb Dunn #, Hb Manitoba-I #, Hb Manitoba-II #, Hb Sassari #, Hb Hazebrouck !!, Hb Port Phillip !!, Hb Vanderbilt !!, "J-Rovigo" Hb A2 variant # !!, "Wayne" Hb A2 variant (peak 2) # !!, denatured Hb S, denatured Hb D-Punjab
Z8	Hb F acétylée, Hb Grifton !!, Hb Lansing !!, Hb Hinsdale !!, Hb Ypsilanti (Ypsi - pic 1) # !!, Hb Auckland !!, Hb Roanne, Hb Southampton (Casper), Hb Yakima, Hb Saint Mandé, Hb Alberta, Hb Bruxelles, Hb Beth Israel, Hb Val de Marne (Footscray) #, Hb Kempsey, Hb Shelby (Leslie), Hb Atlanta, Hb Chemilly, Hb S-Clichy, Hb Sarrebourg, Hb Ypsilanti (Ypsi - pic 2) #, Hb Charolles #, Hb Athens-GA (Waco), Hb Debrousse, Hb Köln (Ube-1) #, Hb Aubagne, Hb Rainier
	Acetylated Hb F, Hb Grifton !!, Hb Lansing !!, Hb Hinsdale !!, Hb Ypsilanti (Ypsi - peak 1) # !!, Hb Auckland !!, Hb Roanne, Hb Southampton (Casper), Hb Yakima, Hb Saint Mandé, Hb Alberta, Hb Bruxelles, Hb Beth Israel, Hb Val de Marne (Footscray) #, Hb Kempsey, Hb Shelby (Leslie), Hb Atlanta, Hb Chemilly, Hb S-Clichy, Hb Sarrebourg, Hb Ypsilanti (Ypsi - peak 2) #, Hb Charolles #, Hb Athens-GA (Waco), Hb Debrousse, Hb Köln (Ube-1) #, Hb Aubagne, Hb Rainier

TABLEAU / TABLE

VARIANTS POTENTIELS PRÉSENTS DANS CHAQUE ZONE - POTENTIAL VARIANTS LOCATED IN EACH ZONE

Zone	Hémoglobines / Hemoglobins (Hb)
Z(A)	Hb A, Hb Presbyterian *, Hb Roubaix (Poland) * #, Hb Silver Springs *, Hb El Escorial * #, Hb Dallas * #, Hb Phnom Penh *, Hb La Coruna *, Hb Bougardirey-Mali *, Hb Saint Nazaire *, Hb Barika * #, Hb Allentown *, Hb Allison Park *, Hb Alperton *, Hb Altdorf *, Hb Alzette *, Hb Anamosa *, Hb Antibes-Juan-Les-Pins *, Hb Arta (pic majeur) * #, Hb Aurillac *, Hb Austin *, Hb Aylesbury *, Hb Aztec *, Hb Bass Hill *, Hb Beirut *, Hb Belleville *, Hb Belluno *, Hb Bethesda *, Hb Bibba *, Hb Bladensburg *, Hb Boghé *, Hb Bonn *, Hb Brem-sur-Mer *, Hb Brest *, Hb Brigham *, Hb Brisbane (Great Lakes) *, Hb Broomhill *, Hb Brugg *, Hb Buenos Aires (Bryn Mawr - pic majeur) * #, Hb Buffalo (Reeuwijk) *, Hb Bushwick *, Hb Caen *, Hb Calvino *, Hb Cardarelli *, Hb Cheverly *, Hb Chicago *, Hb City of Hope *, Hb Coimbra (Ingelheim) *, Hb Columbia Missouri *, Hb Conakry *, Hb Cowtown *, Hb Crete *, Hb Dapu *, Hb Den Haag *, Hb Denver *, Hb Dhaka *, Hb Dhonburi (Neapolis) *, Hb Djelfa (pic 1) * #, Hb Ecuador *, Hb Evans *, Hb Flurlingen *, Hb Fontainebleau *, Hb Frankfurt *, Hb Fukuoka *, Hb Fukuyama *, Hb Geisinger *, Hb Genova (Hyogo) *, Hb Godavari *, Hb Gorwihl (Hinchingbrooke) *, Hb Gouda *, Hb Grange Blanche *, Hb Groene Hart (Bernalda) *, Hb Grove City *, Hb Guanajuato *, Hb Haelen *, Hb Hamilton *, Hb Hammersmith (Chiba) *, Hb Heathrow *, Hb Hekinan *, Hb Hershey *, Hb Hyden *, Hb Inglewood *, Hb Iowa *, Hb Iraq-Halabja *, Hb Jabalpur *, Hb Jeddah *, Hb Johnstown *, Hb Kaiser West End *, Hb Kansas City *, Hb King Ecgbert *, Hb Knossos *, Hb Kokomo *, Hb Kosovo *, Hb La Desirade *, Hb Le Lamentin *, Hb Les Andelys *, Hb Linköping (Meilahti) *, Hb Lisbon *, Hb Little Rock *, Hb Louisville (Bucuresti) *, Hb Lulu Island *, Hb Lyon-Bron *, Hb M-Boston (M-Osaka) *, Hb M-Saskatoon (pic majeur) * #, Hb McKees Rocks *, Hb Malay *, Hb Malmö *, Hb Marijampolé *, Hb Marseille (Long Island) *, Hb Matsudo *, Hb Milledgeville *, Hb Minneapolis Laos *, Hb Mizuho * #, Hb Moriguchi *, Hb Mosella *, Hb Nakhon Ratchasima (Aberystwyth) *, Hb Nantes *, Hb Niguarda *, Hb Noko *, Hb Novara *, Hb Okayama *, Hb Olupona *, Hb Olympia *, Hb Owari *, Hb Ozieri *, Hb Parma *, Hb Part-Dieu *, Hb Perth (Abraham Lincoln) *, Hb Petit Bourg *, Hb Pierre-Bénite *, Hb Pittsburgh *, Hb Pohnpei * #, Hb Port Huron *, Hb Potomac *, Hb Pressath *, Hb Princes Risborough *, Hb Puttelange *, Hb Raleigh *, Hb Ramona *, Hb Ravenscourt Park *, Hb Regina *, Hb Rhode Island (Southwark) *, Hb Riccarton *, Hb Rio Claro *, Hb Rotterdam *, Hb Rouen (Ethiopia) *, Hb Saclay *, Hb Saint-Clair *, Hb Saint-Jacques *, Hb St Joseph's *, Hb Saint-Marcellin *, Hb Saki *, Hb San Bruno *, Hb San Diego *, Hb San Martin *, Hb Santa Barnabas (Croxley Green) *, Hb Santa Juana (Serres) *, Hb Savannah *, Hb Saveh *, Hb Sendagi (Warsaw) *, Hb Sheffield *, Hb Sitia *, Hb Sodertalje *, Hb South Florida *, Hb South Milwaukee *, Hb South Yorkshire *, Hb Sydney *, Hb Taradale (Middlesbrough) *, Hb Taybe *, Hb Templeuve *, Hb Torino *, Hb Toulon *, Hb Twin Peaks *, Hb Ty Gard *, Hb Tyne *, Hb Utrecht *, Hb Uzes *, Hb Valletta *, Hb Valme *, Hb Venetia *, Hb Verona *, Hb Vientiane (Grey Lynn) *, Hb Vila Real *, Hb Villejuif *, Hb Villeparisis *, Hb Villeurbanne *, Hb Volga (Drenthe) *, Hb Voorhees *, Hb Washtenaw *, Hb Waterland *, Hb Weesp *, Hb Wembley *, Hb Westmead *, Hb Wiangpapao *, Hb William-Harvey *, Hb Wood *, Hb Worthing *, Hb Yaounde (Mataro) *, Hb Zoetermeer *, Hb Sinai-Baltimore *, Hb M-Milwaukee-I *, Hb Melusine * #, Hb Pitie-Salpetriere *, Hb Syracuse *, Hb Hounslow, Hb Fort Dodge, Hb Old Dominion (OD/BuT), Hb Camperdown, Hb Duarte !!, Hb Jura (Bamako) # !!
	*Hb A, Hb Presbyterian *, Hb Roubaix (Poland) * #, Hb Silver Springs *, Hb El Escorial * #, Hb Dallas * #, Hb Phnom Penh *, Hb La Coruna *, Hb Bougardirey-Mali *, Hb Saint Nazaire *, Hb Barika * #, Hb Allentown *, Hb Allison Park *, Hb Alperton *, Hb Altdorf *, Hb Alzette *, Hb Anamosa *, Hb Antibes-Juan-Les-Pins *, Hb Arta (main peak) * #, Hb Aurillac *, Hb Austin *, Hb Aylesbury *, Hb Aztec *, Hb Bass Hill *, Hb Beirut *, Hb Belleville *, Hb Belluno *, Hb Bethesda *, Hb Bibba *, Hb Bladensburg *, Hb Boghé *, Hb Bonn *, Hb Brem-sur-Mer *, Hb Brest *, Hb Brigham *, Hb Brisbane (Great Lakes) *, Hb Broomhill *, Hb Brugg *, Hb Buenos Aires (Bryn Mawr, major peak) * #, Hb Buffalo (Reeuwijk) *, Hb Bushwick *, Hb Caen *, Hb Calvino *, Hb Cardarelli *, Hb Cheverly *, Hb Chicago *, Hb City of Hope *, Hb Coimbra (Ingelheim) *, Hb Columbia Missouri *, Hb Conakry *, Hb Cowtown *, Hb Crete *, Hb Dapu *, Hb Den Haag *, Hb Denver *, Hb Dhaka *, Hb Dhonburi (Neapolis) *, Hb Djelfa (peak 1) * #, Hb Ecuador *, Hb Evans *, Hb Flurlingen *, Hb Fontainebleau *, Hb Frankfurt *, Hb Fukuoka *, Hb Fukuyama *, Hb Geisinger *, Hb Genova (Hyogo) *, Hb Godavari *, Hb Gorwihl (Hinchingbrooke) *, Hb Gouda *, Hb Grange Blanche *, Hb Groene Hart (Bernalda) *, Hb Grove City *, Hb Guanajuato *, Hb Haelen *, Hb Hamilton *, Hb Hammersmith (Chiba) *, Hb Heathrow *, Hb Hekinan *, Hb Hershey *, Hb Hyden *, Hb Inglewood *, Hb Iowa *, Hb Iraq-Halabja *, Hb Jabalpur *, Hb Jeddah *, Hb Johnstown *, Hb Kaiser West End *, Hb Kansas City *, Hb King Ecgbert *, Hb Knossos *, Hb Kokomo *, Hb Kosovo *, Hb La Desirade *, Hb Le Lamentin *, Hb Les Andelys *, Hb Linköping (Meilahti) *, Hb Lisbon *, Hb Little Rock *, Hb Louisville (Bucuresti) *, Hb Lulu Island *, Hb Lyon-Bron *, Hb M-Boston (M-Osaka) *, Hb M-Saskatoon (main peak) * #, Hb McKees Rocks *, Hb Malay *, Hb Malmö *, Hb Marijampolé *, Hb Marseille (Long Island) *, Hb Matsudo *, Hb Milledgeville *, Hb Minneapolis Laos *, Hb Mizuho * #, Hb Moriguchi *, Hb Mosella *, Hb Nakhon Ratchasima (Aberystwyth) *, Hb Nantes *, Hb Niguarda *, Hb Noko *, Hb Novara *, Hb Okayama *, Hb Olupona *, Hb Olympia *, Hb Owari *, Hb Ozieri *, Hb Parma *, Hb Part-Dieu *, Hb Perth (Abraham Lincoln) *, Hb Petit Bourg *, Hb Pierre-Bénite *, Hb Pittsburgh *, Hb Pohnpei * #, Hb Port Huron *, Hb Potomac *, Hb Pressath *, Hb Princes Risborough *, Hb Puttelange *, Hb Raleigh *, Hb Ramona *, Hb Ravenscourt Park *, Hb Regina *, Hb Rhode Island (Southwark) *, Hb Riccarton *, Hb Rio Claro *, Hb Rotterdam *, Hb Rouen (Ethiopia) *, Hb Saclay *, Hb Saint-Clair *, Hb Saint-Jacques *, Hb St Joseph's *, Hb Saint-Marcellin *, Hb Saki *, Hb San Bruno *, Hb San Diego *, Hb San Martin *, Hb Santa Barnabas (Croxley Green) *, Hb Santa Juana (Serres) *, Hb Savannah *, Hb Saveh *, Hb Sendagi (Warsaw) *, Hb Sheffield *, Hb Sitia *, Hb Sodertalje *, Hb South Florida *, Hb South Milwaukee *, Hb South Yorkshire *, Hb Sydney *, Hb Taradale (Middlesbrough) *, Hb Taybe *, Hb Templeuve *, Hb Torino *, Hb Toulon *, Hb Twin Peaks *, Hb Ty Gard *, Hb Tyne *, Hb Utrecht *, Hb Uzes *, Hb Valletta *, Hb Valme *, Hb Venetia *, Hb Verona *, Hb Vientiane (Grey Lynn) *, Hb Vila Real *, Hb Villejuif *, Hb Villeparisis *, Hb Villeurbanne *, Hb Volga (Drenthe) *, Hb Voorhees *, Hb Washtenaw *, Hb Waterland *, Hb Weesp *, Hb Wembley *, Hb Westmead *, Hb Wiangpapao *, Hb William-Harvey *, Hb Wood *, Hb Worthing *, Hb Yaounde (Mataro) *, Hb Zoetermeer *, Hb Sinai-Baltimore *, Hb M-Milwaukee-I *, Hb Melusine * #, Hb Pitie-Salpetriere *, Hb Syracuse *, Hb Hounslow, Hb Fort Dodge, Hb Old Dominion (OD/BuT), Hb Camperdown, Hb Duarte !!, Hb Jura (Bamako) # !!*

TABLEAU / TABLE

VARIANTS POTENTIELS PRÉSENTS DANS CHAQUE ZONE - POTENTIAL VARIANTS LOCATED IN EACH ZONE

Zone	Hémoglobines / Hemoglobins (Hb)
Z10	Hb Stockholm !!, Hb Créteil, Hb Nouakchott #, Hb M-Iwate (M-Kankakee) #, Hb Wayne (pic 1) #, Hb Complutense, Hb Camden (Tokuchi), Hb Hope
	Hb Stockholm !!, Hb Créteil, Hb Nouakchott #, Hb M-Iwate (M-Kankakee) #, Hb Wayne (peak 1) #, Hb Complutense, Hb Camden (Tokuchi), Hb Hope
Z11	Hb A dégradée, Hb Vaasa, Hb Tacoma, Hb Providence (pic X-Asn) #, Hb Yamagata, Hb Shepherds Bush, Hb Cook, Hb Corsica, Hb Pisa #, Hb K-Woolwich, Hb Lombard #, Hb J-Guantanamo, Hb Andrew Minneapolis, Hb J-Cape Town (alpha 1) #, Hb Kaohsiung (New York), Hb Fannin-Lubbock I, Hb Saint Claude #, Hb Thionville #, Hb Jackson (alpha 2) #, Hb J-Cape Town (alpha 2) #, Hb Strasbourg, Hb Osler (Fort Gordon), Hb Helsinki, Hb Doha, Hb Linwood, Hb J-Auckland, Hb Nancy, Hb Chesapeake, Hb Himeji, Hb Singapore #, Hb Jackson (alpha 1) #, Hb Cemenelum # !!, Hb Tatras # !!, variant de Hb A2 "I (I-Texas)" #
	Denatured Hb A, Hb Vaasa, Hb Tacoma, Hb Providence (X-Asn peak) #, Hb Yamagata, Hb Shepherds Bush, Hb Cook, Hb Corsica, Hb Pisa #, Hb K-Woolwich, Hb Lombard #, Hb J-Guantanamo, Hb Andrew Minneapolis, Hb J-Cape Town (alpha 1) #, Hb Kaohsiung (New York), Hb Fannin-Lubbock I, Hb Saint Claude #, Hb Thionville #, Hb Jackson (alpha 2) #, Hb J-Cape Town (alpha 2) #, Hb Strasbourg, Hb Osler (Fort Gordon), Hb Helsinki, Hb Doha, Hb Linwood, Hb J-Auckland, Hb Nancy, Hb Chesapeake, Hb Himeji, Hb Singapore #, Hb Jackson (alpha 1) #, Hb Cemenelum # !!, Hb Tatras # !!, "I (I-Texas)" Hb A2 variant #
Z12	Hb Bart, Hb Nikaia # !!, Hb Tokoname # !!, Hb J-Cubujuqui, Hb Hopkins-II (alpha 1) #, Hb J-Calabria (J-Bari), Hb J-Camagüey, Hb J-Tongariki #, Hb Wayne (pic 2) #, Hb J-Meerut (J-Birmingham - alpha 1) #, Hb Hopkins-II (alpha 2) #, Hb Zaïre, Hb J-Meerut (J-Birmingham - alpha 2) #, Hb Trollhättan, Hb Pyrgos (Mizunami), Hb Providence (pic X-Asp) #, Hb Suresnes #, Hb J-Broussais (Tagawa-I - alpha 2) #, Hb Grady (Dakar - alpha 2), Hb Grady (Dakar - alpha 1), Hb Legnano, Hb Hikari, Hb J-Rajappen #, Hb J-Anatolia #, Hb J-Broussais (Tagawa-I - alpha 1) #, Hb J-Chicago, Hb J-Sardegna #, Hb J-Toronto (alpha 1) #, Hb J-Cordoba, Hb J-Meinung (J-Bangkok), Hb Ube-2 #, Hb Dagestan, Hb J-Cambridge (Rambam), Hb Hofu, Hb J-Abidjan #, Hb Ulm, Hb Belliard #, Hb J-Iran, Hb Riyadh (Karatsu), Hb Mexico (J-Paris-II - alpha 1) #, Hb Mexico (J-Paris-II - alpha 2) #, Hb Neuilly-sur-Marne #, Hb Pontoise (J-Pontoise), Hb Ankara, Hb J-Buda, Hb J-Medellin, Hb J-Paris-I (J-Aljezur - alpha 1) #, Hb Thailand #, Hb J-Habana #, Hb J-Baltimore (N-New Haven), Hb J-Wenchang-Wuming (Anantharaj) #, Hb J-Paris-I (J-Aljezur - alpha 2) #, Hb Beijing, Hb J-Oxford (I-Interlaken) #, Hb K-Ibadan !!
	Hb Bart, Hb Nikaia # !!, Hb Tokoname # !!, Hb J-Cubujuqui, Hb Hopkins-II (alpha 1) #, Hb J-Calabria (J-Bari), Hb J-Camagüey, Hb J-Tongariki #, Hb Wayne (peak 2) #, Hb J-Meerut (J-Birmingham - alpha 1) #, Hb Hopkins-II (alpha 2) #, Hb Zaïre, Hb J-Meerut (J-Birmingham - alpha 2) #, Hb Trollhättan, Hb Pyrgos (Mizunami), Hb Providence (X-Asp peak) #, Hb Suresnes #, Hb J-Broussais (Tagawa-I - alpha 2) #, Hb Grady (Dakar - alpha 2), Hb Grady (Dakar - alpha 1), Hb Legnano, Hb Hikari, Hb J-Rajappen #, Hb J-Anatolia #, Hb J-Broussais (Tagawa-I - alpha 1) #, Hb J-Chicago, Hb J-Sardegna #, Hb J-Toronto (alpha 1) #, Hb J-Cordoba, Hb J-Meinung (J-Bangkok), Hb Ube-2 #, Hb Dagestan, Hb J-Cambridge (Rambam), Hb Hofu, Hb J-Abidjan #, Hb Ulm, Hb Belliard #, Hb J-Iran, Hb Riyadh (Karatsu), Hb Mexico (J-Paris-II - alpha 1) #, Hb Mexico (J-Paris-II - alpha 2) #, Hb Neuilly-sur-Marne #, Hb Pontoise (J-Pontoise), Hb Ankara, Hb J-Buda, Hb J-Medellin, Hb J-Paris-I (J-Aljezur - alpha 1) #, Hb Thailand #, Hb J-Habana #, Hb J-Baltimore (N-New Haven), Hb J-Wenchang-Wuming (Anantharaj) #, Hb J-Paris-I (J-Aljezur - alpha 2) #, Hb Beijing, Hb J-Oxford (I-Interlaken) #, Hb K-Ibadan !!
Z13	Hb Al-Ain Abu Dhabi, Hb J-Europa, Hb N-Baltimore (Hopkins-I), Hb J-Rovigo #, Hb J-Lome, Hb Arta (pic mineur) #, Hb J-Norfolk (Kagoshima), Hb Nigeria, Hb J-Kaohsiung (J-Honolulu)
	Hb Al-Ain Abu Dhabi, Hb J-Europa, Hb N-Baltimore (Hopkins-I), Hb J-Rovigo #, Hb J-Lome, Hb Arta (minor peak) #, Hb J-Norfolk (Kagoshima), Hb Nigeria, Hb J-Kaohsiung (J-Honolulu)
Z14	Hb N-Seattle, Hb J-Tashikuergan
	Hb N-Seattle, Hb J-Tashikuergan
Z15	Hb H, Hb I-Toulouse !!, Hb Sudbury, Hb Kurosaki (alpha 1), Poly A (A->G); AATAAA->AATAAG of the alpha2 gene alpha-Thal-2, Hb Kurosaki (alpha 2), Hb F-Emirates, Hb N-Timone, Hb I (I-Texas, I-Philadelphia) #, Hb Shaare Zedek
	Hb H, Hb I-Toulouse !!, Hb Sudbury, Hb Kurosaki (alpha 1), Poly A (A->G); AATAAA->AATAAG of the alpha2 gene alpha-Thal-2, Hb Kurosaki (alpha 2), Hb F-Emirates, Hb N-Timone, Hb I (I-Texas, I-Philadelphia) #, Hb Shaare Zedek

* Pic non ou peu visible car co-migrant de la fraction normale
Hidden or partially hidden peak due to similar migration time to normal fraction

\# Variant avec plusieurs fractions affichées (variant de la chaîne alpha ou variant instable ...)
Variant with several fractions displayed (alpha-chain or unstable variant ...)

!! Pic en bordure de zone (risque de saut de zone)
Peak in zone boundary (risk of zone shift)

Rappel : dans chaque zone les variants Hb sont listés selon leur temps de migration de droite vers la *gauche*
Reminder: *in each zone Hb variants are sorted according to their migration time from right to left*

TABLEAU / TABLE

FR : VARIANTS POTENTIELS PRÉSENTS DANS CHAQUE ZONE	*Zone*	*Hémoglobines (Hb)*	** Pic peu ou pas visible car migrant conjointement avec la fraction normale*
GB : POTENTIAL VARIANTS LOCATED IN EACH ZONE	*Zone*	*Hemoglobins (Hb)*	** Hidden or partially hidden peak due to similar migration time to normal fraction*
DE : POTENZIELLE VARIANTEN IN DEN EINZELNEN ZONEN	*Zone*	*Hämoglobine (Hb)*	** Versteckter oder teilweise versteckter Spitzenwert infolge ähnlicher Migrationszeit wie bei der normalen Fraktion*
NL : POTENTIËLE VARIANTEN IN ELKE ZONE	*Zone*	*Hemoglobinen (Hb)*	** Verborgen of gedeeltelijk verborgen piek vanwege migratietijd die vergelijkbaar is met normale fractie*
IT : VARIANTI POTENZIALI PRESENTI IN CIASCUNA ZONA	*Zona*	*Emoglobine (Hb)*	** Picco invisibile o scarsamente visibile poiché migrante unitamente alla frazione normale*
ES : VARIANTES POTENCIALES PRESENTES EN CADA ZONA	*Zona*	*Hemoglobinas (Hb)*	** Pico oculto o parcialmente oculto debido a migración conjunta con la fracción normal*
PT : VARIANTES POTENCIAIS LOCALIZADAS EM CADA ZONA	*Zona*	*Hemoglobinas (Hb)*	** Pico oculto ou parcialmente oculto devido a tempo de migração similar para fração normal*
SV : POTENTIELLA VARIANTER BELÄGNA I VARJE ZON	*Zon*	*Hemoglobiner (Hb)*	** Dold eller delvis dold topp på grund av liknande migrationstid till normal fraktion*
GR : ΔΥΝΗΤΙΚΕΣ ΠΑΡΑΛΛΑΓΕΣ ΠΟΥ ΕΝΤΟΠΙΖΟΝΤΑΙ ΣΕ ΚΑΘΕ ΖΩΝΗ	*Ζώνη*	*Αιμοσφαιρίνες (Hb)*	** Απόκρυφη ή μερική απόκρυψη κορυφής λόγω παρόμοιου χρόνου ηλεκτροφόρησης σε φυσιολογικό κλάσμα*
HR : POTENCIJALNE VARIJANTE LOCIRANE U SVAKOJ ZONI	*Zona*	*Hemoglobini (Hb)*	** Vrh je potpuno ili djelomično skriven zbog vremena migracije sličnog onome za normalnu frakciju*
LT : GALIMI VARIANTAI, ESANTYS KIEKVIENOJE ZONOJE	*Zona*	*Hemoglobinas (Hb)*	** Paslėpta arba iš dalies paslėpta viršūnė, nes migracijos laikas panašus į normalios frakcijos migracijos laiką*
PL : POTENCJALNE ODMIANY ZLOKALIZOWANE W KAŻDEJ STREFIE	*Strefa*	*Hemoglobiny (Hb)*	** Ukryty lub częściowo ukryty pik ze względu na podobny czas migracji względem frakcji prawidłowej*
RO : VARIANTE POTENŢIALE SITUATE ÎN FIECARE ZONĂ	*Zonă*	*Hemoglobine (Hb)*	** Vârf ascuns sau parţial ascuns datorită timpului de migrare asemănător cu fracţia normală*
CS : POTENCIÁLNE VARIJANTE KOJE SE NALAZE U SVAKOJ ZONI	*Zona*	*Hemoglobini (Hb)*	** Skrivení ili delimično skrivení vrh zbog sličnog vremena migracije u normalnu frakciju*
HU : LEHETSÉGES VARIÁNSOK AZ EGYES ZÓNÁKBAN	*Zóna*	*Hemoglobinok (Hb)*	** A normál fragmentuméhoz hasonló migrációs idő miatt rejtett vagy részben rejtett csúcs*
TR : HER BİR BÖLGEDE YER ALAN VARYANTLAR	*Bölge*	*Hemoglobinler (Hb)*	** Normal fraksiyona benzer migrasyon süresi nedeniyle gizli veya kısmen gizli pik*
CZ : POTENCIÁLNÍ VARIANTY HEMOGLOBINU UMÍSTĚNÉ V KAŽDÉ ZÓNĚ	*Zóna*	*Hemoglobiny (Hb)*	** Skrytý nebo částečně skrytý pík v důsledku podobné doby migrace normální frakce*
BG : ВЪЗМОЖНИ ВАРИАНТИ, РАЗПОЛОЖЕНИ ВЪВ ВСЯКА ЗОНА	*Зона*	*Хемоглобини (Hb)*	** Скрит или частично скрит пик поради време на миграция, подобно на това на нормалната фракция*
NO : POTENSIELLE VARIANTER PLASSERT I HVER SONE	*Sone*	*Hemoglobiner (Hb)*	** Skjult eller delvis skjult topp på grunn av lignende migreringstid til normal fraksjon*
DK : POTENTIELLE VARIANTER I HVER ZONE	*Zone*	*Hæmoglobiner (Hb)*	** Skjult eller delvist skjult top på grund af lignende migrationstid til normal fraktion*
CN : 每个区中潜在的变种	*区*	*血红蛋白 (Hb)*	**由于电泳时间与普通馏分相似，因此峰被隐藏或部分隐藏*
RU : ВОЗМОЖНЫЕ ВАРИАЦИИ, РАСПОЛОЖЕННЫЕ В КАЖДОЙ ЗОНЕ	*Зона*	*Гемоглобин (Hb)*	** Скрытый или частично скрытый пик по причине сходного времени миграции в нормальную фракцию*
JP : 各ゾーンに位置する潜在的な変異体	*ゾーン*	*ヘモグロビン (Hb)*	** 正常フラクションへの移行時間が同一であるため、非表示または部分的に非表示のピーク*
LV : POTENCIĀLIE VARIANTI KATRĀ ZONĀ	*Zona*	*Hemoglobīns (Hb)*	** Slēpta vai daļēji slēpta maksimālā vērtība, ko izraisa migrācijas laiks, kas ir līdzīgs ar normālu frakciju*
SK : POTENCIÁLNE VARIANTY, KTORÉ SA NACHÁDZAJÚ V KAŽDEJ ZÓNE	*Zóna*	*Hemoglobíny (Hb)*	** Skrytá alebo čiastočne skrytá špička v dôsledku podobného času migrácie ako pri normálnej frakcii*
EE : POTENTSIAALSED VARIANDID IGAS TSOONIS	*Tsoon*	*Hemoglobiinid (Hb)*	** Varjatud või osaliselt varjatud piik normaalse fraktsiooniga sarnase migratsiooniaja tõttu*
VN : BIẾN TIỀM ẨN TẠI MỖI VÙNG	*Vùng*	*Hemoglobin (Hb)*	** Đỉnh ẩn hoặc ẩn một phần vì thời gian di chuyển sang mảnh thông thường tương tự*

FR : # Variant avec plusieurs fractions affichées (variant de la chaîne alpha ou variant instable ...)	*!! Pic en bordure de zone (risque de changement de zone)*
GB : # Variant with several fractions displayed (alpha-chain or unstable variant ...)	*!! Peak in zone boundary (risk of zone shift)*
DE : # Variante mit mehreren angezeigten Fraktionen (Alpha-Kette oder instabile Variante ...)	*!! Spitzenwert im Zonengrenzbereich (Risiko einer Zonenverschiebung)*
NL : # Variant met verschillende zichtbare fracties (alfaketen of onstabiele variant ...)	*!! Piek in zonegrens (gevaar voor zonevervorming)*
IT : # Variante con più frazioni visualizzate (variante della catena alfa o variante instabile, ecc.)	*!! Picco sul confine di zona (rischio di variazione di zona)*
ES : # Variante que presenta varias fracciones (variante de cadena alfa o variante inestable ...)	*!! Pico en el límite de la zona (riesgo de cambio de zona)*
PT : # Variante com várias frações apresentadas (cadeia alfa ou variante instável, etc.)	*!! Pico no limite da zona (risco de deslocação de zona)*
SV : # Variant med flera fraktioner som visas (alfa-kedja eller instabil variant ...)	*!! Topp i zongränsen (risk för zonförskjutning)*
GR : # Παραλλαγή με εμφάνιση πολλών κλασμάτων (άλφα αλυσίδα ή ασταθής παραλλαγή ...)	*!! Κορυφή σε όριο ζώνης (κίνδυνος μετατόπισης ζώνης)*
HR : # Varijanta s nekoliko prikazanih frakcija (alfa-lanac ili nestabilna varijanta...)	*!! Vrh u granici zone (opasnost od pomaka zone)*
LT : # Varianto su keliomis rodomomis frakcijomis nr. (alfa grandis arba nestabilus variantas...)	*!! Viršūnė ant zonos ribos (zonos pasislinkimo pavojus)*
PL : # odmiany z kilkoma wyświetlanymi frakcjami (łańcuch alfa lub odmiana niestabilna...)	*!! Pik w granicy strefy (ryzyko przesunięcia strefy)*
RO : # variantă cu mai multe fracţii afişate (lanţ alfa sau variantă instabilă...)	*!! Vârf în limita zonei (risc de schimbare a zonei)*
CS : # Varijanta sa prikazanih nekoliko frakcija (alfa lanac ili nestabilna varijanta ...)	*!! Vrh u graničnoj zoni (rizik od pomaka zone)*
HU : # Több fragmentumot mutató variáns (alfa lánc vagy instabil variáns...)	*!! Csúcs a zóna határánál (zónaáttolódás kockázata)*
TR : # Birden çok fraksiyonun görüntülendiği varyant (alfa zincir veya kararsız varyant ...)	*!! Bölge sınırında pik değeri (bölge kayması riski)*
CZ : # Varianta s několika zobrazenými frakcemi (alfa řetězce nebo nestálá varianta...)	*!! Pík na hranici zóny (riziko posunu zóny)*
BG : # Появява се вариант с няколко фракции (алфа-верига или нестабилен вариант ...)	*!! Пик на границата на зоната (опасност от преместване на зоната)*
NO : # Variant med flere fraksjoner vises (Alpha-kjeden eller ustabil variant ...)	*!! Topp i sonegrense (fare for soneforskyvning)*
DK : # Variant med flere fraktioner vist (alfakæde eller ustabil variant ...)	*!! Top i zonegrænse (risiko for zoneskift)*
CN : # 显示了多个区带的变体（α 链或不稳定变体..）	*!! 区边界峰值（有区位移的风险）*
RU : # Вариация с отображением нескольких фракций (альфа-цепь или неустойчивая вариация ...)	*!! Пик на границе зоны (риск смещения зоны)*
JP : # 数個のフラクションが表示される変異体（α鎖または不安定な変異体 ...）	*!! ゾーン境界でのピーク (ゾーンシフトのリスクがある)*
LV : # Tiek parādīts variants ar vairākām frakcijām (alfa ķēde vai nestabils variants u. c.)	*!! Maksimālā vērtība zonas robežās (zonas maiņas risks)*
SK : # Variant s viacerými zobrazenými frakciami (alfa-reťazec alebo nestabilný variant ...)	*!! Špička v hraničnej zóne (riziko posunutia zóny)*
EE : # Kuvatud on mitme fraktsiooniga variant (alfa-ahel või ebastabiilne variant ...)	*!! Piik tsooni piiril (tsooni nihke risk)*
VN : # Biến có vài mảnh hiển thị (biến chuỗi alpha hay biến không ổn định...)	*!! Đỉnh nằm trong ranh giới vùng (nguy cơ thay đổi vùng)*

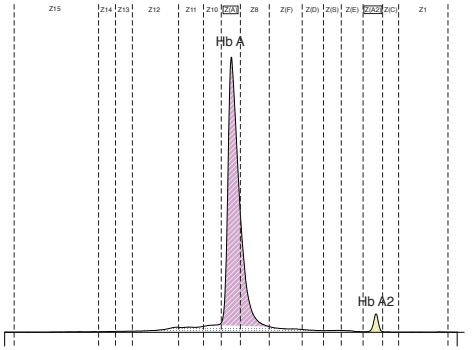
FR : Rappel : Dans chaque zone, les variants Hb sont listés selon leur temps de migration de la droite vers la gauche
GB : Reminder: In each zone, Hb variants are sorted according to their migration time from the right to the left
DE : Hinweis : Die Hb-Varianten werden in allen Zonen nach ihrer Migrationszeit von rechts nach links sortiert
NL : Herinnering : in elke zone worden Hb varianten op basis van hun migratietijd van rechts naar links gesorteerd
IT : NB : In ciascuna zona, le varianti Hb sono elencate in base al loro tempo di migrazione da destra verso sinistra
ES : NOTA : En cada zona, las variantes de la Hb son listadas según su tiempo de migración de derecha a izquierda
PT : Lembrete : Em cada zona, as variantes Hb são ordenadas de acordo com o seu tempo de migração da direita para a esquerda
SV : Påminnelse : I varje zon, sorteras Hb-varianter enligt deras migrationstid från höger till vänster
GR : Υπενθύμιση : Σε κάθε ζώνη, οι παραλλαγές Hb ταξινομούνται ανάλογα με τον χρόνο ηλεκτροφόρησής τους από τα δεξιά προς τα αριστερά
HR : Podsjetnik : Hb varijante razvrstane su u svakoj zoni prema svom vremenu migracije s desne na lijevu stranu
LT : Primename : kiekvienoje zonoje Hb variantai pagal migracijos laiką surūšiuoti iš dešinės į kairę.
PL : Przypomnienie : W każdej strefie odmiany Hb są sortowane według czasu migracji, od prawej do lewej
RO : Memento : În fiecare zonă, variantele Hb sunt sortate în funcţie de timpul de migrare de la dreapta la stânga
CS : Podsetník : U svakoj zoni, Hb varijante se sortiraju prema svom vremenu migracija sa desna na levo
HU : Emlékeztető : A Hb-variánsok mindegyik zónában a migrációs idejüknek megfelelően rendeződnek jobbról balra
TR : Hatırlatma : Her bir bölgede, Hb varyantları sağdan sola migrasyon sürelerine göre sınıflandırılır
CZ : Připomínka : V každé zóně jsou varianty Hb roztříděny podle své doby migrace zprava doleva
BG : Напомняне : Hb варианти във всяка зона се сортират от дясно наляво според времето им на миграция
NO : Påminnelse : I hver sone, er Hb-varianter sortert i henhold til deres migreringstid fra høyre til venstre
DK : Påmindelse : I hver zone sorteres Hb-varianter efter deres migrationstid fra højre til venstre
CN : 提示：在每个区中，根据 Hb 变体从右到左的电泳时间进行排序
RU : Напоминание : вариации Hb сортируются по времени миграции в каждой зоне справа налево
JP : 注意：各ゾーンにおいて、Hb変異体は泳動時間に従って右から左にソートされ（並べ替えられ）ます
LV : Atgādinājums! Katrā zonā Hb varianti tiek sakārtoti pēc to migrācijas laika no labās uz kreiso pusi
SK : Pripomienka : Varianty Hb sú v každej zóne usporiadané sprava doľava podľa času migrácie
EE : Meelespea : Igas tsoonis sorteeritakse Hb variandid vastavalt nende migratsiooniajale paremalt vasakule.
VN : Xin nhắc lại : Ở mỗi vùng, biến thể Hb được sắp xếp theo thời gian di chuyển từ phải sang trái

SCHÉMAS / FIGURES

ABBILDUNGEN - FIGUREN - FIGURE - FIGURAS - BILDER - ΕΙΚΟΝΕΣ - SLIKE - PAVEIKSLAI - RYSUNKI - FIGURI - ÁBRÁK - ŞEKİLLER - OBRÁZKY - ФИГУРИ - FIGURER - 插图 - РИСУНКИ - 図 - CIPARI - JOONISED - SƠ ĐỒ

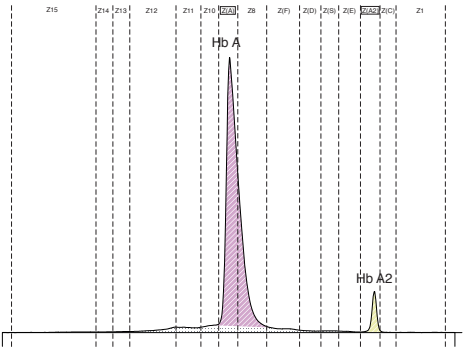
PROFILS ÉLECTROPHORÉTIQUES - ELECTROPHORETIC PATTERNS

1



Sang normal
Normal blood sample

2



Sang bêta-thalassémique
Blood sample with beta-thalassemia

FR : PROFILS ÉLECTROPHORÉTIQUES	*Sang normal*	*Sang bêta-thalassémique*
GB : ELECTROPHORETIC PATTERNS	*Normal blood sample*	*Blood sample with beta-thalassemia*
DE : ELEKTROPHORESEMUSTER	*Normalblutprobe*	*Blutprobe mit Beta-Thalassämie*
NL : ELEKTROFORETISCHE PATRONEN	*Normaal bloedmonster*	*Bloedmonster met bètathalassemie*
IT : PROFILI ELETTROFORETICI	*Sangue normale*	*Sangue beta-talassemico*
ES : PERFILES ELECTROFORÉTICOS	*Sangre normal*	*Sangre con beta talasemia*
PT : PADRÕES ELETROFORÉTICOS	*Amostra de sangue normal*	*Amostra de sangue com beta-talassemia*
SV : ELEKTROFORETISKA MÖNSTER	*Normalt blodprov*	*Blodprov med beta-thalassemi*
GR : ΗΛΕΚΤΡΟΦΟΡΗΤΙΚΑ ΠΡΟΤΥΠΑ	*Φυσιολογικό δείγμα αίματος*	*Δείγμα αίματος με βήτα-θαλασσαιμία*
HR : ELEKTROFORETSKI OBRASCI	*Normalan uzorak krvi*	*Uzorak krvi s beta-talasemijom*
LT : ELEKTROFOREZĖS ŠABLONAI	*Normalus kraujo mėginys*	*Paciento, sergančio beta talasemija, kraujo mėginys*
PL : OBRAZY ELEKTROFORETYCZNE	*Próbka krwi prawidłowej*	*Próbka krwi z beta-talasemią*
RO : TIPARE ELECTROFORETICE	*Probă normală de sânge*	*Probă de sânge cu beta-talasemie*
CS : ELEKTROFORETSKI ŠABLONI	*Normalan uzorak krvi*	*Uzorak krvi sa beta-talasemijom*
HU : ELEKTROFORETIKUS MINTÁZATOK	*Normál vérminta*	*Béta-talasszémiás vérminta*
TR : ELEKTROFORETİK PATERNLER	*Normal kan numunesi*	*Beta-talasemi içeren kan numunesi*
CZ : ELEKTROFORETICKÉ TYPY	*Normální vzorek krve*	*Vzorek krve s beta talasemií*
BG : ЕЛЕКТРОФОРЕТИЧНИ МОДЕЛИ	*Нормална кръвна проба*	*Кръвна проба с бета-таласемия*
NO : ELEKTROFORETISKE MØNSTRE	*Normal blodprøve*	*Blodprøve med beta-talassemi*
DK : ELEKTROFORETISKE MØNSTRE	*Normal blodprøve*	*Blodprøve med beta-thalassæmi*
CN : 电泳图谱	*正常血液样品*	*β -地中海贫血的血液样品*
RU : ЭЛЕКТРОФОРЕТИЧЕСКИЕ ПРОФИЛИ	*Образец нормальной крови*	*Образец крови с бета-талассемией*
JP : 電気泳動パターン	*正常血液サンプル*	*βサラセミアての血液サンプル*
LV : ELEKTROFORĒTISKIE SPEKTRI	*Normāls asins paraugs*	*Asins paraugs ar beta talasēmiju*
SK : ELEKTROFORÉZNE VZORY	*Vzorka normálnej krvi*	*Vzorka krvi s beta-talasémiou*
EE : ELEKTROFOREETILISED MUSTRID	*Normaalne vereproov*	*Beeta-talasseemiaga vereproov*
VN : MÔ HÌNH ĐIỆN DI	*Mẫu máu thông thường*	*Mẫu máu có beta-thalassemia*

SCHÉMAS / FIGURES

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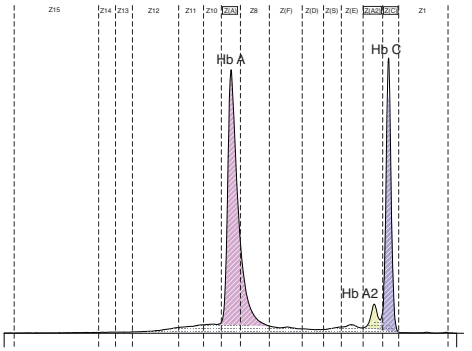
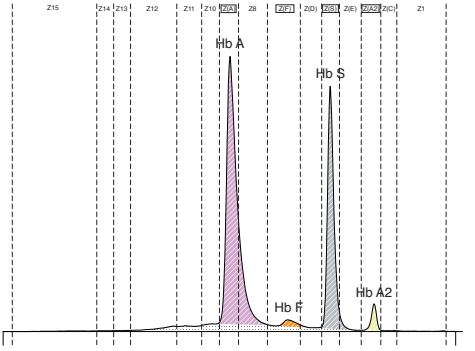
PROFILS ÉLECTROPHORÉTIQUES - ELECTROPHORETIC PATTERNS

3



Sang de patient hétérozygote avec variant Hb C
Blood sample from heterozygous patient with Hb C variant

4



Sang de patient hétérozygote avec variant Hb S
Blood sample from heterozygous patient with Hb S variant

FR : Sang de patient hétérozygote avec variant Hb C
GB : Blood sample from heterozygous patient with Hb C variant
DE : Blutprobe eines heterozygoten Patienten mit Hb C-Variante
NL : Bloedmonster van heterozygote patiënt met Hb C variant
IT : Sangue di paziente eterozigote con variante Hb C
ES : Sangre de paciente heterocigoto con la variante Hb C
PT : Amostra de sangue de doente heterozigótico com variante Hb C
SV : Blodprov från heterozygot patient med Hb C-variant
GR : Δείγμα αίματος από ετερόζυγο ασθενή με παραλλαγή Hb C
HR : Uzorak krvi heterozigotnog bolesnika s varijantom Hb C
LT : Heterozigotinio paciento kraujo, kuriame yra Hb C varianto, kraujo mėginys
PL : Próbka krwi od heterozygotycznego pacjenta z odmianą Hb C
RO : Probă de sânge de la pacient heterozigot cu varianta Hb C
CS : Uzorak krvi od heterozigotnog pacijenta sa Hb C varijantom
HU : Heterozigóta beteg vérmintája Hb C variánssal
TR : Hb C varyantı taşıyan heterozigot hastasına ait kan numunesi
CZ : Vzorek krve heterozygotního pacienta s variantou Hb C
BG : Кръвна проба от хетерозиготен пациент с Hb C вариант
NO : Blodprøve fra heterozygot pasient med Hb C-variant
DK : Blodprøve fra heterozygot patient med Hb C-variant
CN : 来自 Hb C 变体杂合患者的血液样品
RU : Образец крови от гетерозиготного пациента с вариацией Hb C
JP : Hb C変異体を含むヘテロ接合患者からの血液サンプル
LV : Heterozigota pacienta asins paraugs ar Hb C variantu
SK : Vzorka krvi od heterozygotného pacienta s variantom Hb C
EE : Vereproov Hb C variandiga heterosügootselt patsiendilt
VN : Mẫu máu của bệnh nhân bị bệnh dị hợp từ với biến thể Hb C

Sang de patient hétérozygote avec variant Hb S
Blood sample from heterozygous patient with Hb S variant
Blutprobe eines heterozygoten Patienten mit Hb S-Variante
Bloedmonster van heterozygote patiënt met Hb S variant
Sangue di paziente eterozigote con variante Hb S
Sangre de paciente heterocigoto con la variante Hb S
Amostra de sangue de doente heterozigótico com variante Hb S
Blodprov från heterozygot patient med Hb S-variant
Δείγμα αίματος από ετερόζυγο ασθενή με παραλλαγή Hb S
Uzorak krvi heterozigotnog bolesnika s varijantom Hb S
Heterozigotinio paciento kraujo, kuriame yra Hb S varianto, mėginys
Próbka krwi od heterozygotycznego pacjenta z odmianą Hb S
Probă de sânge de la pacient heterozigot cu varianta Hb S
Uzorak krvi od heterozigotnog pacijenta sa Hb S varijantom
Heterozigóta beteg vérmintája Hb S variánssal
Hb S varyantı taşıyan heterozigot hastasına ait kan numunesi
Vzorek krve heterozygotního pacienta s variantou Hb S
Кръвна проба от хетерозиготен пациент с Hb S вариант
Blodprøve fra heterozygot pasient med Hb S-variant
Blodprøve fra heterozygot patient med Hb S-variant
来自 Hb S 变体杂合患者的血液样品
Образец крови от гетерозиготного пациента с вариацией Hb S
Hb S変異体を含むヘテロ接合患者からの血液サンプル
Heterozigota pacienta asins paraugs ar Hb S variantu
Vzorka krvi od heterozygotného pacienta s variantom Hb S
Vereproov Hb S variandiga heterosügootselt patsiendilt
Mẫu máu của bệnh nhân bị bệnh dị hợp tử với biến thể Hb S

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PROFILS ÉLECTROPHORÉTIQUES - ELECTROPHORETIC PATTERNS

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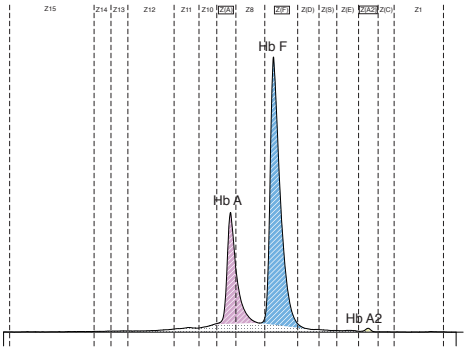

Sang normal de bébé (âgé de 3 semaines)
Normal blood sample from baby (3 weeks old)

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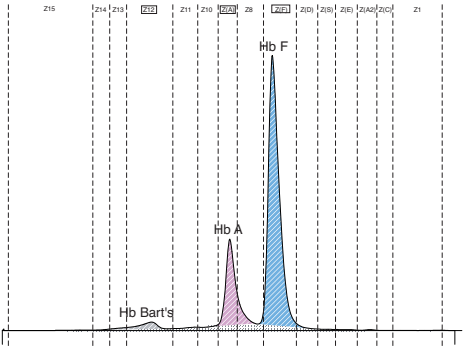

Sang de bébé avec Hb Bart
Baby blood sample with Hb Bart's

FR : Sang normal de bébé (âgé de 3 semaines)
GB : Normal blood sample from baby (3 weeks old)
DE : Normalblutprobe eines Säuglings (Alter: 3 Wochen)
NL : Normaal bloedmonster van baby (3 weken oud)
IT : Sangue normale di neonato (età 3 settimane)
ES : Sangre normal de bebé (3 semanas de edad)
PT : Amostra de sangue normal de bebé (3 semanas de idade)
SV : Normalt blodprov från baby (3 veckor gammal)
GR : Φυσιολογικό δείγμα αίματος από βρέφος (ηλικίας 3 εβδομάδων)
HR : Normalan uzorak krvi dojenčeta (u dobi od 3 tjedna)
LT : Normalus kūdikio (3 savaičių amžiaus) kraujo mėginys
PL : Próbka krwi prawidłowej od niemowlęcia (3-tygodniowego)
RO : Probă normală de sânge de la bebeluș (trei săptămâni)
CS : Normalan uzorak krvi od bebe (stare 3 nedelje)
HU : 3 hetes csecsemő normál vérmintája
TR : Bebekten alınan normal kan numunesi (3 haftalık)
CZ : Normální vzorek krve malého dítěte (věk 3 týdny)
BG : Нормална кръвна проба от бебе (на възраст 3 седмици)
NO : Normal blodprøve fra nyfødt barn (3 uker gammel)
DK : Normal blodprøve fra baby (3 uger gammel)
CN : 来自婴儿（3 个月）的正常血液样品
RU : Образец нормальной крови младенца (возраст — 3 недели)
JP : 新生児（生後3週）からの正常血液サンプル
LV : Mazuļa (3 nedēļas vecs) normāls asins paraugs
SK : Vzorka normálnej krvi od novorodenca (vo veku 3 týždňov)
EE : Normaalne vereproov imikult (3-nädalane)
VN : Mẫu máu thông thường của trẻ sơ sinh (3 tuần tuổi)

Sang de bébé avec Hb Bart
Baby blood sample with Hb Bart's
Blutprobe eines Säuglings mit Hb-Barts
Bloedmonster van baby met Hb Bart
Sangue di neonato con Hb Bart
Sangre de bebé con Hb Bart
Amostra de sangue de bebé com Hb de Bart
Blodprov från baby med Hb Bart's
Δείγμα αίματος βρέφους με Hb Bart's
Uzorak krvi dojenčeta s Bartovim Hb
Kūdikio kraujo, kuriame yra Hb Bart, mėginys
Próbka krwi niemowlęcia z Hb Barta
Probă de sânge de la bebeluș cu Hb Bart's
Vzorek krve malého dítěte s Bartovým Hb
Кръвна проба от бебе с Hb на Bart
Blodprøve fra nyfødt barn med Hb Barts
Babyblodprøve med Hb Bart's
含 Hb Bart's 的血液样品
Образец крови младенца с гемоглобином Барта
Hbバーツを含む新生児の血液サンプル
Mazuļa asins paraugs ar Hb Bart
Vzorka krvi od novorodenca s Hb Bartovým Hb
Imiku vereproov Hb Bart'iga
Mẫu máu của trẻ sơ sinh có Hb Bart's

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PROFILS ÉLECTROPHORÉTIQUES - ELECTROPHORETIC PATTERNS

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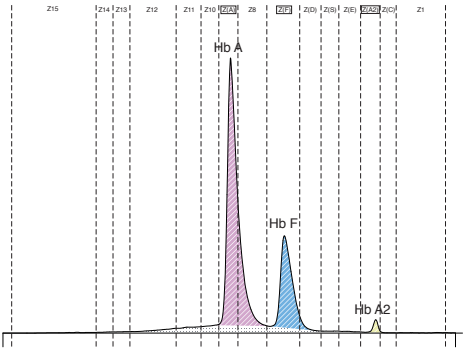

Sang avec Hb F élevée (jeune enfant)
Blood sample with elevated Hb F (young child)

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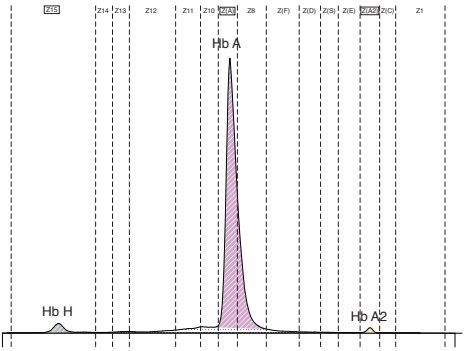

Sang avec Hb H
Blood sample with Hb H

FR : Sang avec Hb F élevée (jeune enfant)
GB : Blood sample with elevated Hb F (young child)
DE : Blutprobe mit erhöhtem Hb F (Kleinkind)
NL : Bloedmonster met verhoogd Hb F niveau (klein kind)
IT : Sangue con Hb F alta (bambino)
ES : Sangre con Hb F elevada (niño de corta edad)
PT : Amostra de sangue com Hb F elevada (criança pequena)
SV : Blodprov med förhöjd Hb F (litet barn)
GR : Δείγμα αίματος με αυξημένο επίπεδο Hb F (μικρό παιδί)
HR : Uzorak krvi s povišenom vrijednošću Hb F (malo dijete)
LT : Kraujo, kuriame padidėjęs Hb F kiekis, měginys (mažo vaiko)
PL : Próbka krwi o podwyższonym stężeniu Hb F (małe dziecko)
RO : Probă de sânge cu Hb F crescută (copil mic)
CS : Uzorak krvi sa povišenim Hb F (malo dete)
HU : Vérminta emelkedett Hb F-fel (kisgyermek)
TR : Yüksek Hb F içeren kan numunesi (genç çocuk)
CZ : Vzorek krve se zvýšeným Hb F (dítě)
BG : Кръвна проба с повишен Hb F (малко дете)
NO : Blodprøve med forhøyet Hb F (små barn)
DK : Blodprøve med forhøjet Hb F (lille barn)
CN : Hb F 升高（幼儿）的血液样品
RU : Образец крови с повышенным уровнем Hb F (ребенок младшего возраста)
JP : Hb Fが高値の血液サンプル（幼児）
LV : Asins paraugs ar paaugstinātu Hb F līmeni (mazs bērns)
SK : Vzorka krvi so zvýšenou hladinou Hb F (dojča)
EE : Vereproov kõrgenenud Hb F-iga (noor laps)
VN : Mẫu máu có Hb F gia tăng (trẻ nhỏ)

Sang avec Hb H
Blood sample with Hb H
Blutprobe mit Hb H
Bloedmonster met Hb H
Sangue con Hb H
Sangre con Hb H
Amostra de sangue com Hb H
Blodprov med Hb H
Δείγμα αίματος με Hb H
Uzorak krvi s Hb H
Kraujo, kuriame yra Hb H, měginys
Próbka krwi z Hb H
Probă de sânge cu Hb H
Uzorak krvi sa Hb H
Vérminta Hb H-val
Hb H içeren kan numunesi
Vzorek krve s Hb H
Кръвна проба с Hb H
Blodprøve med Hb H
Blodprøve med Hb H
含 Hb H 的血液样品
Образец крови с Hb H
Hb Hを含む血液サンプル
Asins paraugs ar Hb H
Vzorka krvi s Hb H
Vereproov Hb H-ga
Mẫu máu có Hb H

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PROFILS ÉLECTROPHORÉTIQUES - ELECTROPHORETIC PATTERNS

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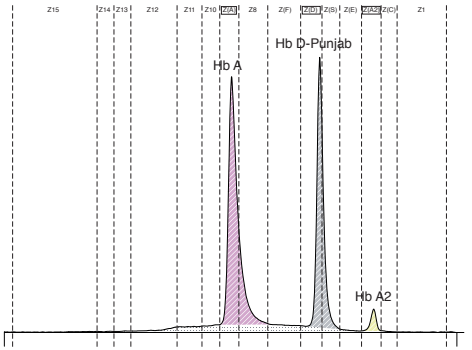

Sang de patient hétérozygote avec variant Hb D-Punjab
Blood sample from heterozygous patient with Hb D-Punjab variant

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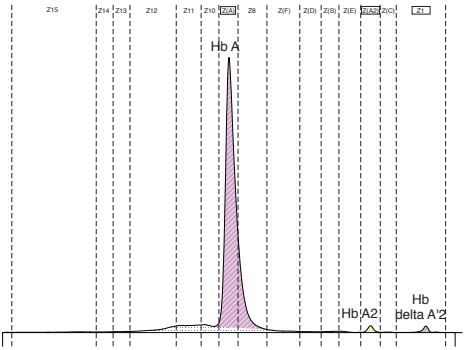

Sang de patient hétérozygote avec variant delta Hb A'2
Blood sample from heterozygous patient with delta Hb A'2 variant

FR : Sang de patient hétérozygote avec variant Hb D-Punjab
GB : Blood sample from heterozygous patient with Hb D-Punjab variant
DE : Blutprobe eines heterozygoten Patienten mit Hb D-Punjab-Variante
NL : Bloedmonster van heterozygote patiënt met Hb D-Punjab variant
IT : Sangue di paziente eterozigote con variante Hb D-Punjab
ES : Sangre de paciente heterocigoto con la variante Hb D-Punjab
PT : Amostra de sangue de doente heterozigótico com variante Hb D-Punjab
SV : Blodprov från heterozygot patient med Hb D-Punjab variant
GR : Δείγμα αίματος από ετερόζυγο ασθενή με παραλλαγή Hb D-Punjab
HR : Uzorak krvi heterozigotnog bolesnika s varijantom Hb D-Punjab
LT : Heterozigotinio paciento kraujo, kuriame yra Hb D-Punjab varianto, méginys
PL : Próbka krwi od heterozygotycznego pacjenta z odmianą Hb D-Punjab
RO : Probă de sânge de la pacient heterozigot cu varianta Hb D-Punjab
CS : Uzorak krvi od heterozigotnog pacijenta sa Hb D-Punjab varijantom
HU : Heterozigóta beteg vérmintája Hb D-Punjab variánssal
TR : Hb D-Punjab varyantı taşıyan heterozigot hastasına ait kan numunesi
CZ : Vzorek krve heterozygotního pacienta s variantou Hb D-Paňdžáb
BG : Кръвна проба от хетерозиготен пациент с Hb D-Punjab вариант
NO : Blodprøve fra heterozygot pasient med Hb D-Punjab variant
DK : Blodprøve fra heterozygot patient med Hb D-Punjab-variant
CN : 来自 Hb D-Punjab 变体杂合患者的血液样品
RU : Образец крови от гетерозиготного пациента с вариацией Hb D-Punjab
JP : Hb D-Punjab変異体を含むヘテロ接合患者からの血液サンプル
LV : Heterozigota pacienta asins paraugs ar Hb D-Punjab variantu
SK : Vzorka krvi od heterozygotného pacienta s variantom Hb D-Punjab
EE : Vereproov Hb D-Punjabi variandiga heterosügootselt patsiendilt
VN : Mẫu máu của bệnh nhân bị bệnh dị hợp tử với biến thể Hb D-Punjab

Sang de patient hétérozygote avec variant delta Hb A'2
Blood sample from heterozygous patient with delta Hb A'2 variant
Blutprobe eines heterozygoten Patienten mit Delta-Hb A2-Variante
Bloedmonster van heterozygote patiënt met delta Hb A'2 variant
Sangue di paziente eterozigote con variante delta Hb A2
Sangre de paciente heterocigoto con variante delta Hb A'2
Amostra de sangue de doente heterozigótico com variante delta Hb A'2
Blodprov från heterozygot patient med delta Hb A'2-variant
Δείγμα αίματος από ετερόζυγο ασθενή με παραλλαγή δέλτα Hb A'2
Uzorak krvi heterozigotnog bolesnika s varijantom delta Hb A'2
Heterozigotinio paciento kraujo, kuriame yra delta Hb A'2 varianto, méginys
Próbka krwi od heterozygotycznego pacjenta z odmianą delta Hb A'2
Probă de sânge de la pacient heterozigot cu varianta delta Hb A'2
Uzorak krvi od heterozigotnog pacijenta sa delta Hb A'2 varijantom
Heterozigóta beteg vérmintája delta Hb A'2 variánssal
Delta Hb A'2 varyantı taşıyan heterozigot hastasına ait kan numunesi
Vzorek krve heterozygotního pacienta s variantou delta Hb A'2
Кръвна проба от хетерозиготен пациент с делта Hb A'2 вариант
Blodprøve fra heterozygot pasient med delta Hb A'2 variant
Blodprøve fra heterozygot patient med Hb A'2-variant
来自 Hb A'2 变体杂合患者的血液样品
Образец крови от гетерозиготного пациента с вариацией delta Hb A'2
デルタHb A'2変異体を含むヘテロ接合患者からの血液サンプル
Heterozigota pacienta asins paraugs ar delta Hb A'2 variantu
Vzorka krvi od heterozygotného pacienta s variantom Hb A'2
Vereproov delta Hb A'2 variandiga heterosügootselt patsiendilt
Mẫu máu của bệnh nhân bị bệnh dị hợp tử với biến thể Hb A'2 delta

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PROFILS ÉLECTROPHORÉTIQUES - ELECTROPHORETIC PATTERNS

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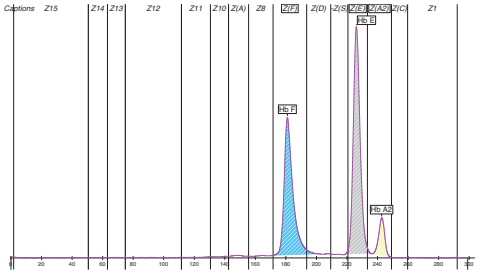

Sang de patient homozygote avec variant Hb E et fraction Hb F élevée
Blood sample from homozygous patient with Hb E variant and elevated Hb F

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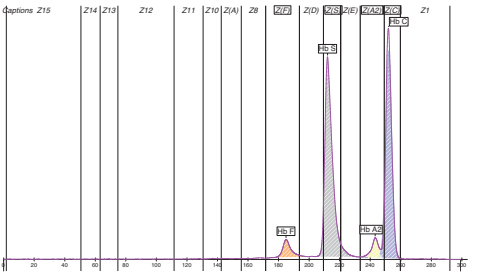

Sang de patient hétérozygote composite avec variants Hb S et Hb C
Blood sample from compound heterozygous patient with Hb S & Hb C variants

FR : Sang de patient homozygote avec variant Hb E et fraction Hb F élevée
GB : Blood sample from homozygous patient with Hb E variant and elevated Hb F
DE : Blutprobe eines homozygoten Patienten mit Hb E-Variante und erhöhtem Hb F
NL : Bloedmonster van homozygote patiënt met Hb E variant en verhoogd Hb F niveau
IT : Sangue di paziente omozigote con variante Hb E e frazione Hb F alta
ES : Sangre de paciente homocigoto con la variante Hb E y la fracción Hb F elevada
PT : Amostra de sangue de doente heterozigótico com variante Hb E e Hb F elevada
SV : Blodprov från heterozygot patient med Hb E variant och förhöjd Hb F
GR : Δείγμα αίματος από ομόζυγο ασθενή με παραλλαγή Hb E και αυξημένο επίπεδο Hb F
HR : Uzorak krvi homozigotnog bolesnika s varijantom Hb E i povišenom vrijednošću Hb F
LT : Homozigotinio paciento kraujo, kuriame yra Hb E varianto ir padidėjęs Hb F kiekis, mėginys
PL : Próbka krwi od homozygotycznego pacjenta z odmianą Hb E i podwyższonym stężeniem Hb F
RO : Probă de sânge de la pacient heterozigot cu varianta Hb E şi Hb F crescută
CS : Uzorak krvi od heterozigotnog pacijenta sa Hb E varijantom i povišenim Hb F
HU : Homozigóta beteg vérmintája Hb E variánssal és emelkedett Hb F-fel
TR : Hb E varyantı ve yüksek Hb F taşıyan homozigot hastasına ait kan numunesi
CZ : Vzorek krve homozygotního pacienta s variantou Hb E a zvýšeným Hb F
BG : Кръвна проба от хомозиготен пациент с Hb E вариант и повишен Hb F
NO : Blodprøve fra homozygot pasient med Hb E variant og forhøyet Hb F
DK : Blodprøve fra homozygot patient med Hb E-variant og forhøjet Hb F
CN : 来自 Hb E 变体和 Hb F 升高杂合患者的血液样品
RU : Образец крови от гомозиготного пациента с вариацией Hb E и повышенным уровнем Hb F
JP : Hb E変異体およびHb Fを含むホモ接合患者からの血液サンプル
LV : Homozigota pacienta asins paraugs ar Hb E variantu un paaugstinātu Hb F līmeni
SK : Vzorka krvi od homozygotného pacienta s variantom Hb E a zvýšenou hladinou Hb F
EE : Vereproov Hb E variandi ja kõrgenenud Hb F-iga heterosügootselt patsiendilt
VN : Mẫu máu của bệnh nhân bị bệnh dị hợp tử với biến thể Hb E và Hb F gia tăng

Sang de patient hétérozygote composite avec variants Hb S et Hb C
Blood sample from compound heterozygous patient with Hb S & Hb C variants
Blutprobe eines compound-heterozygoten Patienten mit Hb S- und Hb C-Varianten
Bloedmonster van samengestelde heterozygote patiënt met Hb S en Hb C varianten
Sangue di paziente eterozigote composto con varianti Hb S e Hb C
Sangre de paciente heterocigoto compuesto con las variantes Hb S y Hb C
Amostra de sangue de doente heterozigótico composto com variantes Hb S e Hb C
Blodprov från förenad heterozygot patient med Hb S & Hb C-varianter
Δείγμα αίματος από σύνθετο ετερόζυγο ασθενή με παραλλαγές Hb S & Hb C
Uzorak krvi složenog heterozigotnog bolesnika s varijantama Hb S i Hb C
Paciento kraujo, kuriame yra heterozigotinių junginių ir Hb S bei Hb C variantų, mėginys
Próbka krwi od heterozygotycznego pacjenta z jednoczesną obecnością odmian Hb S oraz Hb C
Probă de sânge de la pacient heterozigot compus cu variantele Hb S şi Hb C
Uzorak krvi od složenog heterozigotnog pacijenta sa Hb S & Hb C varijantama
Összetett heterozigóta beteg vérmintája Hb S és Hb C variánsokkal
Hb S ve Hb C varyantlarını taşıyan bileşik heterozigot hastasına ait kan numunesi
Vzorek krve sdruženého heterozygotního pacienta s variantami Hb S a Hb C
Кръвна проба от пациент със съставна хетерозиготност с Hb S и Hb C варианти
Blodprøve fra sammensatt heterozygot pasient med Hb S og Hb C-varianter
Blodprøve fra heterozygot patient med Hb S- og Hb C-varianter
来自 Hb S & Hb C 变体杂合患者的血液样品
Образец крови от компаунд-гетерозигота с вариациями Hb S и Hb C
Hb SおよびHb C変異体を含む複合ヘテロ接合患者からの血液サンプル
Kompaunda heterozigota pacienta asins paraugs ar Hb S un Hb C variantu
Vzorka krvi od heterozygotného pacienta s variantmi Hb S a Hb C
Vereproov Hb S ja Hb C variantidega ühend-heterosügootselt patsiendilt
Mẫu máu của bệnh nhân bị bệnh dị hợp tử kép với biến thể Hb S & Hb C

SCHÉMAS / FIGURES

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PROFILS ÉLECTROPHORÉTIQUES - ELECTROPHORETIC PATTERNS

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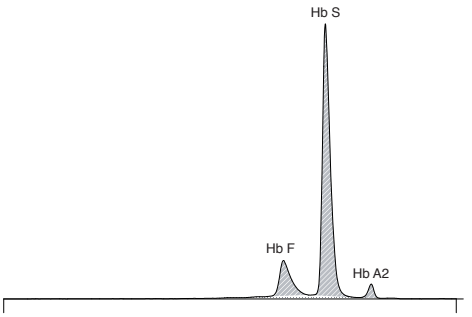

Sang de patient homozygote avec Hb F et variant Hb S
Blood sample from homozygous patient with Hb F and Hb S variant

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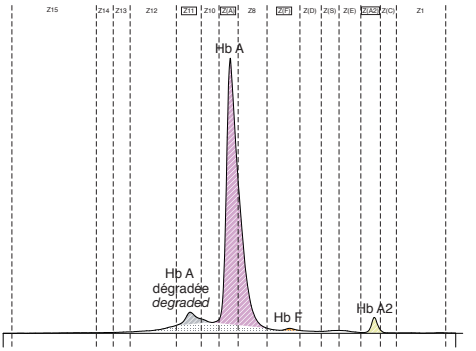

Sang avec Hb A dégradée (Hb A3) et Hb F faible
Blood sample with degraded Hb A (Hb A3) and faint Hb F

FR : Sang de patient homozygote avec Hb F et variant Hb S
GB : Blood sample from homozygous patient with Hb F and Hb S variant
DE : Blutprobe eines homozygoten Patienten mit Hb F- und Hb S-Variante
NL : Bloedmonster van homozygote patiënt met Hb F en Hb S variant
IT : Sangue di paziente omozigote con Hb F e variante Hb S
ES : Sangre de paciente homocigoto con Hb F y la variante Hb S
PT : Amostra de sangue de doente homozigótico com variantes Hb F e Hb S
SV : Blodprov från homozygot patient med Hb F- och Hb S-variant
GR : Δείγμα αίματος από ομόζυγο ασθενή με παραλλαγή Hb F και Hb S
HR : Uzorak krvi homozigotnog bolesnika s varijantama Hb F i Hb S
LT : Homozigotinio paciento kraujo, kuriame yra Hb F bei Hb S variantų, mėginys
PL : Próbka krwi od homozygotycznego pacjenta z odmianą Hb F i Hb S.
RO : Probă de sânge de la pacient heterozigot cu variantele Hb F şi Hb S
CS : Uzorak krvi od heterozigotnog pacijenta sa Hb F i Hb S varijantom
HU : Homozigóta beteg vérmintája Hb F-fel és Hb S variánssal
TR : Hb F ve Hb S varyantlarını taşıyan homozigot hastasına ait kan numunesi
CZ : Vzorek krve homozygotního pacienta s variantami Hb F a Hb S
BG : Кръвна проба от хомозиготен пациент с Hb F и Hb S вариант
NO : Blodprøve fra homozygot pasient med Hb F og Hb S variant
DK : Blodprøve fra heterozygot patient med Hb F- og Hb S-variant
CN : 来自 Hb F 和 Hb S 变体杂合患者的血液样品
RU : Образец крови от гомозиготного пациента с вариациями Hb F и Hb S
JP : Hb FおよびHb S変異体を含むホモ接合患者からの血液サンプル
LV : Heterozigota pacienta asins paraugs ar Hb F un Hb S variantu
SK : Vzorka krvi od homozygotného pacienta s variantmi Hb F a Hb S
EE : Vereproov Hb F ja Hb S variandiga homosügootselt patsiendilt
VN : Mẫu máu của bệnh nhân bị bệnh dị hợp tử với biến Hb thể F và Hb S

Sang avec Hb A dégradée (Hb A3) et Hb F faible
Blood sample with degraded Hb A (Hb A3) and faint Hb F
Blutprobe mit degradiertem Hb A (Hb A3) und schwachem Hb F
Bloedmonster met afgebroken Hb A (Hb A3) and nauwelijks waarneembare Hb F
Sangue con Hb A degradata (Hb A3) e Hb F bassa
Sangre con Hb A degradada (Hb A3) y Hb F débil
Amostra de sangue com Hb A (Hb A3) degradada e Hb F baixa
Blodprov med nedbrutet Hb A (Hb A3) och svagt Hb F
Δείγμα αίματος με αποσυντεθειμένη Hb A (Hb A3) και αμυδρή Hb F
Uzorak krvi s degradiranim Hb A (Hb A3) i slabim Hb F
Kraujo, kuriame yra suskilusio Hb A (Hb A3) ir išblukusio Hb F, mėginys
Próbka krwi z rozłożoną Hb A (Hb A3) i śladową obecnością Hb F
Probă de sânge cu Hb A degradată (Hb A3) şi Hb F slabă
Uzorak krvi sa degradiranim Hb A (Hb A3) i niskim Hb F
Vérminta degradálódott Hb A-val (Hb A3) és halvány Hb F-fel
İndirgenmiş Hb A (Hb A3) ve belirsiz/zayıf Hb F içeren kan numunesi
Vzorek krve s degradovaným Hb A (Hb A3) a slabým Hb F
Кръвна проба с разграден Hb A (Hb A3) и малко количество Hb F
Blodprøve med degradert Hb A (Hb A3) og svakt Hb F
Blodprøve med nedbrudt Hb A (Hb A3) og svag Hb F
Hb A (Hb A3) 降低和Hb F虚弱的血液样品
Образец крови с подвергнувшимся разложению Hb A (Hb A3) и низким Hb F
劣化したHb A (Hb A3) および僅少のHb Fを含む血液サンプル
Asins paraugs ar noārdītu Hb A (Hb A3) un nelielu Hb F daudzumu
Vzorka krvi s degradovaným Hb A (Hb A3) a nevýrazným Hb F
Vereproov lagunenud Hb A (Hb A3) ja ja nõrga Hb F-ga
Mẫu máu có Hb A (Hb A3) suy giảm và Hb F yếu

SCHÉMAS / FIGURES

ABBILDUNGEN - FIGUREN - FIGURE - FIGURAS - BILDER - ΕΙΚΟΝΕΣ - SLIKE - PAVEIKSLAI - RYSUNKI - FIGURI - ÁBRÁK - ŞEKİLLER - OBRÁZKY - ФИГУРИ - FIGURER - 插图 - РИСУНКИ - 図 - CIPARI - JOONISED - SƠ ĐỒ

PROFILS ÉLECTROPHORÉTIQUES - ELECTROPHORETIC PATTERNS

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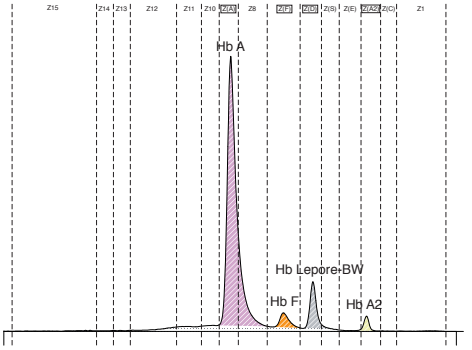

Sang de patient hétérozygote avec variant Hb Lepore-Boston-Washington
Bood sample from heterozygous patient with Hb Lepore-Boston-Washington variant

FR : Sang de patient hétérozygote avec variant Hb Lepore-Boston-Washington
GB : Bood sample from heterozygous patient with Hb Lepore-Boston-Washington variant
DE : Blutprobe eines heterozygoten Patienten mit Hb Lepore-Boston-Washington-Variante
NL : Bloedmonster van heterozygote patiënt met Hb Lepore-Boston-Washington variant
IT : Sangue di paziente eterozigote con variante Hb Lepore-Boston-Washington
ES : Sangre de paciente heterocigoto con la variante Hb Lepore-Boston-Washington
PT : Amostra de sangue de doente heterozigótico com variante Hb Lepore-Boston-Washington
SV : Blodprov från heterozygot patient med Hb Lepore-Boston-Washington-variant
GR : Δείγμα αίματος από ετερόζυγο ασθενή με παραλλαγή Hb Lepore-Boston-Washington
HR : Uzorak krvi heterozigotnog bolesnika s varijantom Hb Lepore-Boston-Washington
LT : Heterozigotinio paciento kraujo, kuriame yra Hb Lepore-Boston-Washington varianto, kraujo méginys
PL : Próbka krwi od heterozygotycznego pacjenta z odmianą Hb Lepore-Boston-Washington
RO : Probă de sânge de la pacient heterozigot cu varianta Hb Lepore-Boston-Washington
CS : Uzorak krvi od heterozigotnog pacijenta sa Hb Lepore-Boston-Washington varijantom
HU : Heterozigóta beteg vérmintája Hb Lepore-Boston-Washington variánssal
TR : Hb Lepore-Boston-Washington varyantı taşıyan heterozigot hastasına ait kan numunesi
CZ : Vzorek krve heterozygotního pacienta s variantou Hb Lepore-Boston-Washington
BG : Кръвна проба от хетерозиготен пациент с Hb Lepore-Boston-Washington вариант
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RU : Образец крови от гетерозиготного пациента с вариацией Hb Lepore-Boston-Washington
JP : Hb Lepore-Boston-Washington変異体を含むヘテロ接合患者からの血液サンプル
LV : Heterozigota pacienta asins paraugs ar Hb Lepore-Boston-Washington variantu
SK : Vzorka krvi od heterozygotného pacienta s variantom Hb Lepore-Boston-Washington
EE : Vereproov Hb Lepore-Boston-Washingtoni variandiga heterosügootselt patsiendilt
VN : Mẫu máu của bệnh nhân bị bệnh dị hợp tử với biến thể Hb Lepore-Boston-Washington

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