

## HIGHLIGHTS OF PRESCRIBING INFORMATION

These highlights do not include all the information needed to use CroFab® safely and effectively. See full prescribing information for CroFab®.

**CroFab® Crotalidae Polyvalent Immune Fab (Ovine)  
For Intravenous Injection Only – Lyophilized Powder for Solution  
Initial U.S. Approval: 2000**

-----RECENT MAJOR CHANGES-----	
Preparation and Administration (2.2)	March 2012
Dosage Forms and Strengths (3)	March 2012
Warnings and Precautions - Mercury Toxicity (5.3)	March 2012
Description (10)	March 2012
Animal Toxicology and/or Pharmacology (12.2)	March 2012

-----INDICATIONS AND USAGE-----  
CroFab® is an antivenin indicated for the management of patients with North American crotalid envenomation. Early use of CroFab® (within 6 hours of snakebite) is advised to prevent clinical deterioration and the occurrence of systemic coagulation abnormalities. (1)

### -----DOSAGE AND ADMINISTRATION-----

#### For intravenous use only

- Initial dose is between 4 and 6 vials followed by repeat 4-6 vial doses as needed to gain initial control of envenomation. After initial control is established, additional 2-vial doses every 6 hours for 18 hours (3 doses) should be administered. (2)
- At the time of administration, each vial of CroFab® should be reconstituted with 18 mL of 0.9% Saline and mixed by continuous manual inversion until no solid material is visible in the vial. Do not shake. The entire dose should then be further diluted in 250 mL of normal saline. Each dose is administered over at least 1 hour by intravenous (IV) infusion. (2)

### -----DOSAGE FORMS AND STRENGTHS-----

CroFab® is available as lyophilized powder. Each vial contains up to 1 gram of total protein, a maximum of 0.03 mg of mercury, and not less than the indicated number of mouse LD<sub>50</sub> neutralizing units:

Snake Species Used for Antivenin Component	Minimum mouse LD <sub>50</sub> Units per vial
C. atrox (Western Diamondback rattlesnake)	1270
C. adamanteus (Eastern Diamondback rattlesnake)	420
C. scutulatus (Mojave rattlesnake)	5570
A. piscivorus (Cottonmouth or Water Moccasin)	780

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## -----CONTRAINDICATIONS-----

CroFab® should not be administered to patients with a known history of hypersensitivity to any of its components, or to papaya or papain unless the benefits outweigh the risks and appropriate management for anaphylactic reactions is readily available. (4)

## -----WARNINGS AND PRECAUTIONS-----

- Patients who experience coagulopathy due to snakebite should be monitored for recurrent coagulopathy for up to 1 week or longer. (5.1)
- Anaphylaxis and hypersensitivity reactions can occur and patients should be monitored closely during treatment. Patients with allergies to papain, chymopapain, other papaya extracts, or the pineapple enzyme bromelain may also be at risk for an allergic reaction to CroFab®. (5.2)
- CroFab® contains mercury in the form of ethyl mercury from thimerosal. The final product contains up to 30 mcg or approximately 0.03 mg of mercury per vial, which amounts to no more than 0.6 mg of mercury per dose (based on the maximum dose of 18 vials studied in clinical trials of CroFab®). (5.3)

## -----ADVERSE REACTIONS-----

The most common adverse events reported in clinical studies were mild or moderate reactions involving the skin and appendages (primarily urticaria, rash or pruritus), which occurred in 14 out of 42 patients. Three patients experienced a serious adverse event. Two patients had a severe allergic reaction (severe hives and a severe rash and pruritus) following treatment. One patient had a recurrent coagulopathy due to envenomation, which required re-hospitalization and additional antivenin administration. One patient discontinued CroFab® therapy due to an allergic reaction. (6.1)

To report SUSPECTED ADVERSE REACTIONS, contact 1-877-377-3784 or FDA at 1-800-FDA-1088 or [www.fda.gov/medwatch](http://www.fda.gov/medwatch).

## -----USE IN SPECIFIC POPULATIONS-----

- Pregnancy: No human or animal data. Use only if clearly needed. (8.1)
- Specific studies in pediatric patients have not been conducted. (8.3)

See 16 for PATIENT COUNSELING INFORMATION

Revised: March 2012

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## FULL PRESCRIBING INFORMATION: CONTENTS\*

### 1 INDICATIONS AND USAGE

CroFab<sup>®</sup> is indicated for the management of patients with North American crotalid envenomation (see [Table 5 in Clinical Studies section \(13\) for definitions](#)). The term crotalid is used to describe the Crotalinae subfamily (formerly known as Crotalidae) of venomous snakes which includes rattlesnakes, copperheads and cottonmouths/water moccasins. Early use of CroFab<sup>®</sup> (within 6 hours of snakebite) is advised to prevent clinical deterioration and the occurrence of systemic coagulation abnormalities.

### 2 DOSAGE AND ADMINISTRATION For Intravenous Use after Reconstitution

#### 2.1 Dosage

- Antivenin dosage requirements are contingent upon an individual patient's response; however, based on clinical experience with CroFab<sup>®</sup>, the recommended initial dose is 4 to 6 vials.
- Administration of antivenin should be initiated as soon as possible after crotalid snakebite in patients who develop signs of progressive envenomation (e.g., worsening local injury, coagulation abnormality, or systemic signs of envenomation). CroFab<sup>®</sup> was shown in the clinical studies to be effective when given within 6 hours of snakebite.
- The patient should be observed for up to 1 hour following the completion of this first dose to determine if initial control of the envenomation has been achieved (as defined by complete arrest of local manifestations, and return of coagulation tests and systemic signs to normal). If initial control is not achieved by the first dose, an additional dose of 4 to 6 vials should be repeated until initial control of the envenomation syndrome has been achieved.
- After initial control has been established, additional 2-vial doses of CroFab<sup>®</sup> every 6 hours for up to 18 hours (3 doses) is recommended. Optimal dosing following the 18-hour scheduled dose of CroFab<sup>®</sup> has not been determined. Additional 2-vial doses may be administered as deemed necessary by the treating physician, based on the patient's clinical course.
- Additional Patient Care (Supportive and Adjunctive Therapy):* Supportive measures are often utilized to treat certain manifestations of crotalid snake envenomation, such as pain, swelling, hypotension, and wound infection. Poison control centers are a helpful resource for individual treatment advice.

#### 2.2 Preparation and Administration

- Parenteral drug products should be inspected visually for particulate matter and discoloration prior to administration, whenever solution and container permit.
- Each vial of CroFab<sup>®</sup> should be reconstituted with 18 mL of 0.9% Saline (diluent not included) and mixed by continuous manual inversion until no solid material is visible in the vial. Do not shake. The contents of all of the reconstituted vials should be further diluted in 250 mL of 0.9% Sodium Chloride USP and mixed by gentle swirling.
- The initial dose of CroFab<sup>®</sup> diluted in 250 mL of saline should be infused intravenously over 60 minutes. However, the infusion should proceed slowly over the first 10 minutes at a 25- 50 mL/hour rate with careful observation for any allergic reaction. If no such reaction occurs, the infusion rate may be increased to the full 250 mL/hour rate until completion. Close patient monitoring is necessary.
- The reconstituted and diluted product should be used within 4 hours.

### 3 DOSAGE FORMS AND STRENGTHS

CroFab<sup>®</sup> is supplied as a sterile, nonpyrogenic, purified, lyophilized powder. Each vial contains up to 1 gram of total protein, a maximum of 0.03 mg of mercury, and not less than the indicated number of mouse LD<sub>50</sub> neutralizing units\*:

Snake Species Used for Antivenin Component	Minimum mouse LD <sub>50</sub> Units per vial
C. atrox (Western Diamondback rattlesnake)	1270
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C. scutulatus (Mojave rattlesnake)	5570
A. piscivorus (Cottonmouth or Water Moccasin)	780

\* As of 2008, the potency assay has been optimized for a new strain of mice, which has resulted in changes to the minimum mouse LD<sub>50</sub> neutralizing units. These changes do not reflect any change in product potency, but only a different biological response of the mouse strain to the venom.

### 4 CONTRAINDICATIONS

CroFab<sup>®</sup> should not be administered to patients with a known history of hypersensitivity to papaya or papain unless the benefits outweigh the risks and appropriate management for anaphylactic reactions is readily available.

### 5 WARNINGS AND PRECAUTIONS

#### 5.1 Coagulopathy

Coagulopathy is a complication noted in many victims of viper envenomation that arises due to the ability of the snake venom to interfere with the blood coagulation cascade [4, 8, 9], and is seen more frequently in severely envenomated patients. In clinical trials with CroFab<sup>®</sup>, recurrent coagulopathy (the return of a coagulation abnormality after it has been successfully treated with antivenin), characterized by decreased fibrinogen, decreased platelets, and elevated prothrombin time, occurred in approximately half of patients studied. The clinical significance of these recurrent abnormalities is not known. Recurrent coagulation abnormalities were observed only in patients who experienced coagulation abnormalities during their initial hospitalization, although coagulopathy can initially appear at any time before, during or after treatment. Optimal dosing to completely prevent recurrent coagulopathy has not been determined. Because CroFab<sup>®</sup> has a shorter persistence in the blood than crotalid venoms that can leak from depot sites over a prolonged period of time, repeat dosing to prevent or treat such recurrence may be necessary (see [Dosage and Administration \(2\)](#)).

Recurrent coagulopathy may persist for 1 to 2 weeks or more. Patients who experience coagulopathy due to snakebite during hospitalization for initial treatment should be monitored for signs and symptoms of recurrent coagulopathy for up to 1 week or longer at the physician's discretion. During this period, the physician should carefully assess the need for re-treatment with CroFab<sup>®</sup> and use of any type of anticoagulant or anti-platelet drug.

Because snake envenomation can cause coagulation abnormalities, the following conditions, which are also associated with coagulation defects, should be considered: cancer, collagen disease, congestive heart failure, diarrhea, elevated temperature, hepatic disorders, hyperthyroidism, poor nutritional state, steatorrhea, vitamin K deficiency.

#### 5.2 Hypersensitivity Reactions

Severe hypersensitivity reactions may occur with CroFab<sup>®</sup>. In case of acute hypersensitivity reactions, including anaphylaxis and anaphylactoid reactions, discontinue infusion and institute appropriated emergency treatment.

CroFab<sup>®</sup> contains purified immunoglobulin fragments from the blood of sheep that have been immunized with snake venoms (see [10 Description](#)). Injection of heterologous animal proteins can cause severe acute and delayed hypersensitivity reactions (late serum reaction or serum sickness) and a possible febrile response to immune complexes formed by animal antibodies and neutralized venom components [10].

Papain is used to cleave antibodies into fragments during the processing of CroFab<sup>®</sup>, and trace amounts of papain or inactivated papain residues may be present. Patients allergic to papain, chymopapain, other papaya extracts, or the pineapple enzyme bromelain may also have an allergic reaction to CroFab<sup>®</sup>. Some dust mite allergens and some latex allergens share antigenic structures with papain and patients with these allergies may be allergic to papain.

The following precautions should be used to manage hypersensitivity reactions:

Emergency medical care (e.g., epinephrine, intravenous antihistamines and/or albuterol) should be readily available.

Carefully monitored patients for signs and symptoms of an acute allergic reaction (e.g., urticaria, pruritus, erythema, angioedema, bronchospasm with wheezing or cough, stridor, laryngeal edema, hypotension, tachycardia).

Follow-up all patients for signs and symptoms of delayed allergic reactions or serum sickness (e.g., rash, fever, myalgia, arthralgia).

It has been noted in the literature with the use of other antibody therapies, that reactions during the infusion, such as fever, low back pain, wheezing and nausea are often related to the rate of infusion and can be controlled by decreasing the rate of administration of the solution [11].

Patients who receive a course of treatment with a foreign protein such as CroFab<sup>®</sup> may become sensitized to it. Therefore, caution should be used when administering a repeat course of treatment with CroFab<sup>®</sup> for a subsequent envenomation episode.

Skin testing has not been used in clinical trials of CroFab<sup>®</sup> and is not required.

### 5.3 Mercury Toxicity

The final product contains up to 30 mcg or approximately 0.03 mg of mercury per vial, which amounts to no more than 0.6 mg of mercury per dose (based on the maximum dose of 18 vials studied in clinical trials of CroFab<sup>®</sup>). While there are no definitive data on the toxicity of ethyl mercury, literature suggests that information related to methyl mercury toxicities may be applicable.

## 6 ADVERSE REACTIONS

### 6.1 Clinical Trials Experience

Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in clinical practice.

- The most common adverse events reported in the clinical studies were urticaria and rash. Adverse events involving the skin and appendages (primarily rash, urticaria, and pruritus) were reported in 14 of the 42 patients (Table 1).
- Of the 25 patients who experienced adverse reactions, 3 patients experienced severe or serious adverse reactions.
  - The 1 patient who experienced a serious adverse event had a recurrent coagulopathy due to envenomation, which required re-hospitalization and additional antivenin administration. This patient eventually made a complete recovery.
  - The other 2 had severe adverse reactions that consisted of 1 patient who developed severe hives following treatment and 1 patient who developed a severe rash and pruritus several days following treatment. Both patients recovered following treatment with antihistamines and prednisone.
- One patient discontinued CroFab<sup>®</sup> therapy due to an allergic reaction.

**Table 1 Incidence of Clinical Adverse Events in Studies of CroFab<sup>®</sup> by Body System**

Adverse Events	n=42* Number of Events
<i>Body as a Whole</i>	
Back pain	2
Chest pain	1
Cellulitis	1
Wound infection	1
Chills	1
Allergic reaction†	1
Serum sickness	1
<i>Skin and Appendages</i>	
Urticaria	7
Rash	5
Pruritus	3
Subcutaneous nodule	1
<i>Cardiovascular System</i>	
Hypotension	1
<i>Respiratory System</i>	
Asthma	1
Cough	1
Increased sputum	1
<i>Digestive System</i>	
Nausea	3
Anorexia	1
<i>Hematologic/Lymphatic</i>	
Coagulation disorder	3
Ecchymosis	1
<i>Musculoskeletal</i>	
Myalgia	1
<i>Nervous System</i>	
Circumoral paresthesia	1
General paresthesia	1
Nervousness	1

\* Of the 42 patients receiving CroFab<sup>®</sup> in the clinical studies, 25 experienced an adverse event. A total of 40 adverse events was experienced by these 25 patients.

† Allergic reaction consisted of urticaria, dyspnea and wheezing in 1 patient.

In the 42 patients treated with CroFab<sup>®</sup> for minimal or moderate crotalid envenomations, there were 7 events classified as early serum reactions and 5 events classified as late serum reactions, and none were serious (Table 2). In the clinical studies, serum reactions consisted mainly of urticaria and rash, and all patients recovered without sequelae.

**Table 2 Incidence of Early and Late Serum Reactions (Reactions Associated with CroFab® Infusion)**

	n=42* Number of Events
<i>Early Serum Reactions</i>	
Urticaria	5
Cough	1
Allergic reaction**	1
<i>Late Serum Reactions</i>	
Rash	2
Pruritus	1
Urticaria	1
Serum sickness†	1

\* 6 of 42 patients experienced an adverse event associated with an early serum reaction and 4 experienced an adverse event associated with a late serum reaction. Two additional patients were considered to have a late serum reaction by the investigator, although no associated adverse event was reported.

\*\* Allergic reaction consisted of urticaria, dyspnea and wheezing in 1 patient.

† Serum sickness consisted of severe rash and pruritus in 1 patient.

## 6.2 Post-marketing Experience

The following adverse reactions have been identified during the post approval use of CroFab®. Because these reactions are reported voluntarily from a population of uncertain size, it is not always possible to reliably estimate their frequency or establish a causal relationship to product exposure:

- Acute allergic reactions including anaphylaxis or anaphylactoid type reactions during or shortly following CroFab® infusion, manifested by one or more of the following: anxiety, bronchospasm, chills, edema, fever, hypotension, pruritus, rash, urticaria, voice alteration, and/or wheezing
- Delayed allergic reaction manifested by fever, pruritus and/or rash
- Delayed or recurrent coagulopathy or thrombocytopenia
- Failure to achieve initial control
- Recurrent swelling refractory to treatment
- Thrombocytopenia refractory to treatment
- Prolonged hospitalization
- Bleeding
- Nausea
- Tremor
- Worsening eye sight
- Treatment failure resulting in death

A retrospective study of data collected by the Rocky Mountain Poison and Drug Center for post-marketing use of CroFab® was conducted (13.2).

- There were a total of 36 immediate adverse drug reactions reported in 6.1% (15/247) of patients in the post-marketing retrospective study, including one patient in the severely envenomated group (3.6%, n = 28) and 13 patients in the mild/moderate severity group (7.2%, n = 181) (not significantly different rates).
  - There were 11 immediate serious adverse events related to CroFab® administration reported in four patients. The events included two episodes each of hypotension and tongue swelling, and one episode each of chest discomfort, angioedema, bronchospasm, wheezing, tracheal edema, dyspnea, and lip swelling.
  - There were 22 immediate non-serious adverse events related to CroFab® administration reported in 12 patients. The events included four episodes each of rash and pruritus, three episodes of urticaria, and one episode each of tachycardia, tachypnea, erythema, swelling, hyperhidrosis, dizziness, headache, musculoskeletal chest pain, chills, feeling cold, and nervousness.

- Delayed hypersensitivity reactions were reported for two patients. In one patient the symptoms occurred 6 days post-dosing, were not serious, and described as hives, itching and epigastric pressure. In the second patient symptoms were not described in the medical records and were therefore not captured in this study.
- Recurrent coagulopathy developed in 5 severely envenomated patients and in 6 mild/moderate envenomated patients. In addition, 7 mild/moderate patients experienced delayed-onset coagulopathy. One severely envenomated patient with recurrent coagulopathy experienced medically significant bleeding.

## Additional Published Clinical Studies Experience

From a literature review of nine publications on CroFab® containing patient exposure data, 15 of 313 (4.8%) patients receiving CroFab® experienced acute hypersensitivity reactions.

The most common signs and symptoms associated with these reactions were rash (10 patients) and wheezing (3 patients). Most reactions were mild, resolved after antihistamine therapy, and did not require discontinuation of antivenom therapy. No patient developed a life-threatening hypersensitivity reaction, required intubation, suffered lasting ill-effect, or died as a result of CroFab® administration.

Follow up data (minimum of six days after treatment) were available in 94 of the 313 patients and delayed hypersensitivity reactions were reported in 10 cases. The most common signs and symptoms of delayed hypersensitivity were rash (9 patients) and fever (3 patients). Most were mild and treated with antihistamines and steroids.

## 7 DRUG INTERACTIONS

Studies of drug interactions have not been conducted with CroFab®.

## 8 USE IN SPECIFIC POPULATIONS

### 8.1 Pregnancy

Pregnancy Category C. Animal reproduction studies have not been conducted with CroFab®. It is also not known whether CroFab® can cause fetal harm when administered to a pregnant woman or can affect reproduction capacity. CroFab® should be given to a pregnant woman only if clearly needed.

**CroFab® contains mercury in the form of ethyl mercury from thimerosal (see Warnings and Precautions, Mercury (5.3)). Although there are limited toxicology data on ethyl mercury, high dose and acute exposures to methyl mercury have been associated with neurological and renal toxicities. Developing fetuses and very young children are most susceptible and therefore, at greater risk**

### 8.2 Nursing Mothers

It is not known whether CroFab® is excreted in human breast milk. Because many drugs are excreted in human milk, caution should be exercised when CroFab® is administered to a nursing woman.

### 8.3 Pediatric Use

Specific studies in pediatric patients have not been conducted. Limited clinical experience has not shown that a dosage adjustment for age should be made.

**CroFab® contains mercury in the form of ethyl mercury from thimerosal (see Warnings and Precautions, Mercury (5.3)). Although there are limited toxicology data on ethyl mercury, high dose and acute exposures to methyl mercury have been associated with neurological and renal toxicities. Developing fetuses and very young children are most susceptible and therefore, at greater risk.**

### 8.4 Geriatric Use

Specific studies in elderly patients have not been conducted.

## 9 OVERDOSAGE

The maximum amount of CroFab<sup>®</sup> that can safely be administered in single or multiple doses has not been determined. Doses of up to 18 vials (approximately 13.5 g of protein) have been administered without any observed direct toxic effect.

## 10 DESCRIPTION

CroFab<sup>®</sup> [Crotalidae Polyvalent Immune Fab (Ovine)] is a sterile, nonpyrogenic, purified, lyophilized preparation of ovine Fab (monovalent) immunoglobulin fragments obtained from the blood of healthy sheep flocks immunized with one of the following North American snake venoms: *Crotalus atrox* (Western Diamondback rattlesnake), *Crotalus adamanteus* (Eastern Diamondback rattlesnake), *Crotalus scutulatus* (Mojave rattlesnake), and *Agkistrodon piscivorus* (Cottonmouth or Water Moccasin). To obtain the final antivenin product, the four different monospecific antivenins are mixed. Each monospecific antivenin is prepared by fractionating the immunoglobulin from the ovine serum, digesting it with papain, and isolating the venom specific Fab fragments on ion exchange and affinity chromatography columns.

CroFab<sup>®</sup> is standardized by its ability to neutralize the lethal action of each of the four venom immunogens following intravenous injection in mice. The potency of the product will vary from batch to batch; however, a minimum number of mouse LD<sub>50</sub> neutralizing units against each of the four venoms is included in every vial of final product, as shown in Table 3.

**Table 3 Minimum Mouse LD<sub>50</sub> Neutralizing Units<sup>1</sup> for Each Venom Component**

Venom	Minimum Potency per Vial of CroFab <sup>®2</sup>
<i>Crotalus atrox</i>	≥ 1270
<i>Crotalus adamanteus</i>	≥ 420
<i>Crotalus scutulatus</i>	≥ 5570
<i>Agkistrodon piscivorus</i>	≥ 780

<sup>1</sup> One neutralizing unit is determined as the amount of the mixed monospecific Fab proteins necessary to neutralize one LD<sub>50</sub> of each of the four venoms, where the LD<sub>50</sub> is the amount of venom that would be lethal in 50% of mice.

<sup>2</sup> As of 2008, the potency assay has been optimized for a new strain of mice, which has resulted in changes to the minimum mouse LD<sub>50</sub> neutralizing units. These changes do not reflect any change in product potency, but only a different biological response of the mouse strain to the venom.

Each vial of CroFab<sup>®</sup> contains up to 1 g of total protein and sodium phosphate buffer consisting of dibasic sodium phosphate USP and sodium chloride USP. Thimerosal is used as a preservative in the manufacturing process, and as such, mercury is carried over into the final product at an amount no greater than 30 mcg per vial, which amounts to no more than 0.6 mg of mercury per dose (based on the maximum dose of 18 vials used in clinical studies of CroFab<sup>®</sup>). The product is intended for intravenous administration after reconstitution with 18 mL of 0.9% Saline.

## 11 CLINICAL PHARMACOLOGY

### 11.1 Mechanism of Action

CroFab<sup>®</sup> is a venom-specific Fab fragment of immunoglobulin G (IgG) that works by binding and neutralizing venom toxins, facilitating their redistribution away from target tissues and their elimination from the body.

### 11.2 Pharmacokinetics

The pharmacokinetic study of CroFab<sup>®</sup> was not adequately performed. A limited number of samples were collected from three patients. Based on these data, estimates of elimination half-life were made. The elimination half life for total Fab ranged from approximately 12 to 23 hours. These limited pharmacokinetic estimates of half-life are augmented by data obtained with an analogous ovine Fab product produced by Protherics Inc. using a similar production process. In that study, 8 healthy subjects were given 1 mg of intravenous digoxin followed by an approximately equimolar neutralizing dose of 76 mg of digoxin immune Fab (ovine). Total Fab was shown to have a volume of distribution of 0.3 L/kg, a systemic clearance of 32 mL/min (approximately 0.4 mL/min/kg) and an elimination half-life of approximately 15 hours.

## 12 NONCLINICAL TOXICOLOGY

### 12.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

Animal carcinogenicity and reproduction studies have not been conducted with CroFab<sup>®</sup>.

### 12.2 Animal Toxicology and/or Pharmacology

CroFab<sup>®</sup> was effective in neutralizing the venoms of 10 clinically important North American crotalid snakes in a murine lethality model (see Table 4 [1]). In addition, preliminary data from experiments in mice using whole IgG from the sheep immunized for CroFab<sup>®</sup> production suggest that CroFab<sup>®</sup> might possess antigenic cross-reactivity against the venoms of some Middle Eastern and North African snakes, however, there are no clinical data available to confirm these findings.

**Table 4 Average ED<sub>50</sub> Values for CroFab<sup>®</sup> in Mice**

Study Objective & Design	Endpoint Measured	Major Findings and Conclusions																				
To determine the cross-neutralizing ability of CroFab <sup>®</sup> to protect mice from the lethal effects of venom from clinically important species.	ED <sub>50</sub> for each venom	(Note: Lower numbers represent increased potency against venoms listed)																				
		<table border="0"> <tr> <td>Challenge Venom</td> <td>ED<sub>50</sub></td> </tr> <tr> <td><i>C. atrox</i></td> <td>3</td> </tr> <tr> <td><i>C. adamanteus</i></td> <td>18</td> </tr> <tr> <td><i>C. scutulatus</i></td> <td>18</td> </tr> <tr> <td><i>A. piscivorus</i></td> <td>4</td> </tr> <tr> <td><i>C. h. atricaudatus</i></td> <td>11</td> </tr> <tr> <td><i>C. v. helleri</i></td> <td>6</td> </tr> <tr> <td><i>C. m. molossus</i></td> <td>5</td> </tr> <tr> <td><i>A. c. contortrix</i></td> <td>8</td> </tr> <tr> <td><i>S. m. barbouri</i></td> <td>12</td> </tr> <tr> <td><i>C. h. horridus</i></td> <td>6</td> </tr> </table>	Challenge Venom	ED <sub>50</sub>	<i>C. atrox</i>	3	<i>C. adamanteus</i>	18	<i>C. scutulatus</i>	18	<i>A. piscivorus</i>	4	<i>C. h. atricaudatus</i>	11	<i>C. v. helleri</i>	6	<i>C. m. molossus</i>	5	<i>A. c. contortrix</i>	8	<i>S. m. barbouri</i>	12
Challenge Venom	ED <sub>50</sub>																					
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Separate groups of mice were injected with increasing doses of CroFab <sup>®</sup> pre-mixed with two LD <sub>50</sub> of each venom tested.		Based on data from studies in mice, CroFab <sup>®</sup> has relatively good cross-protection against venoms not used in the immunization of flocks used to produce it. For <i>C. v. helleri</i> and <i>C. m. molossus</i> , higher doses may be required based on historical data.																				



### 13 CLINICAL STUDIES

No clinical studies have been conducted comparing CroFab® with other antivenins, therefore, no comparisons can be made between CroFab® and other antivenins.

#### 13.1 Pre-marketing Studies

Two prospective clinical trials using CroFab® have been conducted. They were prospectively defined, open label, multi-center trials conducted in otherwise healthy patients 11 years of age or older who had suffered from minimal or moderate (as defined in Table 5) North American crotalid envenomation that showed evidence of progression. Progression was defined as the worsening of any evaluation parameter used in the grading of an envenomation: local injury, laboratory abnormality or symptoms and signs attributable to crotalid snake venom poisoning. Both clinical trials excluded patients with Copperhead envenomation.

**Table 5 Definition of Minimal, Moderate, and Severe Envenomation in Clinical Studies of CroFab®**

Envenomation Category	Definition
Minimal	<u>Swelling, pain, and ecchymosis</u> limited to the immediate bite site; <u>Systemic signs and symptoms</u> absent; <u>Coagulation parameters</u> normal with no clinical evidence of bleeding.
Moderate	<u>Swelling, pain, and ecchymosis</u> involving less than a full extremity or, if bite was sustained on the trunk, head or neck, extending less than 50 cm; <u>Systemic signs and symptoms</u> may be present but not life threatening, including but not limited to nausea, vomiting, oral paresthesia or unusual tastes, mild hypotension (systolic blood pressure >90 mmHg), mild tachycardia (heart rate <150), and tachypnea; <u>Coagulation parameters</u> may be abnormal, but no clinical evidence of bleeding present. Minor hematuria, gum bleeding and nosebleeds are allowed if they are not considered severe in the investigator's judgment.
Severe	<u>Swelling, pain, and ecchymosis</u> involving more than an entire extremity or threatening the airway; <u>Systemic signs and symptoms</u> are markedly abnormal, including severe alteration of mental status, severe hypotension, severe tachycardia, tachypnea, or respiratory insufficiency; <u>Coagulation parameters</u> are abnormal, with serious bleeding or severe threat of bleeding.

In both clinical studies, efficacy was determined using a Snakebite Severity Score (SSS) [2] (referred to as the efficacy score or ES in these clinical studies) and an investigator's clinical assessment (ICA) of efficacy. The SSS (referred to as the ES) is a tool used to measure the severity of envenomation based on six body categories: local wound (e.g., pain, swelling and ecchymosis), pulmonary, cardiovascular, gastrointestinal, hematological, and nervous system effects. A higher score indicates worse symptoms. In a retrospective study using medical records of 108 snakebite victims [2], the SSS has been shown to correlate well with physicians' assessment of the patient's condition at presentation (Pearson correlation coefficient:  $r=0.63$ ,  $p<0.0001$ ) and when the patient's condition was at its worst ( $r=0.70$ ,  $p<0.0001$ ). In this study, the condition of 87/108 patients worsened during hospitalization. Changes in the physicians' assessment of condition correlated well with changes in SSS. CroFab® was required to prevent an increase in the ES in order to demonstrate efficacy.

The ICA was based on the investigator's clinical judgment as to whether the patient had a:

- Clinical response (pre-treatment signs and symptoms of envenomation were arrested or improved after treatment)
- Partial response (signs and symptoms of envenomation worsened, but at a slower rate than expected after treatment)
- Non-response (the patient's condition was not favorably affected by the treatment).

Safety was assessed by monitoring for early allergic events, such as anaphylaxis and early serum reactions during CroFab® infusion, and late events, such as late serum reactions.

#### TA001:

In the first clinical study of CroFab®, 11 patients received an intravenous dose of 4 vials of CroFab® over 60 minutes. An additional 4-vial dose of CroFab® was administered after completion of the first CroFab® infusion, if deemed necessary by the investigator. At the 1-hour assessment, 10 out of 11 patients had no change or a decrease in their ES. Ten of 11 patients were also judged to have a clinical response by the ICA. Several patients, after initial clinical response, subsequently required additional vials of CroFab® to stem progressive or recurrent symptoms and signs. No patient in this first study experienced an anaphylactic or anaphylactoid response or evidence of an early or late serum reaction as a result of administration of CroFab®.

#### TA002:

Based on observations from the first study, the second clinical study of CroFab® compared two different dosage schedules. Patients were given an initial intravenous dose of 6 vials of CroFab® with an option to retreat with an additional 6 vials, if needed, to achieve initial control of the envenomation syndrome. Initial control was defined as complete arrest of local manifestations, and return of coagulation tests and systemic signs to normal. Once initial control was achieved, patients were randomized to receive additional CroFab® either every 6 hours for 18 hours (Scheduled Group) or as needed (PRN Group).

In this trial, CroFab® was administered safely to 31 patients with minimal or moderate crotalid envenomation. All 31 patients enrolled in the study achieved initial control of their envenomation with CroFab®, and 30, 25 and 26 of the 31 patients achieved a clinical response based on the ICA at 1, 6 and 12 hours respectively following initial control. Additionally, the mean ES was significantly decreased across the patient groups by the 12-hour evaluation time point ( $p=0.05$  for the Scheduled Group;  $p=0.05$  for the PRN Group) (see Table 6). There was no statistically significant difference between the Scheduled Group and the PRN Group with regard to the decrease in ES.

**Table 6 Summary of Patient Efficacy Scores for Scheduled and PRN Groups**

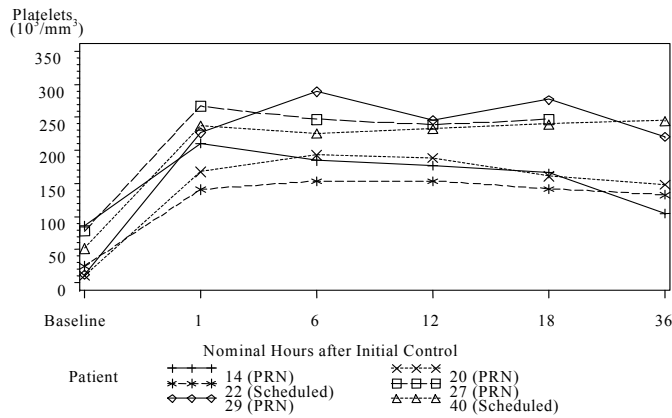
Time Period	Scheduled Group (n=15) Efficacy Score* Mean ± SD	PRN Group (n=16) Efficacy Score* Mean ± SD
Baseline	4.0 ± 1.3	4.7 ± 2.5
End of Initial Control Antivenin Infusion(s)	3.2 ± 1.4	3.3 ± 1.3
1 hour after Initial Control achieved	3.1 ± 1.3	3.2 ± 0.9
6 hours after Initial Control achieved	2.6 ± 1.5	2.6 ± 1.3
12 hours after Initial Control achieved	2.4 ± 1.1**	2.4 ± 1.2**

\* No change or a decline in the Efficacy Score was considered an indication of clinical response and a sign of efficacy.

\*\* For both the Scheduled and the PRN Groups, differences in the Efficacy Score at the four post-baseline assessment times were statistically decreased from baseline by Friedman's test ( $p < 0.001$ ).

In published literature accounts of rattlesnake bites, it has been noted that a decrease in platelets can accompany moderately severe envenomation, which whole blood transfusions could not correct [3]. These platelet count decreases have been observed to last for many hours and often several days following the venomous bite [3, 4, 5]. In this clinical study, 6 patients had pre-dosing platelet counts below 100,000/mm<sup>3</sup> (baseline average of 44,000/mm<sup>3</sup>). Of note, the platelet counts for all 6 patients increased to normal levels (average 209,000/mm<sup>3</sup>) at 1 hour following initial control dosing with CroFab<sup>®</sup> (see Figure 1).

**Figure 1 Graph of Platelet Counts from Baseline to 36 Hours for Patients with Counts <100,000/mm<sup>3</sup> at Baseline (Study TAb002)**



Although there was no significant difference in the decrease in ES between the two treatment groups, the data suggest that Scheduled dosing may provide better control of envenomation symptoms caused by the continued leaking of venom from depot sites. Scheduled patients experienced a lower incidence of coagulation abnormalities at follow up compared with PRN patients (see Table 7 and Figure 2). In addition, the need to administer additional CroFab<sup>®</sup> to patients in the PRN Group after initial control suggests that there is a continued need for antivenin for adequate treatment.

**Table 7 Lower Incidence of Recurrence of Coagulopathies at Follow-Up in Scheduled and PRN Dosing Groups**

	Scheduled Group (n=14)* (percent of patients with abnormal values)^	PRN Group (n=16) (percent of patients with abnormal values)^
<b>Platelet</b>	2/14 (14%)**	9/16 (56%)**
<b>Fibrinogen</b>	2/14 (14%)	7/16 (44%)

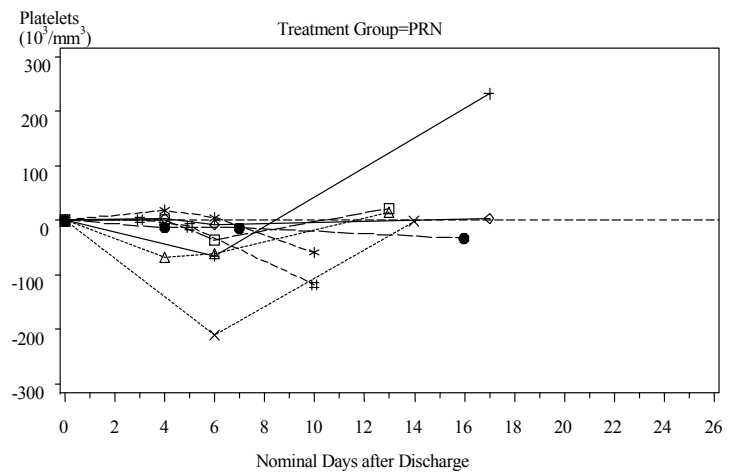
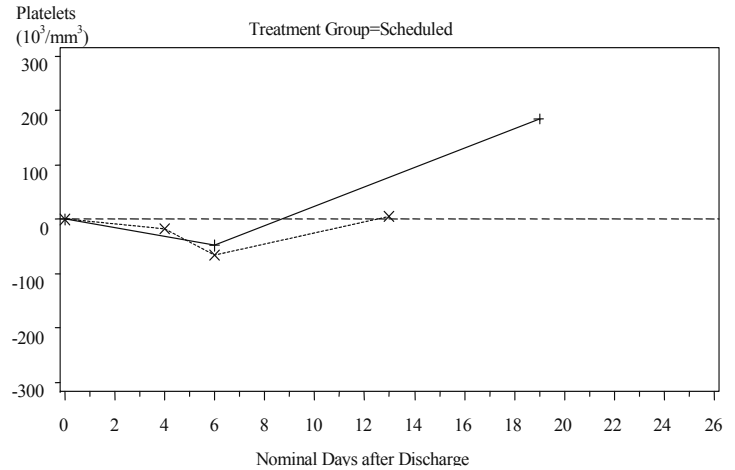
^ Numbers are expressed as percent of patients that had a follow-up platelet count that was less than the count at hospital discharge, or a fibrinogen level less than 50% of the level at hospital discharge.

\* Follow-up data not available for one patient.

\*\* Statistically significant difference, p=0.04 by Fisher's Exact test.

**Figure 2 Change in Platelet Counts in Individual Patients between Follow-Up Visits and Discharge**

Patients in the Scheduled and PRN Groups are plotted separately. More patients in the PRN Group showed a reduction in platelet count after discharge than in the Scheduled Group. Only patients showing a reduced platelet count after discharge are shown.



### 13.2 Post-marketing Studies

Following marketing approval of CroFab<sup>®</sup> a retrospective study was conducted to assess the efficacy of CroFab<sup>®</sup> in severe envenomation. This study was a multi-center retrospective chart review of medical records of snakebite patients treated with CroFab<sup>®</sup> and compared treatment and outcomes of severe envenomations to those of mild and moderate envenomations. The primary efficacy variable was severity of envenomation as determined by a 7-point severity score. Patients were classified as having mild, moderate, or severe envenomation based on their scores just prior to receiving antivenom. Those subjects with a severity score of 5 or 6 at the start of antivenom therapy were *a priori* defined as severe envenomations; those with a score of 3 or 4 were defined as moderate envenomations, and those with a score of 1 or 2 were defined as mild envenomations (see Table 5). A total of 247 patients of all severities were included in the study. Patients with enough data to determine baseline severity were included in the efficacy evaluation; this comprised a cohort of 209 patients, of which 28 were classified as severe.

Improvement in the severity score was observed in all 28 severely envenomated patients. Improvement was noted in every one of the severe venom effects studied, including limb pain and swelling, cardiovascular, respiratory, gastrointestinal and neurologic effects, as well as coagulopathy/defibrination syndrome, thrombocytopenia, and significant/spontaneous bleeding. The median dose of CroFab® administered to control these severe venom effects was 9.0 vials (median of 2.0 doses). Initial control of envenomation was achieved in 57% (16/28) of severely envenomated patients and 87% (158/181) of mild/moderate envenomated patients. In both groups failure to achieve initial control was most commonly attributable to persistent coagulopathy and/or thrombocytopenia, although medically significant bleeding has been reported (occurring in only 1 severe patient that did not reach initial control). All 12 severe patients who did not reach initial control received only one bolus dose of 4 to 6 vials to try to achieve initial control of envenomation. Of the 23 mild/moderate cases who did not reach initial control, 19 did not follow recommended dosing for number of doses and vials. Whether initial control could have been achieved with larger initial doses of antivenom cannot be determined from this retrospective study. All patients, whether they achieved initial control or not, experienced significant improvement of venom effects and decreased severity scores after receiving CroFab®. Among the patients with severe envenomation who did not achieve initial control, the median severity score improved from 5.0 (range: 5.0 – 6.0) before CroFab® administration to 2.0 (range: 1.0 – 4.0) at the last loading dose. No patient in this analysis had a severity score greater than 3.0 at the time of final clinical assessment.

#### 14 REFERENCES

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#### 15 HOW SUPPLIED/STORAGE AND HANDLING

CroFab® is supplied as a carton that contains 2 vials of product (diluent not included). Each vial of CroFab® contains up to 1 gram of lyophilized total protein and not less than the indicated number of mouse LD<sub>50</sub> neutralizing units:

Snake Species Used for Antivenin Component	Minimum mouse LD <sub>50</sub> Units per vial
<i>C. atrox</i> (Western Diamondback rattlesnake)	1270
<i>C. adamanteus</i> (Eastern Diamondback rattlesnake)	420
<i>C. scutulatus</i> (Mojave rattlesnake)	5570
<i>A. piscivorus</i> (Cottonmouth or Water Moccasin)	780

NDC 50633-110-12

- Store at 2° to 8°C (36° to 46°F).
- Do not freeze.
- Use within 4 hours after reconstitution.

#### 16 PATIENT COUNSELING INFORMATION

- Advise patients to contact their physician immediately if they experience unusual bruising or bleeding (e.g., nosebleeds, excessive bleeding after brushing teeth, the appearance of blood in stools or urine, excessive menstrual bleeding, petechiae, excessive bruising or persistent oozing from superficial injuries) after hospital discharge.
  - Such bruising or bleeding may occur for up to 1 week or longer following initial treatment.
- Advise patients to contact their physician immediately if they experience any signs and symptoms of delayed allergic reactions or serum sickness (e.g., rash, pruritus, urticaria) after hospital discharge.

#### Rx only

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West Conshohocken, PA 19428

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Revised March 2012

P11012C

