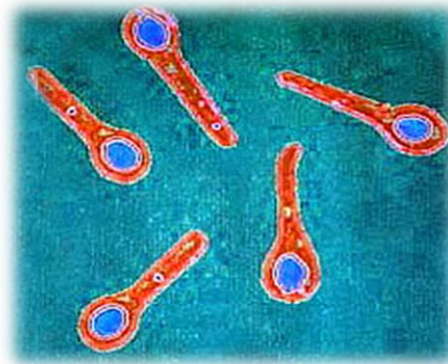


TETANUS

Dr.T.V.Rao MD

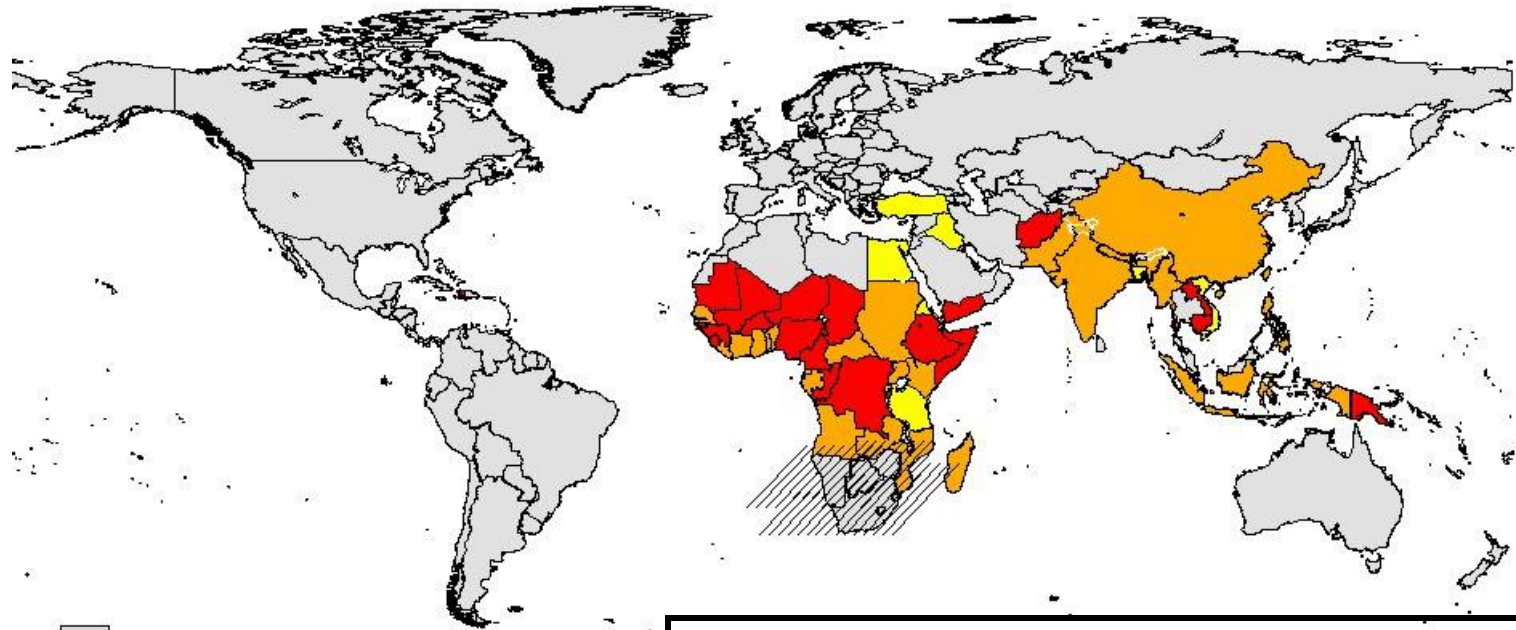


What is Tetanus?

- Tetanus is an illness characterized by an acute onset of hypertonia, painful muscular contractions (usually of the muscles of the jaw and neck), and generalized muscle spasms without other apparent medical causes.
- Despite widespread immunization of infants and children in the United States since the 1940s, tetanus still occurs in the United States.

Distribution

MNT Elimination Status as of December 2002



-  MNT eliminated (135 countries)
-  MNT provisionally eliminated (4 countries)
-  MNT eliminated from over 90% of districts (8 countries)
-  MNT eliminated between 50 - 90% of districts (24 countries)
-  MNT eliminated from less than 50% of districts (21 countries)

It's often called the silent killer, since infants often die before their birth is recorded.

Source: WHO/UNICEF MNT collected data 2002

As of 24 March 2003

Dr.T.V.Rao MD

The boundaries and names shown and the designation used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legitimacy of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines indicate approximate boundaries for which there may not yet be full agreement.



Caused by *Clostridium Tetani*

Gram positive

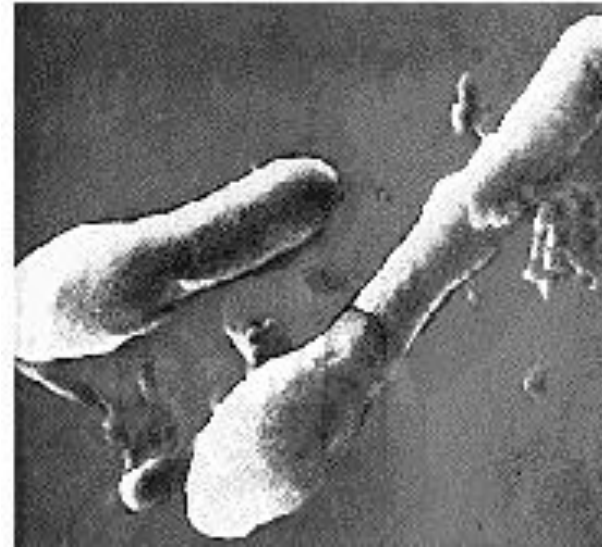
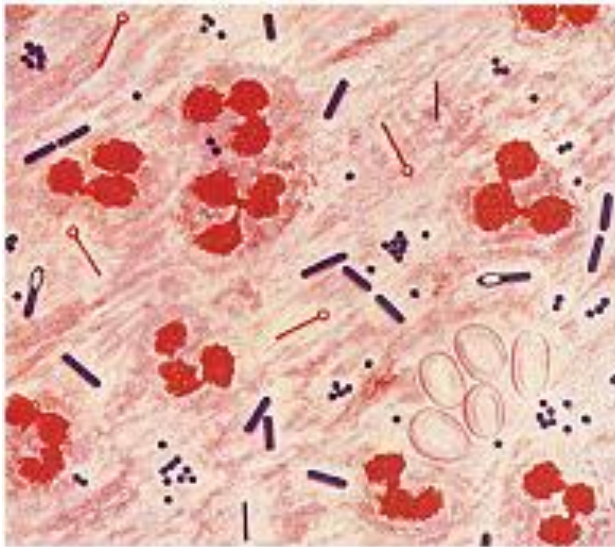
Spore-forming

Anaerobic bacilli



Causative agent

- *Clostridium tetani*

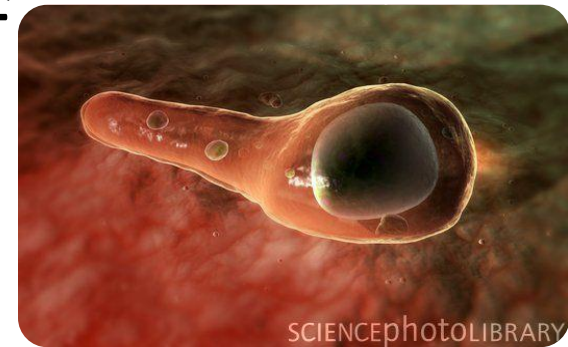


Left. Stained pus from a mixed anaerobic infection. At least three different clostridia are apparent.

Right. Electron micrograph of vegetative *Clostridium tetani* cells.

Morphology & Physiology

- Relatively large, Gram-positive, rod-shaped bacteria
- Spore-forming, anaerobic.
- Found in soil, especially heavily-manured soils, and in the intestinal tracts and feces of various animals.
- Strictly fermentative mode of metabolism.



C.tetani spores are found everywhere

- **Spores of *C. tetani* are found in soils throughout the world**

Spores are very resistant to harsh conditions

- **heat**
- **radiation**
- **chemicals**
- **drying**
- **Spores can survive for a long time in environment--100yrs possibly!**

Methods of transmission

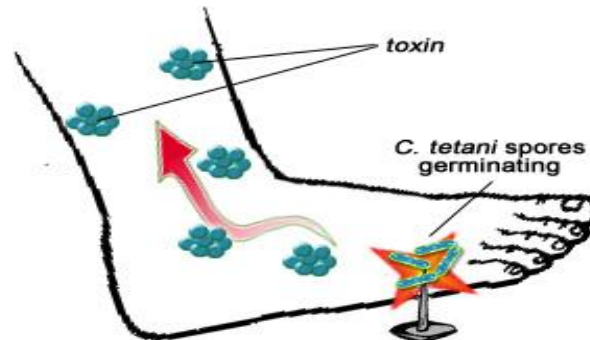
- *C. tetani* can live for years as spores in animal feces and soil. As soon as it enters the human body through a major or minor wound and the conditions are anaerobic, the spores germinate and release the toxins.
- Tetanus may follow burns, deep puncture wounds, ear or dental infections, animal bites, abortion.
- Only the growing bacteria can produce the toxin.
- It is the only vaccine-preventable disease that is *infectious but not contagious* from person to person.

Methods of transmission

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***C.tetani* - Entry of spores**

- **Entry of *C. tetani* into the body usually involves implantation of spores into a wound**
- **After gaining entry, *C. tetani* spores can persist in the body for months, waiting for the proper low oxygen growth conditions to develop**

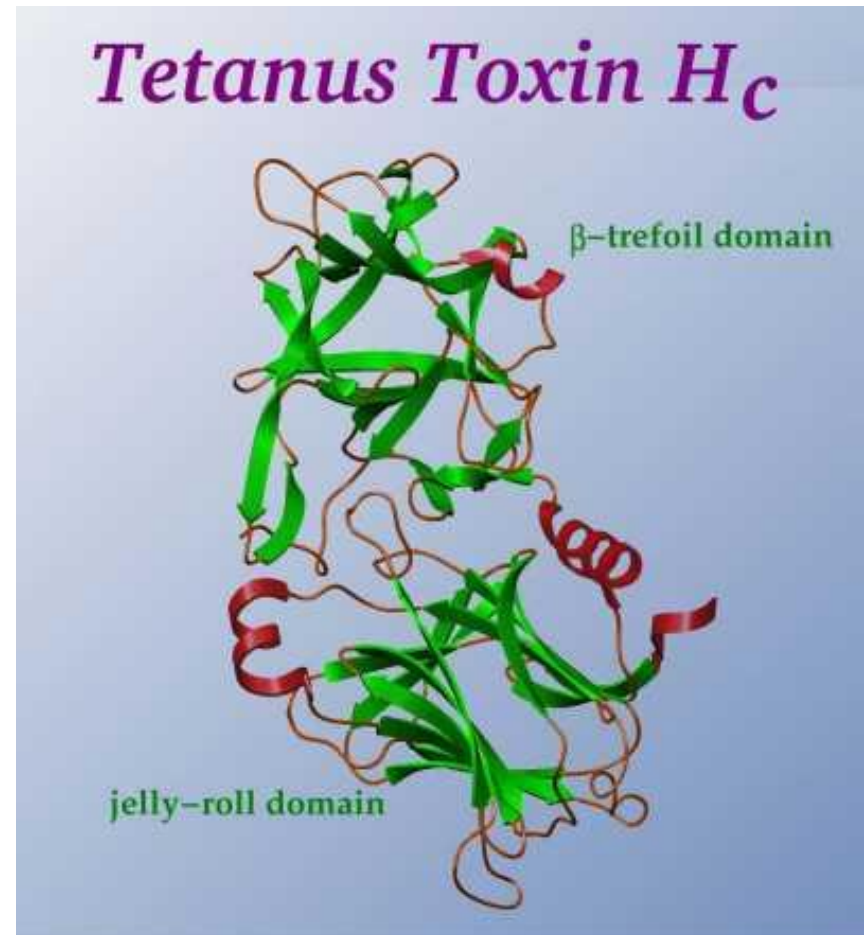


C.tetani produces toxigenic Disease

- *C. tetani* spores enter the body, they are again in an oxygen-free environment where they can germinate. The spores usually enter the body through a deep puncture wound or cut, but animal bites or even a splinter also can allow spore entry. The bacteria then produce tetanus toxins, which circulate in the body. One of the toxins blocks nerve impulses that allow muscles to relax. This toxin is responsible for causing generalized tetanus, the most common form of the disease.

Virulence & Pathogenicity

- Not pathogenic to humans and animals by invasive infection but by the production of a potent protein toxin
 - tetanus toxin or tetanospasmin
 - The second exotoxin produced is tetanolysin—function not known.



Toxin and C.tetani

- Tetanospasmin (exotoxin) produced locally , released into bloodstream .
- Binds to peripheral motor neuron terminals & nerve cells of ant.horn of spinal cord
- The toxin after entering axon , transported to nerve cell body in brain stem & spinal cord – **retrograde intraneuronal transport**
- Toxin – migrates across synapse – presynaptic terminals- blocks the release of **Glycine & GABA** from vesicles.

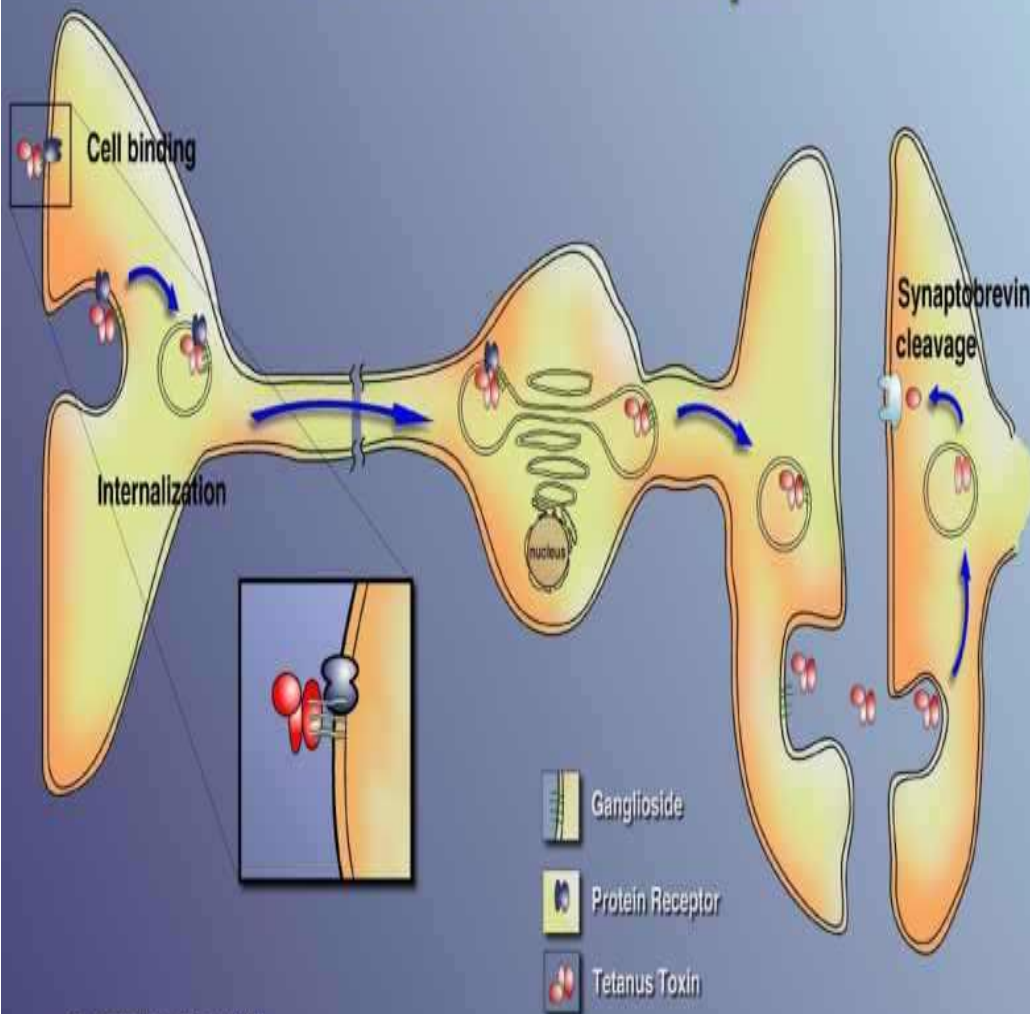
Tetanus toxin

- Produced when spores germinate and vegetative cells grow after gaining access to wounds. The organism multiplies locally and symptoms appear remote from the infection site.
- One of the three most poisonous substances known on a weight basis, the other two being the toxins of botulism and diphtheria.

Tetanus toxin

- Tetanus toxin is produced in vitro in amounts up to 5 to 10% of the bacterial weight.
- Estimated lethal human dose of Tetanospasmin = 2.5 nanograms/kg body
- Because the toxin has a specific affinity for nervous tissue, it is referred to as a **neurotoxin**. The toxin has no known useful function to *C. tetani*.

Tetanus Toxin Transport



After Montecucco & Shiavo (1995)

- **Initially binds to peripheral nerve terminals**
- **Transported within the axon and across synaptic junctions until it reaches the central nervous system.**
- **Becomes rapidly fixed to gangliosides at the presynaptic inhibitory motor nerve endings, then taken up into the axon by endocytosis.**

Toxic manifestations

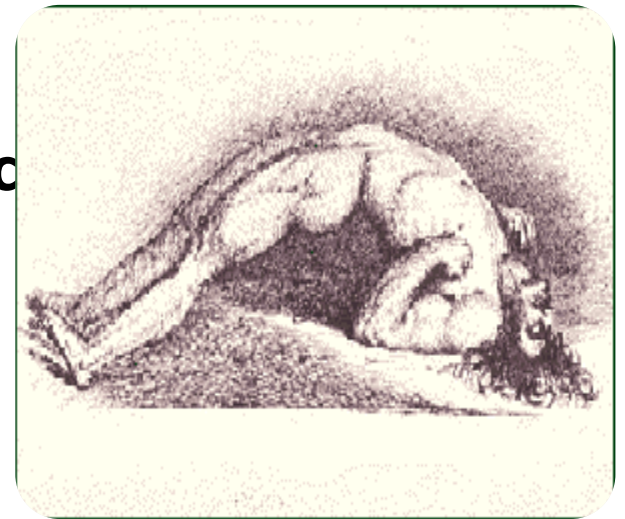
- **As growing cells of *C. tetani* produce tetanospasmin at the wound site, the toxin starts to migrate along nerves into the Central Nervous System where it blocks the release of inhibitory neurotransmitters**
- **As a consequence of too much “activator transmitters”, muscles are Overstimulated to repeatedly contract—called spastic paralysis**

How the toxin acts

- **Blocks the release of inhibitory neurotransmitters (glycine and gamma-aminobutyric acid) across the synaptic cleft, which is required to check the nervous impulse.**
 - **If nervous impulses cannot be checked by normal inhibitory mechanisms, it leads to unopposed muscular contraction and spasms that are characteristic of tetanus.**

Symptoms

- **Tetanic seizures (painful, powerful bursts of muscle contraction)**
- if the muscle spasms affect the larynx or chest wall, they may cause asphyxiation
- stiffness of jaw (also called lockjaw)
- stiffness of abdominal and back muscles
- contraction of facial muscles
- fast pulse
- fever
- sweating



Patient Manifests with

- **A person suffering from tetanus undergoes convulsive muscle contractions of the jaw-- called LOCKJAW**
- **The contractions by the muscles of the back and extremities may become so violent and strong that bone fractures may occur**
- **The affected individual is conscious throughout the illness, but cannot stop these contractions**

Trismus





The back muscles are more powerful, thus creating the arc backward

“Oposthotonus” by Sir Charles Bell, 1809.



Baby has neonatal tetanus with complete rigidity

Types of tetanus:

local, cephalic, generalized, neonatal

- *Incubation period: 3-21 days, average 8 days.*

Uncommon types:

- **Local tetanus:** persistent muscle contractions in the same anatomic area as the injury, which will however subside after many weeks; very rarely fatal; milder than generalized tetanus, although it could precede it.
- **Cephalic tetanus:** occurs with ear infections or following injuries of the head; facial muscles contractions.

Most common types:

Generalized tetanus

- descending pattern: lockjaw → stiffness of neck → difficulty swallowing → rigidity of abdominal and back muscles.
- Spasms continue for 3-4 weeks, and recovery can last for months
- Death occurs when spasms interfere with respiration.

Neonatal tetanus:

- **Form of generalized tetanus that occurs in newborn infants born without protective passive immunity because the mother is not immune.**
- **Usually occurs through infection of the unhealed umbilical stump, particularly when the stump is cut with an unsterile instrument.**

Methods of diagnosis

- Based on the patient's account and physical findings that are characteristic of the disease.
- Diagnostic studies generally are of little value, as cultures of the wound site are negative for *C. tetani* two-thirds of the time.
 - When the culture is positive, it confirms the diagnosis of tetanus

Biochemical reactions will characterise the C.tetani

COOKED MEAT

NO_3^-

LITMUS MILK

SUCROSE

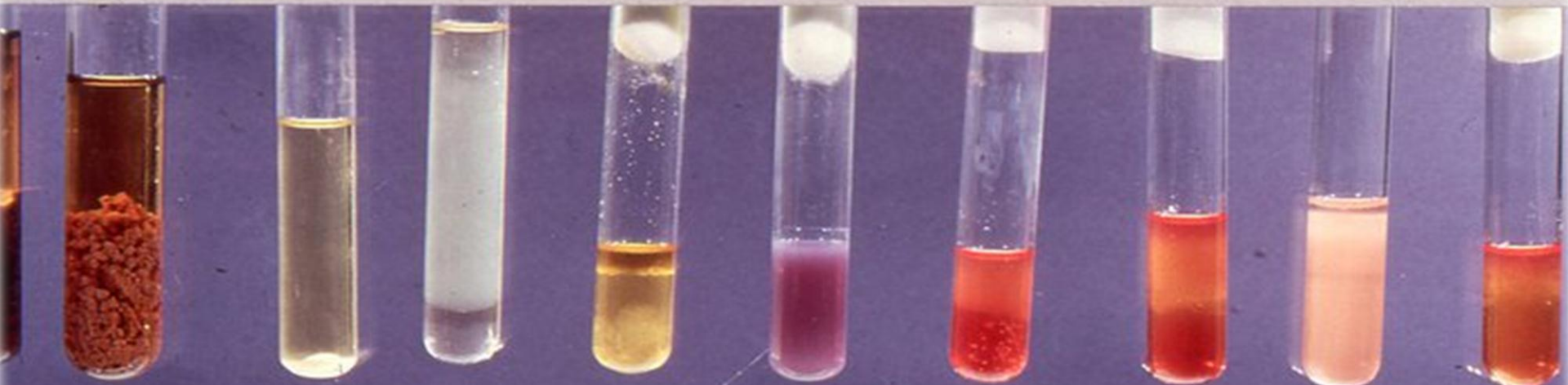
SALICIN

GELATIN

INDOLE

GLUCOSE

LACTOSE



Diagnosis

- Tests that may be performed include the following:
 - Culture of the wound site (may be negative even if tetanus is present)
 - Tetanus antibody test
 - Other tests may be used to rule out meningitis, rabies, strychnine poisoning, or other diseases with similar symptoms.

Clinical treatment

- If treatment is not sought early, the disease is often fatal.
- The **bacteria** are killed with antibiotics, such as penicillin or tetracycline; further toxin production is thus prevented.
- **The toxin is neutralized with shots of tetanus immune globulin, TIG.**
- Other drugs may be given to provide sedation, relax the muscles and relieve pain.
- Due to the extreme potency of the toxin, immunity does not result after the disease.

Method of prevention - Immunization

- A person recovering from tetanus should begin active immunization with tetanus toxoid (Td) during convalescence.
- The tetanus toxoid is a formalin-inactivated toxin, with an efficiency of approx. 100%.
- The **DTaPe** includes tetanus, diphtheria and pertussis toxoids; it is routinely given in the US during childhood. After 7 years of age, only Td needs to be administered.
- Because the antitoxin levels decrease over time, booster immunization shots are needed every 10 years.

Other supporting measures?

- **Remove and destroy the source of the toxin through surgical exploration and cleaning of the wound (debridement).**
- **Bed rest with a nonstimulating environment (dim light, reduced noise, and stable temperature) may be recommended.**
- **Sedation may be necessary to keep the affected person calm.**
- **Respiratory support with oxygen, endotracheal tube, and mechanical ventilation may be necessary.**

Specific Treatment

- b. Wound should be debrided widely.
- c. Maintain an adequate airway.
- d. Employ sedation (as indicated) or muscle relaxant.
- e. Active immunization should be initiated concurrently with therapy.

6. Destruction of environmental spores:

- **esp. in operating theatres.**
- Special air-flow equipment and filtered ventilation. - Reduce airborne particles. Surgical instruments and dressing sterilization (**use of autoclaves**). Disinfect. e.g. formaldehyde.

Tetanus Toxoid

- Formalin-inactivated tetanus toxin
- Schedule Three or four doses + booster
Booster every 10 years
- Efficacy Approximately 100%
- Duration Approximately 10 years
- Should be administered with diphtheria toxoid as DTaP, DT, Td, or Tdap

Routine DTaP Primary Vaccination Schedule

Dose

Primary 1	2 months	
Primary 2	4 months	4 wks
Primary 3	6 months	4 wks
Primary 4	15-18 months	6 mos

Active & Passive Immunization

- In non immunized persons
- 1500 IU of ATS / 250-500 units of Human Ig in one arm & 0.5 ml of adsorbed tetanus toxoid into other arm /gluteal region
- 6 wks later, 0.5 ml of tetanus toxoid
- 1 yr later , 0.5 ml of tetanus toxoid

Children Who Receive DT

- The number of doses of DT needed to complete the series depends on the child's age at the first dose:
 - if first dose given at <12 months of age, 4 doses are recommended
 - if first dose given at ≥ 12 months, 3 doses complete the primary series

Prognosis in Infected

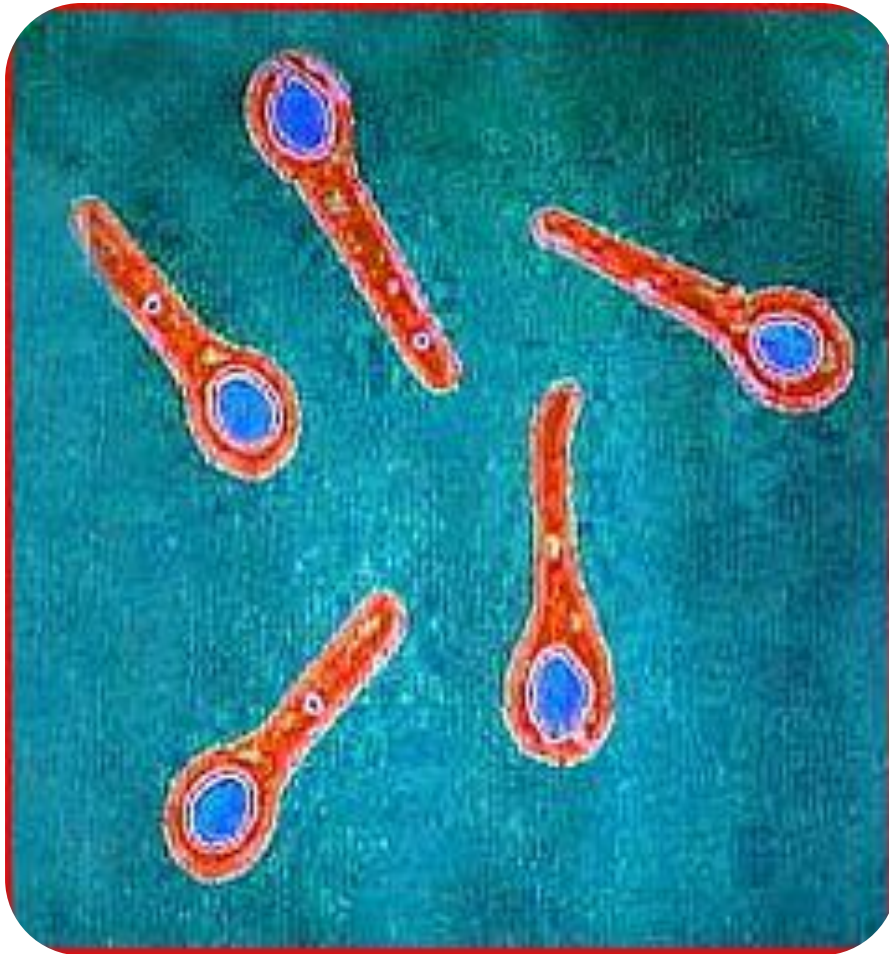
- Prognosis is dependent on incubation period, time from spore inoculation to first symptom, and time from first symptom to first tetanic spasm.
- In general, shorter intervals indicate more severe tetanus and a poorer prognosis.
- Patients usually survive tetanus and return to their pre disease state of health.
- Recovery is slow and usually occurs over 2-4 months.
- Clinical tetanus does not produce a state of immunity; therefore, patients who survive the disease require active immunization with tetanus toxoid to prevent a recurrence.

Care in the Hospital to eliminate C.tetani spores

.Destruction of environmental spores:

- **Specially in operating theatres.**
- Special air-flow equipment and filtered ventilation. - Reduce airborne particles. Surgical instruments and dressing sterilization (**use of autoclaves**). Disinfect. e.g. formaldehyde.

Tetanus is a Vaccine Preventable Disease- Do vaccinate without fail



- **Created by Dr.T.V.Rao MD for
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Students**

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