



## BeneFIX™

### 1. Name of the Medicinal Product

#### 1.1 Product name

BeneFIX

#### 1.2 Strength

250 IU, 500 IU, 1,000 IU or 2,000 IU in single-use vials

#### 1.3 Pharmaceutical dosage form

Powder and solvent for solution for injection

### 2. Qualitative and Quantitative Composition

#### BeneFIX 250 IU powder and solvent for solution for injection

Each vial contains nominally 250 IU nonacog alfa (recombinant coagulation factor IX). After reconstitution with the accompanying 5 mL (0.234%) sodium chloride solution for injection, each mL of the solution contains approximately 50 IU nonacog alfa.

#### BeneFIX 500 IU powder and solvent for solution for injection

Each vial contains nominally 500 IU nonacog alfa (recombinant coagulation factor IX). After reconstitution with the accompanying 5 mL (0.234%) sodium chloride solution for injection, each mL of the solution contains approximately 100 IU nonacog alfa.

#### BeneFIX 1,000 IU powder and solvent for solution for injection

Each vial contains nominally 1,000 IU nonacog alfa (recombinant coagulation factor IX). After reconstitution with the accompanying 5 mL (0.234%) sodium chloride solution for injection, each mL of the solution contains approximately 200 IU nonacog alfa.

#### BeneFIX 2,000 IU powder and solvent for solution for injection

Each vial contains nominally 2,000 IU nonacog alfa (recombinant coagulation factor IX). After reconstitution with the accompanying 5 mL (0.234%) sodium chloride solution for injection, each mL of the solution contains approximately 400 IU nonacog alfa.

The potency (IU) is determined using the European Pharmacopoeia one-stage clotting assay. The specific activity of BeneFIX is not less than 200 IU/mg protein.

BeneFIX contains recombinant coagulation factor IX, (INN = nonacog alfa). Nonacog alfa is a purified protein that has 415 amino acids in a single chain. It has a primary amino acid sequence that is comparable to the Ala<sup>148</sup> allelic form of plasma-derived factor IX, and some post-translational modifications of the recombinant molecule are different from those of the plasma-derived molecule. Recombinant coagulation factor IX is a glycoprotein that is secreted by genetically engineered mammalian cells derived from a Chinese hamster ovary (CHO) cell line.

For the full list of excipients, see section 6.1.

### **3. Pharmaceutical Form**

Powder and solvent for solution for injection

White/almost white powder and clear and colourless solvent.

### **4. Clinical Particulars**

#### **4.1 Therapeutic indications**

BeneFIX is a human blood coagulation factor indicated in adults and children with hemophilia B (congenital factor IX deficiency or Christmas disease) for:

- On-demand treatment and control of bleeding episodes.
- Perioperative management of bleeding.
- Routine prophylaxis to reduce the frequency of bleeding episodes.

#### Limitations of Use

BeneFIX is not indicated for induction of immune tolerance in patients with hemophilia B.

#### **4.2 Posology and method of administration**

**For intravenous use after reconstitution only.**

- Each vial of BeneFIX has the recombinant Factor IX (rFIX) potency in the International Units (IU) stated on the vial.
- Initiate treatment under the supervision of a physician experienced in the treatment of hemophilia B.
- Dosage and duration of treatment with BeneFIX depend on the severity of the factor IX deficiency, the location and extent of bleeding, and the patient's clinical condition, age and recovery of factor IX.
- Dosing of BeneFIX may differ from that of plasma-derived factor IX products, see section 5. Subjects at the low end of the observed factor IX recovery may require upward dosage adjustment of BeneFIX to as much as two times (2X) the initial empirically calculated dose in order to achieve the intended rise in circulating factor IX activity.
- Monitor patients using a factor IX activity assay to ensure that the desired factor IX activity level has been achieved. Titrate the dose using the factor IX activity, pharmacokinetic parameters, such as half-life and recovery, as well as taking the clinical situation into consideration in order to adjust the dose as appropriate.

## Dose

### Calculating Initial Dose

- Use the following formula to calculate the initial dose of BeneFIX:

number of factor IX IU required (IU)	=	Body weight (kg)	X	Desired factor IX increase (% or IU/dL)	X	reciprocal of observed recovery (IU/kg per IU/dL)*
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### Average Recovery

#### *Adolescents/Adults (≥12 years)*

In adults, on average, one International Unit (IU) of BeneFIX per kilogram of body weight increased the circulating activity of factor IX by  $0.8 \pm 0.2$  IU/dL (range 0.4 to 1.2 IU/dL). Use the following formula to estimate the dose with 0.8 IU/dL average increase of factor IX per IU/kg body weight administered:

$$\text{number of factor IX IU required (IU)} = \text{Body weight (kg)} \times \text{Desired factor IX increase (\% or IU/dL)} \times 1.3 \text{ (IU/kg per IU/dL)*}$$

*Children (<12 years)*

In children, on average, one international unit of BeneFIX per kilogram of body weight increased the circulating activity of factor IX by  $0.7 \pm 0.3$  IU/dL (range 0.2 to 2.1 IU/dL; median of 0.6 IU/dL per IU/kg). Use the following formula to estimate the dose with 0.7 IU/dL average increase of factor IX per IU/kg body weight administered:

$$\text{number of factor IX IU required (IU)} = \text{Body weight (kg)} \times \text{Desired factor IX increase (\% or IU/dL)} \times 1.4 \text{ (IU/kg per IU/dL)*}$$

Doses administered should be titrated to the patient's clinical response. Patients may vary in their pharmacokinetic (e.g., half-life, recovery) and clinical responses to BeneFIX. Although the dose can be estimated by the calculations above, it is highly recommended that, whenever possible, appropriate laboratory tests, including serial factor IX activity assays, be performed.

Dosing for On-demand Treatment and Control of Bleeding Episodes and Perioperative Management

Type of Hemorrhage	Circulating Factor IX Activity Required (% or IU/dL)	Dosing Interval (hours)	Duration of Therapy (days)
<b>Minor</b>			
Uncomplicated hemarthroses, superficial muscle, or soft tissue	20-30	12-24	1-2
<b>Moderate</b>			
Intramuscular or soft tissue with	25-50	12-24	Treat until bleeding stops and healing

Type of Hemorrhage	Circulating Factor IX Activity Required (% or IU/dL)	Dosing Interval (hours)	Duration of Therapy (days)
dissection, mucous membranes, dental extractions, or hematuria			begins; about 2 to 7 days
<b>Major</b> Pharynx, retropharynx, retroperitoneum, CNS, surgery	50-100	12-24	7-10

Adapted from: Roberts and Eberst

### Routine Prophylaxis

For long-term prophylaxis against bleeding, the recommended regimen is 100 IU/kg once weekly. Children (<12 years) have lower recovery, shorter half-life and higher clearance (based on per kg body weight) as compared to adolescents and adults. Adjust the dosing regimen (dose or frequency) based on the patient's clinical response.

### **Preparation and Reconstitution**

The procedures below are provided as general guidelines for the preparation and reconstitution of BeneFIX.

#### Preparation

1. Always wash hands before performing the following procedures.
2. Use aseptic technique (meaning clean and germ-free) during the reconstitution procedure.
3. Use all components in the reconstitution and administration of this product as soon as possible after opening their sterile containers to minimize unnecessary exposure to the atmosphere.
4. Pooling: If needing more than one vial of BeneFIX per infusion, reconstitute each vial according to the following instructions. Remove the diluent syringe leaving the vial adapter in place, and use a separate large luer lock syringe to draw back the reconstituted

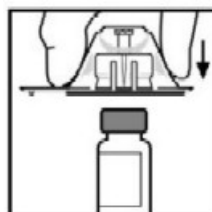
contents of each vial. Do not detach the diluent syringes or the large luer lock syringe until you are ready to attach the large luer lock syringe to the next vial adapter.

### Reconstitution

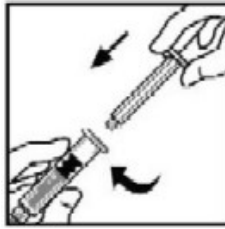
1. If refrigerated, allow the vial of lyophilized BeneFIX and the pre-filled diluent syringe to reach room temperature.
2. Remove the plastic flip-top cap from the BeneFIX vial to expose the central portions of the rubber stopper.



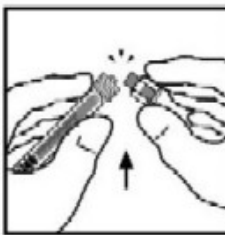
3. Wipe the top of the vial with the alcohol swab provided, or use another antiseptic solution, and allow to dry. After cleaning, do not touch the rubber stopper with your hand or allow it to touch any surface.
4. Peel back the cover from the clear plastic vial adapter package. Do not remove the adapter from the package.
5. Place the vial on a flat surface. While holding the adapter in the package, place the vial adapter over the vial. Press down firmly on the package until the adapter snaps into place on the top of the vial, with the adapter spike penetrating the vial stopper. Leave the adapter package in place.



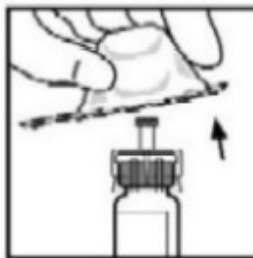
6. Grasp the plunger rod as shown in the diagram. Avoid contact with the shaft of the plunger rod. Attach the threaded end of the plunger rod to the diluent syringe plunger by pushing and turning firmly.



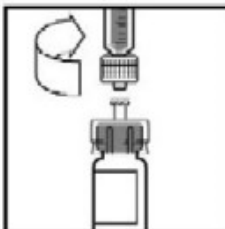
7. Break off the tamper-resistant plastic-tip cap from the diluent syringe by snapping the perforation of the cap. Do not touch the inside of the cap or the syringe tip. The diluent syringe may need to be recapped (if not administering reconstituted BeneFIX immediately), so place the cap on its top on a clean surface in a spot where it would be least likely to become environmentally contaminated.



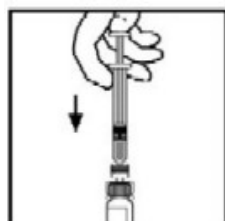
8. Lift the package away from the adapter and discard the package.



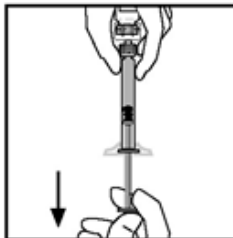
9. Place the vial on a flat surface. Connect the diluent syringe to the vial adapter by inserting the tip into the adapter opening while firmly pushing and turning the syringe clockwise until the connection is secured.



10. Slowly depress the plunger rod to inject all the diluent into the BeneFIX vial.



11. Without removing the syringe, gently swirl the contents of the vial until the powder is dissolved.
12. Invert the vial and slowly draw the solution into the syringe.



13. Detach the syringe from the vial adapter by gently pulling and turning the syringe counter-clockwise. Discard the vial with the adapter attached.
14. The reconstituted solution should be clear and colorless. If it is not, discard and use a new kit. If the solution is not to be used immediately, recap the syringe. Do not touch the syringe tip or the inside of the cap.
15. Store the reconstituted solution at room temperature and use it within 3 hours.

Note: BeneFIX, when reconstituted, contains polysorbate-80, which is known to increase the rate of di-(2-ethylhexyl) phthalate (DEHP) extraction from polyvinyl chloride (PVC). This should be considered during the preparation and administration of BeneFIX, including storage time elapsed in a PVC container following reconstitution. It is important that the recommendations for dosage and administration be followed closely, see section 4.2.

Note: The tubing of the infusion set included with this kit does not contain DEHP.

## **Administration**

### **For intravenous use after reconstitution only.**

**The safety and efficacy of administration by continuous infusion have not been established, see section 4.4.**

- Inspect BeneFIX solution for particulate matter and discoloration prior to administration, whenever solution and container permit.
- Administer BeneFIX using the tubing provided in this kit, and the pre-filled diluent syringe provided, or a single sterile disposable plastic syringe.
- Do not mix or administer BeneFIX in the same tubing or container with other medicinal products.

### Administration

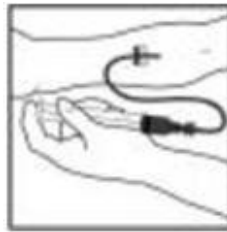
1. Attach the syringe to the luer end of the infusion set tubing provided.



2. Apply a tourniquet and prepare the injections site by wiping the skin well with an alcohol swab provided in the kit.



3. Perform venipuncture. Insert the needle on the infusion set tubing into the vein, and remove the tourniquet. Inject the reconstituted BeneFIX intravenously over several minutes. Adjust the rate of administration based on the patient's comfort level.



Note: Agglutination of red blood cells in the tubing/syringe has been reported with the administration of BeneFIX. No adverse events have been reported in association with this observation. To minimize the possibility of agglutination, it is important to limit the amount of blood entering the tubing. Blood should not enter the syringe. If red blood cell agglutination is observed in the tubing or syringe, discard all material (tubing, syringe and BeneFIX solution) and resume administration with a new package.

4. Following completion of BeneFIX treatment, remove and discard the infusion set. Dispose of all unused solution, empty vial(s), and used needles and syringes in an appropriate container.

#### **4.3 Contraindications**

BeneFIX may be contraindicated in patients with a known history of hypersensitivity to any of the constituents of the preparation or in patients with a known history of hypersensitivity to hamster proteins.

#### **4.4 Special warnings and precautions for use**

## **Hypersensitivity**

Allergic type hypersensitivity reactions, including anaphylaxis, have been reported for all factor IX products, including BeneFIX. Frequently, these events have occurred in close temporal association with the development of factor IX inhibitors. Patients should be informed of the early symptoms and signs of hypersensitivity reactions, including hives, generalized urticaria, chills (rigors), flushing, angioedema, chest tightness, laryngospasm, bronchospasm, dyspnea, wheezing, faintness, hypotension, tachycardia, blurred vision, and anaphylaxis. If allergic or anaphylactic reactions occur, administration of BeneFIX should be stopped immediately, and appropriate medical management should be given, which may include treatment for shock. Patients should be advised to discontinue use of the product and contact their physician and/or seek immediate emergency care, depending on the type/severity of the reaction, if any of these symptoms occur.

Nephrotic syndrome has been reported following immune tolerance induction with factor IX products in hemophilia B patients with factor IX inhibitors and a history of allergic reactions to factor IX. The safety and efficacy of using BeneFIX for immune tolerance induction have not been established.

In case of severe allergic reactions, alternative hemostatic measures should be considered.

## **Activity-neutralizing antibodies (inhibitors)**

Inhibitors have been detected in patients receiving factor IX-containing products. As with all factor IX products, patients using BeneFIX should be monitored for the development of factor IX inhibitors. Patients with factor IX inhibitors may be at an increased risk of anaphylaxis upon subsequent challenge with factor IX. Patients experiencing allergic reactions should be evaluated for the presence of inhibitor. Preliminary information suggests a relationship may exist between the presence of major deletion mutations in a patient's factor IX gene and an increased risk of inhibitor formation and of acute hypersensitivity reactions. Patients known to have major deletion mutations of the factor IX gene should be observed closely for signs and symptoms of acute hypersensitivity reactions, particularly during the early phases of initial exposure to product. In view of the potential for allergic reactions with factor IX concentrates, the initial administrations (approximately 10-20) of factor IX should be performed under medical supervision where proper medical care for allergic reactions could be provided.

## **Thrombosis**

Historically, the administration of factor IX complex concentrates derived from human plasma, containing factors II, VII, IX and X, has been associated with the development of thromboembolic complications. Although BeneFIX contains no coagulation factor other than factor IX, the potential risk of thrombosis and DIC observed with other products containing factor IX should be recognized. Because of the potential risk of thromboembolic complications, caution should be exercised when administering this product to patients with liver disease, to patients post-operatively, to neonates, or to patients at risk of thromboembolic phenomena or DIC.

The safety and efficacy of BeneFIX administration by continuous infusion have not been established. See sections 4.2 and 4.8. There have been post-marketing reports of thrombotic events, including life-threatening superior vena cava (SVC) syndrome in critically ill neonates, while receiving continuous-infusion BeneFIX through a central venous catheter.

In each of these situations, the benefit of treatment with BeneFIX should be weighed against the risk of these complications.

#### **4.5 Interaction with other medicinal products and other forms of interaction**

No interactions of recombinant coagulation factor IX products with other medicinal products are known.

Temporary correction of abnormal partial thromboplastin time (PTT) was observed; no effect on normal PTT was seen.

#### **4.6 Fertility, pregnancy and lactation**

##### **Pregnancy**

Animal reproduction and lactation studies have not been conducted with BeneFIX. There is insufficient experience with the use of factor IX products in pregnant women. Therefore, factor IX should be administered to pregnant women only if clearly indicated.

##### **Lactation**

There is insufficient experience with the use of factor IX products in lactating women. Therefore, factor IX should be administered to lactating women only if clearly indicated.

#### **4.7 Effects on ability to drive and use machines**

On the basis of the pharmacodynamic and pharmacokinetic profile and reported adverse reactions BeneFIX has no or negligible influence on the ability to drive or use machines.

#### 4.8 Undesirable effects

The table below lists adverse reactions reported in the clinical trials of previously treated patients and previously untreated patients and identified in post-marketing use. The frequencies are based on all causality treatment emergent events in pooled clinical trials with 287 subjects.

**Table 2: Adverse Reactions Table**

<b>System Organ Class</b>	<b>Very Common ≥ 1/10</b>	<b>Common ≥ 1/100 to &lt; 1/10</b>	<b>Uncommon ≥ 1/1000 to &lt; 1/100</b>	<b>Frequency not known (cannot be estimated from available data)</b>
Infections and infestations			Infusion-site cellulitis <sup>k</sup>	
Blood and lymphatic system		Factor IX inhibition <sup>c</sup>		
Immune system disorders		Hypersensitivity <sup>d</sup>		Anaphylactic reaction <sup>o</sup>
Nervous system disorders	Headache <sup>a</sup>	Dizziness; dysgeusia	Somnolence; tremor	
Eye disorders			Visual impairment <sup>l</sup>	
Cardiac disorders			Tachycardia <sup>m</sup>	
Vascular disorders		Phlebitis; hypotension <sup>e</sup> ; flushing <sup>f</sup>		Superior vena cava syndrome <sup>o,p</sup> ; deep vein thrombosis <sup>o</sup> ; thrombosis <sup>o</sup> ; thrombophlebitis <sup>o</sup>
Respiratory, thoracic and mediastinal disorders	Cough <sup>b</sup>		Respiratory distress	
Gastrointestinal	Vomiting	Nausea		

<b>System Organ Class</b>	<b>Very Common ≥ 1/10</b>	<b>Common ≥ 1/100 to &lt; 1/10</b>	<b>Uncommon ≥ 1/1000 to &lt; 1/100</b>	<b>Frequency not known (cannot be estimated from available data)</b>
disorders				
Skin and subcutaneous disorders		Rash <sup>g</sup> ; urticaria		
Renal and urinary disorders			Renal infarct <sup>n</sup>	
General disorders and administration site conditions	Pyrexia	Chest discomfort <sup>h</sup> ; infusion-site reaction <sup>j</sup> ; infusion-site pain <sup>i</sup>	Chills	Inadequate therapeutic response <sup>o</sup>
Investigations				Inadequate factor IX recovery <sup>o,q</sup>

<sup>a</sup> including migraine, sinus headache

<sup>b</sup> including productive cough

<sup>c</sup> low-titer transient inhibitor formation and high-titer inhibitor formation

<sup>d</sup> including drug hypersensitivity, angioedema, bronchospasm, wheezing, dyspnoea, and laryngospasm

<sup>e</sup> including blood pressure decreased

<sup>f</sup> including hot flush, feeling hot, skin warm

<sup>g</sup> including rash macular, rash papular, rash maculopapular

<sup>h</sup> including chest pain and chest tightness

<sup>i</sup> including infusion-site pruritus, infusion-site erythema

<sup>j</sup> including injection site pain, infusion-site discomfort

<sup>k</sup> including cellulitis

<sup>l</sup> including scintillating scotoma and blurred vision

<sup>m</sup> including heart rate increased, sinus tachycardia

<sup>n</sup> developed in a hepatitis C antibody-positive patient 12 days after a dose of BeneFIX for a bleeding episode.

<sup>o</sup> ADR identified in post-marketing

<sup>p</sup> superior vena cava (SVC) syndrome in critically ill neonates, while receiving continuous-infusion of BeneFIX through a central venous catheter

<sup>q</sup> This is a verbatim term. No MedDRA 17.1 PT was retrieved.

If any suspected hypersensitivity reaction takes place that is thought to be related to the administration of BeneFIX see sections 4.2 and 4.4.

### **Inhibitor development**

Patients with hemophilia B may develop neutralizing antibodies (inhibitors).

A clinically relevant, low-responding transient inhibitor (maximum titer 1.5 BU) was detected in 1 out of 65 BeneFIX patients (including 9 patients participating only in the surgery study) who had previously received plasma-derived products (PTPs). This patient was able to continue treatment with BeneFIX with no anamnestic rise in inhibitor or anaphylaxis.

From results of the PUP study, 2/63 patients developed inhibitors after 7 and 15 exposure days. Both were high-titer inhibitors. Both patients experienced allergic manifestations in temporal association with their inhibitor development.

### **4.9 Overdose**

No symptoms of overdose have been reported with recombinant coagulation factor IX products.

## **5. Pharmacological Properties**

### **5.1 Pharmacodynamic properties**

Antihemorrhagic: Blood Coagulation Factor IX

ATC Code: B02BD04

### **Mechanism of action**

BeneFIX contains recombinant coagulation factor IX, (nonacog alfa). Recombinant coagulation factor IX is a single chain glycoprotein with an approximate molecular mass of 55,000 Daltons that is a member of the serine protease family of vitamin K-dependent coagulation factors.

Recombinant coagulation factor IX is a recombinant DNA-based protein therapeutic, which has structural and functional characteristics comparable to endogenous factor IX. Factor IX is activated by factor VII/tissue factor complex in the extrinsic pathway as well as factor XIa in the intrinsic coagulation pathway activate factor IX. Activated factor IX, in combination with activated factor VIII, activates factor X. This results ultimately in the conversion of prothrombin to thrombin.

Thrombin then converts fibrinogen into fibrin and a clot can be formed. Factor IX activity is absent or greatly reduced in patients with hemophilia B and substitution therapy may be required.

Hemophilia B is a sex-linked hereditary disorder of blood coagulation due to decreased levels of factor IX and results in profuse bleeding into joints, muscles or internal organs, either spontaneously or as a result of accidental or surgical trauma. By replacement therapy the plasma levels of factor IX is increased, thereby enabling a temporary correction of the factor deficiency and correction of the bleeding tendencies.

### **Clinical trials data on efficacy**

Text below is from studies using Previous Formulation BeneFIX and is also applicable to Reformulated BeneFIX.

In 4 clinical studies of BeneFIX, a total of 128 subjects (56 previously treated patients [PTPs], 9 subjects participating only in the surgical study, and 63 previously untreated patients [PUPs]) received more than 28 million IU administered over a period of up to 64 months. The studies included 121 HIV-negative and 7 HIV-positive subjects.

Fifty-six PTPs received approximately 20.9 million IU of BeneFIX in two clinical studies. The median number of exposure days was 83.5. These PTPs who were treated for bleeding episodes on an on-demand basis or for the prevention of bleeds were followed over a median interval of 24 months (range 1 to 29 months; mean  $23.4 \pm 5.34$  months). Fifty-five of these PTPs received a median of 42.8 IU/kg (range 6.5 to 224.6 IU/kg; mean  $46.6 \pm 23.5$  IU/kg) per infusion for bleeding episodes. All subjects were evaluable for efficacy. One subject discontinued the study after one month of treatment due to bleeding episodes that were difficult to control; he did not have a detectable inhibitor. The subject's dose had not been adequately titrated. The remaining 55 subjects were treated successfully. Bleeding episodes that were managed successfully included hemarthroses and bleeding in soft tissue and muscle. Data concerning the severity of bleeding episodes were not reported. Eighty-eight percent of the total infusions administered for bleeding episodes were rated as providing an "excellent" or "good" response. Eighty-one percent of all bleeding episodes were managed with a single infusion of BeneFIX. One subject developed a low-titer, transient inhibitor (maximum titer 1.5 BU). This subject had previously received plasma-derived products without a history of inhibitor development. He was able to continue treatment with BeneFIX with no anamnestic rise in inhibitor or anaphylaxis; however, increased

frequency of BeneFIX administration was required; subsequently, the subject's factor IX inhibitor and its effect on the half-life of BeneFIX resolved.

Forty-one of the subjects had measurements of fibrinopeptide A and prothrombin fragment 1 + 2 prior to infusion, 4 to 8 hours and then 24 hours following the infusion. Twenty-nine of the subjects had elevations in fibrinopeptide A with a maximum value of 35.3 nmol/L (22 of the 29 subjects had elevated baseline values). Ten of the subjects had elevated prothrombin fragment 1 + 2 with a maximum value of 1.82 nmol/L (3 of the 10 subjects had elevated baseline values).

### **Prophylaxis**

A total of 20 PTPs were treated with BeneFIX for secondary prophylaxis (the regular administration of FIX replacement therapy to prevent bleeding in patients who may have already demonstrated clinical evidence of hemophilic arthropathy or joint disease) at some regular interval during the study with a mean of 2.0 infusions per week. Nineteen subjects were administered BeneFIX for routine secondary prophylaxis (at least twice weekly) for a total of 345 patient-months with a median follow-up period of 24 months per subject. The average dose used by these 19 subjects was 40.3 IU/kg, ranging from 13 to 78 IU/kg. One additional subject was treated weekly, using an average dose of 33.3 IU/kg, over a period of 21 months. Ninety-three percent of the responses were rated as "excellent" or "effective". These 20 PTPs received a total of 2,985 infusions of BeneFIX for routine prophylaxis. Seven of these PTPs experienced a total of 26 spontaneous bleeding episodes within 48 hours after an infusion.

#### Once-weekly 100 IU/kg dosing regimen

In an open-label study of 25 patients (range 12-54 years) comparing on-demand treatment versus prophylaxis when administered at a dose of 100 IU/kg once weekly for approximately 52 weeks, the annualised bleed rate (ABR) for the prophylaxis period was significantly lower ( $p < 0.0001$ ) than the ABR for the on-demand period (mean:  $3.6 \pm 4.6$ , median: 2.0, min-max: 0.0 - 13.8 versus mean:  $32.9 \pm 17.4$ , median: 33.6, min-max: 6.1 - 69.0, respectively). In an open-label crossover study in patients aged 6-64 years, of 100 IU/kg once-weekly (44 patients) and 50 IU/kg twice-weekly (43 patients) with 4-month prophylaxis treatment periods, the ABR for the 100 IU/kg once-weekly prophylaxis period was mean  $4.4 \pm 10.0$  (median 0.0) and mean  $2.8 \pm 5.7$  (median 0.0) for the 50 IU/kg twice-weekly prophylaxis period.

Management of hemostasis was evaluated in the surgical setting. Thirty-six surgical procedures have been performed in 28 subjects. Thirteen (13) minor surgical procedures were performed in



12 subjects, including 7 dental procedures, 1 punch biopsy of the skin, 1 cyst removal, 1 male sterilization, 1 nevus ablation, and 2 ingrown toenail removals. Twenty-three (23) major surgical procedures were performed in 19 subjects, including a liver transplant, splenectomy, 3 inguinal hernia repairs, 11 orthopedic procedures, a calf-debridement and 6 complicated dental extractions.

Twenty-three (23) subjects underwent 27 surgical procedures with a pulse-replacement regimen. The mean perioperative (preoperative and intraoperative) dose for these procedures was  $85 \pm 32.8$  IU/kg (range 25-154.9 IU/kg). The mean total post-operative (inpatient and outpatient) dose was  $63.1 \pm 22.0$  IU/kg (range 28.6-129.0).

Total BeneFIX coverage during the surgical period for the major procedures ranged from 4,230 to 385,800 IU. The pre-operative dose for the major procedures ranged from 75 to 155 IU/kg. Nine of the major surgical procedures were performed in 8 subjects using a continuous infusion regimen. Following pre-operative bolus doses (94.1 -144.5 IU/kg), continuous infusion of BeneFIX was administered at a median rate of 6.7 IU/kg/hr (range of average rates: 4.3-8.6 IU/kg/hr; mean  $6.4 \pm 1.5$  IU/kg/hr) for a median duration of 5 days (range 1-11 days; mean  $4.9 \pm 3.1$ ). Six of the 8 subjects who had received continuous infusion of BeneFIX in conjunction with major surgeries were switched over to intermittent pulse regimens at a median dose of 56.3 IU/kg (range 33.6-89.1 IU/kg; mean  $57.8 \pm 18.1$  IU/kg SD) for a median of 3.5 exposure days (range 1-5 days, mean  $3.3 \pm 1.4$  SD) during the post-operative period. Although circulating factor IX levels targeted to restore and maintain hemostasis were achieved with both pulse replacement and continuous infusion regimens, clinical trial experience with continuous infusion of BeneFIX for surgical prophylaxis in hemophilia B has been too limited to establish the safety and clinical efficacy of administration of the product by continuous infusion. Subjects administered BeneFIX by continuous infusion for surgical prophylaxis also received intermittent bolus infusions of the product.

Among the surgery subjects, the median increase in circulating factor IX activity was 0.7 IU/dL per IU/kg infused (range 0.3-1.2 IU/dL; mean  $0.8 \pm 0.2$  IU/dL per IU/kg). The median elimination half-life for the surgery subjects was 19.4 hours (range 10-37 hours; mean  $21.3 \pm 8.1$  hours).

Hemostasis was maintained throughout the surgical period; however, one subject required evacuation of a surgical wound site hematoma, and another subject who received BeneFIX after a tooth extraction required further surgical intervention due to oozing at the extraction site. There

was no clinical evidence of thrombotic complications in any of the subjects. In seven subjects for whom fibrinopeptide A and prothrombin fragment 1 + 2 were measured pre-infusion, at 4 to 8 hours, and then daily up to 96 hours, there was no evidence of significant increase in coagulation activation. Data from two other subjects were judged to be not evaluable.

Sixty-three PUPs received approximately 6.2 million IU of BeneFIX in an open-label safety and efficacy study over 89 median exposure days. These PUPs were followed over a median interval of 37 months (range 4 to 64 months; mean  $38.1 \pm 16.4$  months). Fifty-four of these PUPs received a median dose of 62.7 IU/kg (range 8.2 to 292.0 IU/kg; mean  $75.6 \pm 42.5$  IU/kg) per infusion for bleeding episodes. Data concerning the severity of bleeding episodes were not reported. Ninety-four percent of the infusions administered to initiate treatment of bleeding were rated as providing “excellent” or “good” response.

Seventy-five percent of all bleeding episodes were managed with a single infusion of BeneFIX. Three of these 54 subjects were not successfully treated, including one episode in a subject due to delayed time to infusion and insufficient dosing, and in 2 subjects due to inhibitor formation. One subject developed a high-titer inhibitor (maximum titer 42 BU) on exposure day 7. A second subject developed a high-titer inhibitor (maximum titer 18 BU) after 15 exposure days. Both subjects experienced allergic manifestations in temporal association with their inhibitor development.

Thirty-two PUPs administered BeneFIX for routine prophylaxis. Twenty-four PUPs administered BeneFIX at least twice weekly for a total of 2,587 infusions. The mean dose per infusion was  $72.5 \pm 37.1$  IU/kg, and the mean duration of prophylaxis was  $13.4 \pm 8.2$  months. Eight PUPs administered BeneFIX once weekly for a total of 571 infusions. The mean dose per infusion was  $75.9 \pm 17.9$  IU/kg, and the mean duration of prophylaxis was  $17.6 \pm 7.4$  months. Five PUPs experienced a total of 6 spontaneous bleeding episodes within 48 hours after an infusion.

Twenty-three PUPs received BeneFIX for surgical prophylaxis in 30 surgical procedures. All surgical procedures were minor, except 2 hernia repairs. The preoperative bolus dose ranged from 32.3 IU/kg to 247.2 IU/kg. The perioperative total dose ranged from 385 to 23,280 IU. Five of the surgical procedures were performed using a continuous infusion regimen over 3 to 5 days. Clinical trial experience with continuous infusion of BeneFIX for surgical prophylaxis in hemophilia B has been too limited to establish the safety and clinical efficacy of administration of the product by continuous infusion.

## Pediatric population

Safety and efficacy have been demonstrated in previously treated and previously untreated pediatric patients. See also section 4.2.

For dosing information regarding use in children, see section 4.2.

## 5.2 Pharmacokinetic properties

A single infusion of BeneFIX in patients (baseline data) with hemophilia B has shown mean  $\pm$  SD recovery values, determined by age,  $0.78 \pm 0.23$  IU/dL/IU/kg (range 0.4 to 1.4 IU/dL per IU/kg) for those  $\geq 15$  years old (n=37), and  $0.68 \pm 0.30$  IU/dL per IU/kg (range 0.18 to 2.08 IU/dL per IU/kg) for those < 15 years old (n=56).

In a randomized, cross-over pharmacokinetic study, BeneFIX reconstituted in 0.234% sodium chloride diluent was shown to be pharmacokinetically equivalent to the previously marketed BeneFIX (reconstituted with Sterile Water for Injection) in 24 PTP patients ( $\geq 12$  years) at a dose of 75 IU/kg. In addition, pharmacokinetic parameters were followed up in 23 of the same PTP after repeated administration of BeneFIX for six months and found to be unchanged compared with those obtained at the initial evaluation. A summary of pharmacokinetic data are presented in Table 3:

**Table 3: Pharmacokinetic Parameter Estimates for BeneFIX (75 IU/kg) at Baseline and Month 6 in Previously Treated Patients with Hemophilia B**

Parameter	Baseline n = 24	Month 6 n = 23
	Mean $\pm$ SD	Mean $\pm$ SD
$C_{max}$ (IU/dL)	54.5 $\pm$ 15.0	57.3 $\pm$ 13.2
$AUC_{\infty}$ (IU·hr/dL)	940 $\pm$ 237	923 $\pm$ 205
$t_{1/2}$ (hr)	22.4 $\pm$ 5.3	23.8 $\pm$ 6.5
CL (mL/hr/kg)	8.47 $\pm$ 2.12	8.54 $\pm$ 2.04
Recovery (IU/dL/IU/kg)	0.73 $\pm$ 0.20	0.76 $\pm$ 0.18

Abbreviations:  $AUC_{\infty}$  = area under the plasma concentration-time curve from time zero to infinity;  $C_{max}$  = peak concentration;  $t_{1/2}$  = plasma elimination half-life; CL = clearance; SD = standard deviation.

A single-dose pharmacokinetic study reported a longer estimate of  $t_{1/2}$  when sample collection to measure factor IX activity (FIX) was extended to 96 hours. A summary of pharmacokinetic data is presented in Table 4.

**Table 4: Pharmacokinetic Parameter Estimates for BeneFIX (50 IU/kg) in Previously Treated Patients with Hemophilia B aged 6 – <12 years and  $\geq$  18 years**

Parameter	6 - < 12 years n = 4	$\geq$ 18 years n = 8
	Mean $\pm$ SD	Mean $\pm$ SD
$C_{max}$ (IU/dL)	39.8 $\pm$ 9.93	42.8 $\pm$ 7.52
$AUC_{\infty}$ (IU·hr/dL)	791 $\pm$ 118	1178 $\pm$ 181
$t_{1/2}$ (hr)	27.9 $\pm$ 4.49	39.6 $\pm$ 7.38
CL (mL/hr/kg)	6.44 $\pm$ 1.03	4.34 $\pm$ 0.655
Recovery (IU/dL per IU/kg)	0.80 $\pm$ 0.20	0.83 $\pm$ 0.15

Abbreviations:  $AUC_{\infty}$  = area under the plasma concentration-time curve from time zero to infinity;  $C_{max}$  = peak concentration;  $t_{1/2}$  = plasma elimination half-life; CL = clearance; SD = standard deviation.

### 5.3 Preclinical safety data

BeneFIX has been shown to be non-mutagenic in the Ames assay and non-clastogenic in a chromosomal aberrations assay. No investigations on carcinogenesis or impairment of fertility have been conducted.

## 6. Pharmaceutical Particulars

### 6.1 List of excipients

#### Powder

Sucrose

Glycine

L-Histidine

Polysorbate 80

Hydrochloric acid

Nitrogen gas

#### Solvent

Sodium chloride solution

## Water for injection

### **6.2 Incompatibilities**

In the absence of incompatibility studies, reconstituted BeneFIX should not be administered in the same tubing or container with other medicinal products. Only the provided infusion set should be used. Treatment failure can occur as a consequence of human coagulation factor IX adsorption to the internal surfaces of some infusion equipment.

### **6.3 Shelf life**

Refer to carton for expiry date.

Product after reconstitution: The product does not contain a preservative and should be used within 3 hours.

### **6.4 Special precautions for storage**

Stored at 2°C to 8°C (Refrigerate) and protect from light for 3 years. Prior to the expiration date, BeneFIX may be stored at or below 30°C, for up to 6 months.

Do not freeze to prevent damage to the diluent syringe

### **6.5 Nature and contents of container**

The drug product is contained in a Type I glass vial with an elastomeric closure.

### **6.6 Special precautions for disposal and other handling**

Freezing should be avoided to prevent damage to the pre-filled diluent syringe. BeneFIX, when reconstituted, contains polysorbate-80, which is known to increase the rate of di-(2-ethylhexyl)phthalate (DEHP) extraction from polyvinyl chloride (PVC). This should be considered during the preparation and administration of BeneFIX, including storage time elapsed in a PVC container following reconstitution. It is important that the recommendations in section 4.2 be followed closely.

Reconstitute lyophilized BeneFIX powder for injection with the supplied diluent (0.234% sodium chloride solution) from the pre-filled syringe provided. Once the diluent has been injected into the vial, gently rotate the vial until all powder is dissolved. After reconstitution, the solution is drawn back into the syringe and infused.

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The solution should be clear and colorless. The solution should be discarded if visible particulate matter or discoloration is observed. The product does not contain a preservative, and the reconstituted solution should be used within 3 hours after reconstitution.

All unused solution, empty vials and used needles and syringes must be discarded in accordance with local requirements.

## **7. Marketing Authorization Holder**

Pfizer (Thailand) Limited

## **8. Marketing Authorization Numbers**

## **9. Date of Authorization**

## **10. Date of Revision of the Text**

11 April 2022

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