

# Smallpox Vaccination

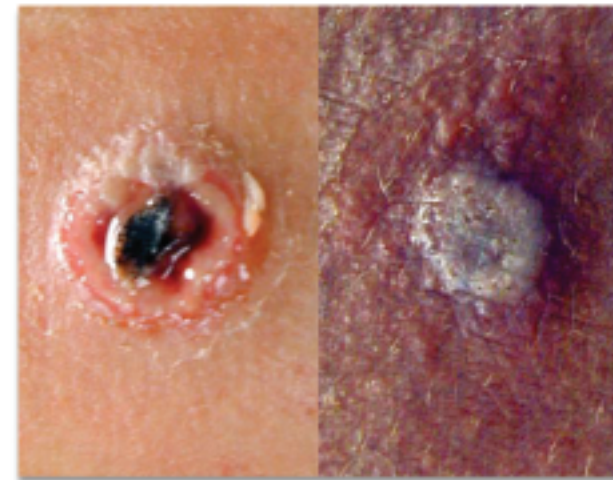
## Vaccination Method & Reactions

Because routine smallpox vaccination ceased 30 years ago, many clinicians are unacquainted with the vaccinia (smallpox) vaccine.

This pocket guide provides health care personnel with concise information on the vaccine, method of vaccination and the nature of the expected responses to vaccination. Additional in-depth information is available by visiting:

[www.bt.cdc.gov/agent/smallpox](http://www.bt.cdc.gov/agent/smallpox)

The guide also includes images and text to help differentiate the more common, self-limiting adverse reactions of vaccination from those that are serious and may require intervention.



## About the Vaccine/Contraindications

### About the Vaccine

The vaccinia (smallpox) vaccine is a live virus that multiplies in the superficial layers of the skin. It does not contain variola virus, the virus that causes smallpox. A successful vaccination is often referred to as a "take."

Two vaccine types will be used in the coming years:

1. Calf-lymph vaccine: Dryvax (Wyeth and Aventis)
2. Tissue culture cell vaccine (Acambis/Baxter)

### Immunity

Primary vaccination Fades after 5 years, after 20 years probably negligible

Revaccination Found to persist 30+ years (1)

Vaccination after exposure to smallpox  
Within 2-3 days, can protect against smallpox  
Within 4-5 days, may protect against a fatal outcome

(1) May protect against a fatal outcome, but not against developing a milder form of smallpox

### Contraindications for Vaccinees & Their Close Physical Contacts (E.g., Household Members)

- Pregnancy
- Immunodeficiencies
- Extensive skin diseases (1)
- Immunosuppressive therapies (2)
- Inflammatory eye diseases (3)
- Atopic dermatitis (eczema); present, past, or "healed"
- Vaccine component allergy (4)
- Breastfeeding (5)
- Less than 12 months of age (5)

(1) E.g., acne, burns, wounds, recent incisions, impetigo, contact dermatitis

(2) E.g., cancer therapy, organ transplants, other conditions with therapy

(3) Only in vaccinee with eye disease or on steroid eye therapy

(4) Vaccinee (only) allergy to Dryvax component: polymyxin B sulfate, streptomycin sulfate, chlortetracycline hydrochloride, neomycin sulfate

(5) Only in vaccinee

### Smallpox Outbreak

In the event of a smallpox outbreak, those who normally would have a contraindication for vaccination, but who are at risk of exposure to smallpox, would be offered the vaccination.

## Vaccination Method

### Recommended Vaccination Method

Multiple puncture vaccination on the deltoid area of the upper arm, using an individually wrapped, sterile, bifurcated needle.



### Step-by-Step Instructions

1. NO alcohol: vaccination will be inhibited. No skin preparation is required prior to vaccination.
2. Dip needle in vaccine vial; a minute drop is retained.
3. Make 3 or 15 (see package insert) perpendicular insertions within a 5-mm diameter area.  
NOTE: Strokes should be vigorous enough to evoke a trace of blood after 15-30 seconds.
4. Absorb excess vaccine with sterile gauze and discard gauze in a biohazard waste receptacle.
5. Cover site with sterile gauze (loosely taped).
6. Prevent contact transmission.

Unlike other immunizations, smallpox vaccination is characterized by a virus that propagates in the skin and can potentially contaminate the vaccinee's hands or the skin and mucosa of others with whom the vaccinee comes into contact.

Caution vaccinee and/or guardian (until scab has fallen off on its own) to:

- Keep the vaccination site covered
- Do not touch, scratch or rub the site, even though it is itchy
- Avoid person-to-person contact with susceptible individuals (see contraindications)
- Avoid touching, rubbing or any other maneuvers that might transfer vaccinia virus to the eye or surrounding skin
- Discard used gauze safely in a sealed plastic bag
- After handling used gauze, thoroughly wash hands

Health care worker caution: Treat contaminated materials as infectious waste. At work, cover gauze bandage with semipermeable dressing and pay strict attention to hand hygiene.



Dip Needle

Retained Vaccine



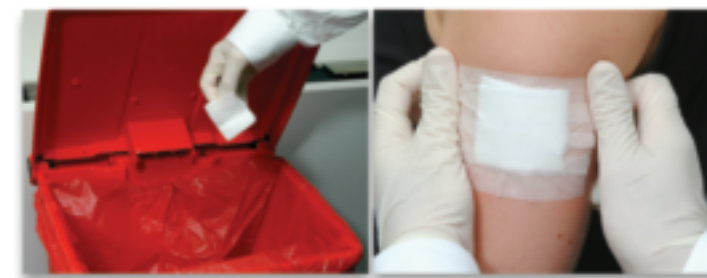
Proper Position

3 or 15 Insertions



Post-insertion

Absorb Excess



Discard Properly

Sterile Cover

## Normal Primary Vaccination

### Normal Reaction Timeline

Day	Description
0	Vaccination
3-4	Papule
5-6	Vesicle with surrounding erythema -> vesicle with depressed center
8-9	Well-formed pustule
12+	Pustule crusts over -> scab
17-21	Scab detaches revealing scar

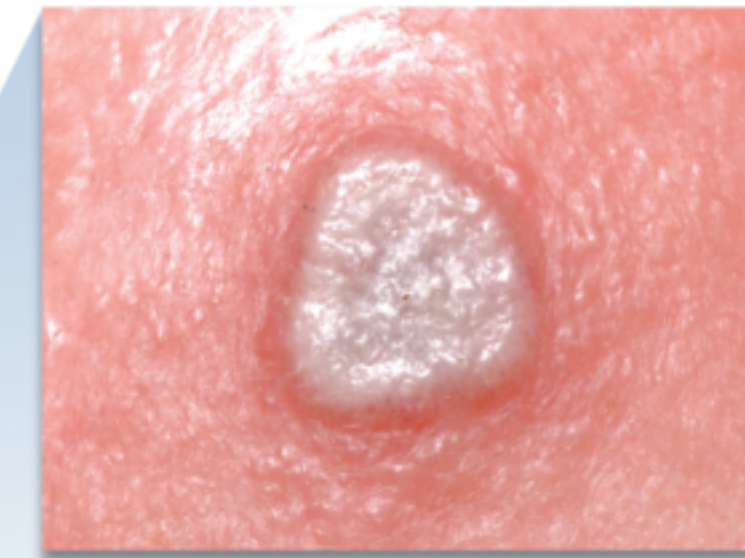
### No Reaction

A non-reaction means no immunity and vaccination must be repeated.

### Systemic Symptoms

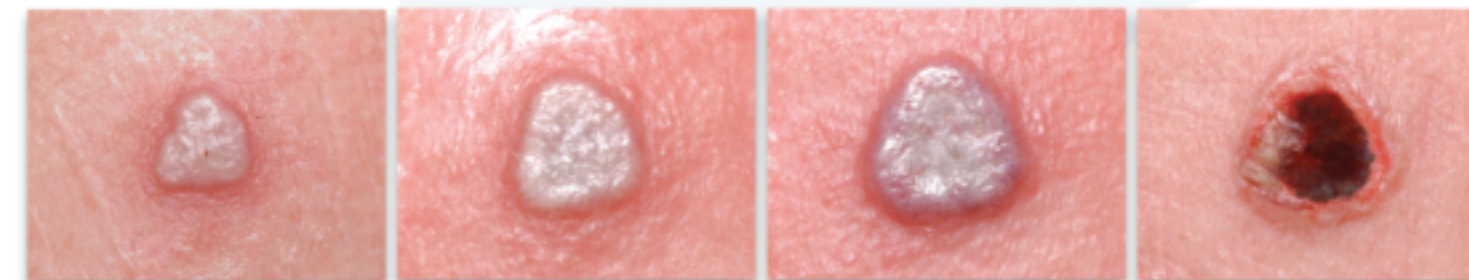
Approximately one week after vaccination:

- Fever
- Malaise
- Myalgia
- Soreness at the vaccination site
- Local lymphadenopathy
- Intense erythema ringing the vaccination



Day 8

Most vaccinees experience only a mild fever and local discomfort with localized redness and swelling.

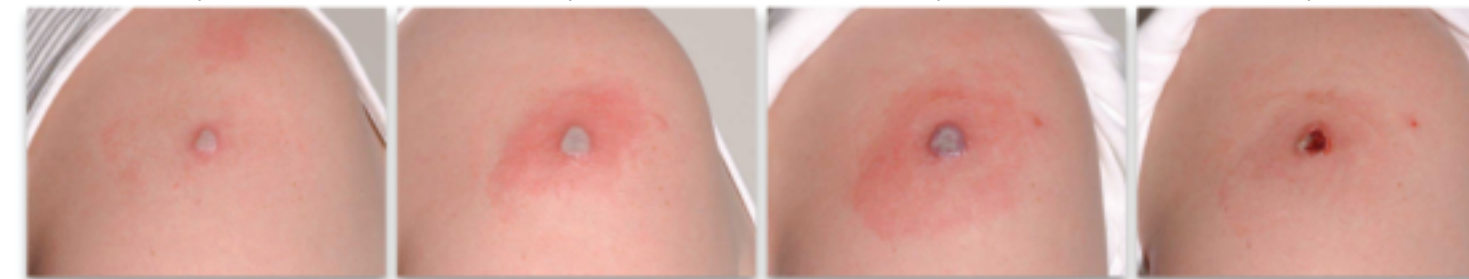


Day 6

Day 8

Day 10

Day 14



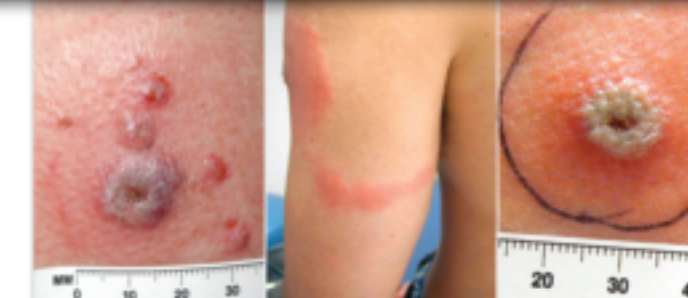
Day 6

Day 8

Day 10

Day 14

## Normal Variants/Revaccination



Satellite Lesions

Lymphangitis

Edema

### Normal Variants

Normal variants (rate: 2.4% - 6.6%) are NOT adverse events and require no specific treatment. They include:

- Satellite lesions
- Lymphangitis from the site to regional nodes
- Regional lymphadenopathy
- Considerable local edema at the site
- Intense erythema (viral cellulitis)

### Revaccination

Potential revaccination responses:

Response	Description
Typical primary reaction	Clear-cut pustule 6-8 days after vaccination

Major reaction Area of definite induration or congestion surrounding a central lesion that may be a scab or ulcer 6-8 days after vaccination. The evolution of the lesion is more rapid than following a primary reaction.

Equivocal reaction Any other reaction or response; E.g., an "allergic" reaction (revaccination is indicated) or no reaction (revaccination is indicated)

If a patient has never had a successful take, the patient should be informed that he/she is almost certainly NOT immune.

## Vaccinia Immune Globulin (VIG)

Vaccinia Immune Globulin (VIG) was produced in the 1960's from plasma obtained from recently vaccinated donors and was administered intramuscularly (IM-VIG). Recently, intravenous VIG (IV-VIG) has also been produced.

Vials of IM-VIG and IV-VIG are stored at the CDC and are available only under IND protocols.

### VIG Administration

#### Indicated

- Accidental implantation (extensive lesions)
- Eczema vaccinatum
- Generalized vaccinia (if severe or recurrent)
- Progressive vaccinia

#### Not Recommended

- Accidental implantation (mild instances)
- Generalized vaccinia (mild or limited - most instances)
- Erythema multiforme
- Vaccinia keratitis (see back of guide for details)
- Post-vaccinial encephalitis

### Dosage

The usual dose of IM-VIG is 0.6 ml/kg body weight. As much as 1-10 ml/kg body weight has been used in serious, life-threatening complications.

To calculate the weight-based dose of IV-VIG, refer to the IND protocol or package insert that accompanies the IV-VIG product. Repeated doses may be necessary to fully treat adverse events such as eczema vaccinatum or progressive vaccinia that present with more severe clinical manifestations.

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## ADVERSE REACTIONS

### Adverse Reactions: **Accidental Implantation**



### Adverse Reactions: **Bacterial Infections**



### Adverse Reactions: **Eczema Vaccinatum**



### Adverse Reactions: **Erythema Multiforme**



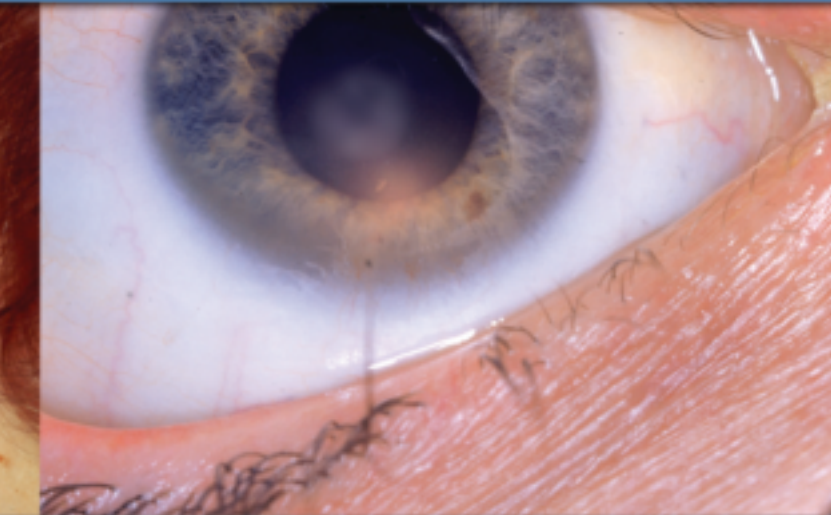
### Adverse Reactions: **Generalized Vaccinia**



### Adverse Reactions: **Progressive Vaccinia**



### Adverse Reactions: **Vaccinia Keratitis**



#### **Smallpox (vaccinia) vaccination is a generally safe, effective preventative against smallpox.**

Some individuals may experience an adverse event; many are harmless, a few are mild to moderate and require specific treatment, and rarely, more serious adverse events occur in susceptible individuals.

#### **Reporting Adverse Events**

To report adverse events or request consultation about an adverse event, please call your state or local public health authorities.

#### **Accidental Administration**

Occasionally, an individual may ingest vaccine accidentally or may be injected inadvertently by the intramuscular or subcutaneous route. These are not recommended routes of administration. It is prudent to follow the individual clinically and to examine the administration site for a vaccination lesion. **Severity:** Benign **Frequency:** Rare

#### **Post-Vaccinial Encephalitis**

Post-vaccinial encephalitis is a rare complication of primary vaccination (15/million). Encephalitis occurs 10-14 days after vaccination with headache, vomiting, drowsiness and fever as the first symptoms. In severe cases life-threatening complications can develop.

**Severity:** Severe - hospitalize **Frequency:** Rare

#### **Accidental Implantation**

Accidental implantation by autoinoculation or contact is one of the most common adverse events. Although no age group is spared, infants and children are most susceptible to more extensive inoculations because of their tendency to scratch an itching vaccination site.

This surface virus is easily transferred to the hands and to fomites. Either may be the source of inoculation elsewhere, but most implantations occur as a result of transfer from hand to skin or to mucosa.

Lesions follow the same course as the primary vaccination, except in patients with cell-mediated immune dysfunction where each lesion progresses without an inflammatory response, does not heal, and expands.

If there are only one or a few lesions, no specific treatment is required. Multiple lesions, especially if they are confluent and cover large portions of the body warrant treatment with Vaccinia Immune Globulin (VIG).

**Severity:** Mild to severe - hospitalize severe

**Frequency:** Common

**VIG:** Indicated with extensive lesions

Not recommended for mild instances

#### **Bacterial Infections**

Bacterial infections of the vaccination site are not common. Children are at greater risk as they may manipulate the site more often and contaminate the vaccination. Occlusive dressings may lead to maceration and increased risk of infection.

The most common organisms are Staphylococcus aureus and Group A Beta Hemolytic Streptococci. Anaerobic organisms occasionally infect the site. Impetiginous vesiculo-pustular lesions are seen in staph infection and piled-up eschar formation is common in streptococcal infections, although lesions identical to the staph infections also occur. Mixed infections may be encountered.

Bacterial cultures should be obtained from the site by swabbing or aspiration.

Treatment is with antibiotics specific to the agent. Initial treatment should anticipate staphylococcal and streptococcal etiology.

**Severity:** Mild

**Frequency:** Unknown

**VIG:** Not recommended

#### **Eczema Vaccinatum**

Individuals with eczema (i.e., atopic dermatitis), active or healed, are at special risk from implantation of vaccinia virus into the diseased skin, sometimes with a fatal outcome.

Transfer of vaccinia virus can occur from autoinoculation or from contact with a vaccinee whose lesion is in the florid stages. Because most individuals have large contiguous patches of skin in the affected areas, confluent lesions are the rule (on the face and limbs primarily).

Diagnosis may be more difficult in contact cases, because history of contact with a vaccinee may be unknown or unappreciated as to risk.

With early recognition and prompt treatment with Vaccinia Immune Globulin (VIG), mortality can be reduced to zero, and morbidity alleviated. Scarring may be extensive.

**Severity:** Severe, especially if untreated

**Frequency:** Somewhat common

**VIG:** Indicated

#### **Erythema Multiforme**

Toxic and/or hypersensitivity rashes are common 1-2 weeks after vaccination. The rash varies from erythematous macular lesions, to vesicles, urticaria, pustules and typical bulls-eye lesions, all under the rubric "erythema multiforme". These are benign lesions that do not progress. Itching may accompany the rash. The most serious reaction, Stevens-Johnson Syndrome (SJS) is rare.

Diagnosis is by typical rash seen in temporal association with primary vaccination. In the vesicular and pustular forms it is necessary to distinguish these from generalized vaccinia or inoculation vaccinia. The vesicles and pustules in erythema multiforme do not progress into typical vaccinations and usually can be distinguished on this basis.

Treatment is symptomatic, usually employing an anti-histamine and measures to counteract itching, if present. Mucosal involvement and evolution into SJS requires hospitalization and supportive care.

**Severity:** Benign

(exception: Stevens-Johnson Syndrome (SJS) - severe)

**Frequency:** Most common (exception: SJS - rare)

**VIG:** Not recommended

#### **Generalized Vaccinia**

Generalized vaccinia is rare, usually benign, and the result of viremia. Within a week, lesions appear on any part of the body (most often on the trunk and abdomen, less commonly on the face, limbs, palms and soles). Lesions undergo rapid evolution to scarring. Rarely, lesions may recur at 4-6 week intervals for as long as one year.

Subtle minor immunologic abnormalities, particularly of the immunoglobulin B-cell system, are suspected to be present. Differentiate from erythema multiforme, eczema vaccinatum, progressive vaccinia, severe chickenpox and smallpox. Consultation with an immunologist is strongly recommended.

Most instances of generalized vaccinia, particularly if the lesions are few, require no specific therapy. In some cases, with extensive lesions, or in recurrent disease, Vaccinia Immune Globulin (VIG) should be administered.

**Severity:** Benign, avoid hospitalization

(exception: recurrent generalized vaccinia - hospitalize)

**Frequency:** Rare

(exception: recurrent generalized vaccinia - very rare)

**VIG:** Indicated (if severe or recurrent)

Not recommended (if mild or limited - most instances)

#### **Progressive Vaccinia**

Progressive vaccinia is a rare complication occurring primarily in T-cell deficient persons. Congenital T-cell deficient children, those with T-cell deficient diseases (cancer, immunosuppressive therapy, HIV/AIDS) are at risk.

The primary vaccination fails to heal and spreads locally and by viremia to other parts of the body; each lesion spreads without inflammatory response. Untreated patients succumb to viral effect or to secondary fungal, parasitic or bacterial infections.

Complications include septic shock, disseminated intravascular coagulation, and superimposed microbial infections. If viable lymphocytes are administered, the patient may experience graft-versus-host disease.

Viral and immunologic laboratory investigation is mandatory. Therapy consists of intensive administration of antibody, usually in the form of Vaccinia Immune Globulin (VIG).

**Severity:** Severe - hospitalize

**Frequency:** Rare

**VIG:** Indicated

#### **Vaccinia Keratitis**

Although rare, vaccinia virus can be implanted into the periorbital structures and even into the cornea. Viral replication and the immune response lead to ulceration with subsequent corneal scarring or clouding.

Ten days after inoculation the clinical signs appear; a central, grayish, disciform corneal lesion is most common. Topical antiviral agents are the treatment of choice in consultation with an experienced ophthalmologist.

Vaccinia Immune Globulin (VIG) is not recommended for vaccinia keratitis, but should be given if it occurs as part of a life-threatening complication, such as eczema vaccinatum or progressive vaccinia, in which case it must be administered. In instances of severe periorbital disease accompanied by keratitis, VIG is not recommended, but some experts believe that it can be administered in a single dose at 0.6 ml/kg, or at most two such doses.

**Severity:** Severe if untreated

**Frequency:** Rare

**VIG:** Not recommended as noted above, consult with

CDC for up-to-date information