Infections transmitted by touch.

Christopher Whitty

Gresham College 2022

Route of transmission is key to understanding and combatting infectious diseases.

- Vector-borne (insects etc).
- Oral- food, water and other drink.
- Sexual (STI) & bloodborne.
- Respiratory.
- **Touch.**

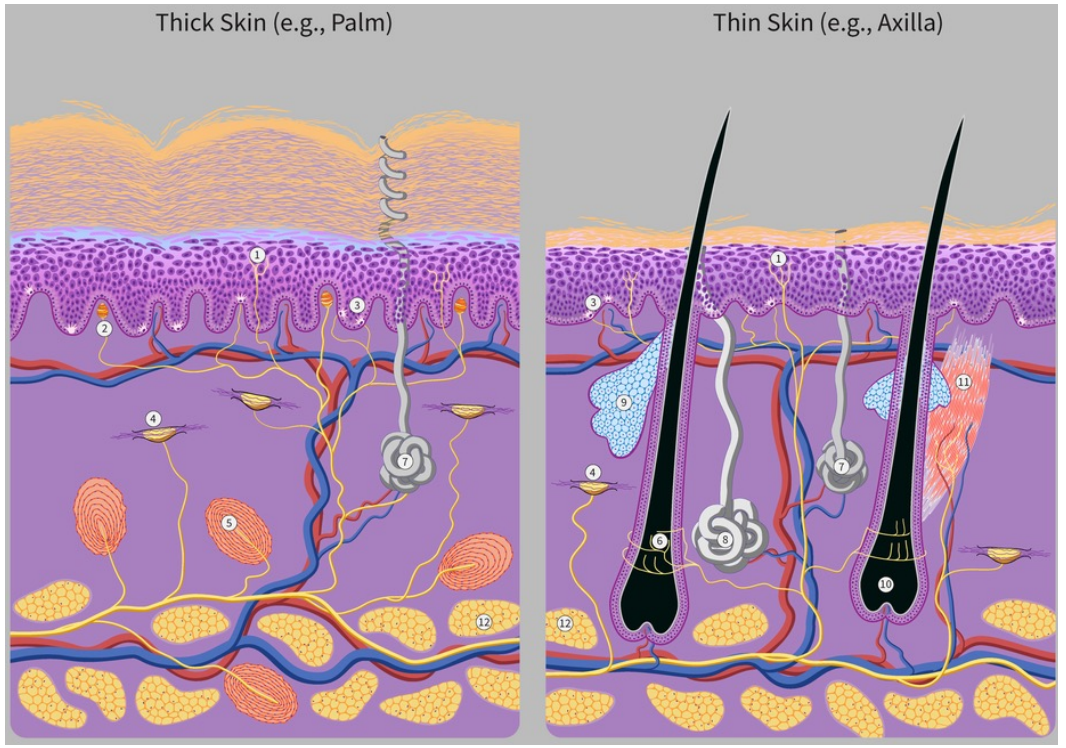
- Usually one route dominant.
  Sometimes secondary routes.

Auguste Rodin
La Cathédrale
LS Zecchinato

Getting an infection via the touch route harder than you might think. The skin is both tough and well defended.

- Strong cultural norms not to touch strangers.
- Clothes add a further layer of defence.
- Frequent bathing and washing/ironing clothes.

- The skin is very tough, has good immunological defences, and most infections do not go through it.



Guido4/Hegasy

When is it normal for people to touch non-family?

An important part of affection, closeness or trust.

But strongly bounded.

Jarek Tuszyński / Kiwi

Flikr / Rufino Uribe

University Hospitals Birmingham

Several ways infections passed on principally by touch.

Include:

- Skin-to-skin infections like viral warts, scabies.
- Several bacterial skin infections.
- Hospital acquired infections.
- Touch to mucus membrane. Ebola, Lassa.
- Touching soil, sand, water. Several parasites, fungi, bacteria.
- Puncture of skin- wound infections, rabies, tetanus.

Raya Sharbain

Infections transmitted by touch can affect every organ of the body.

- Some infections transmitted by touch are skin diseases.
- Many however affect other organs such as the gut or nerves.
- Include some of the most feared multi-system diseases of humans.

- On the other hand some major infections affecting the skin are transmitted by other routes.

Viral skin infections.

- Several viruses specialised in transmission by touch, including:

- Warts of hands and feet (verruca). Direct contact, or via floor/object (esp wet).
- Not dangerous, but sometimes unsightly, can be uncomfortable.

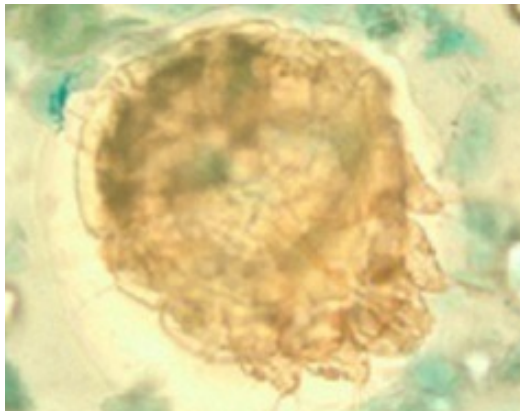
- Molluscum contagiosum.

NHS

Parasites passed person-to-person by touch.

- Scabies.
- A mite that burrows into the skin. Can be very itchy. Prolonged contact.
- Usually not serious in UK but needs to be treated.

- Nits (head lice).

NHS/CDC/Gilles San Martin

Fungal skin infections passed person-to-person.

- Ringworm- contact with people, animals, infected towels etc.
- Athletes foot. Commonly caught walking barefoot in shower or changing rooms.

- Both can usually be treated with creams or other treatment from pharmacist.
- Sometimes need antifungal drugs from GP.

NHS

Bacterial infections passed person-to-person by touch.

- Impetigo an example. *Streptococcus pyogenes* or *Staphylococcus aureus*.
- Crusting skin infection.
- Most common in younger children.
- Washing hands and not sharing linen (eg towels) reduce risk.

CNX OpenStax/ CDC

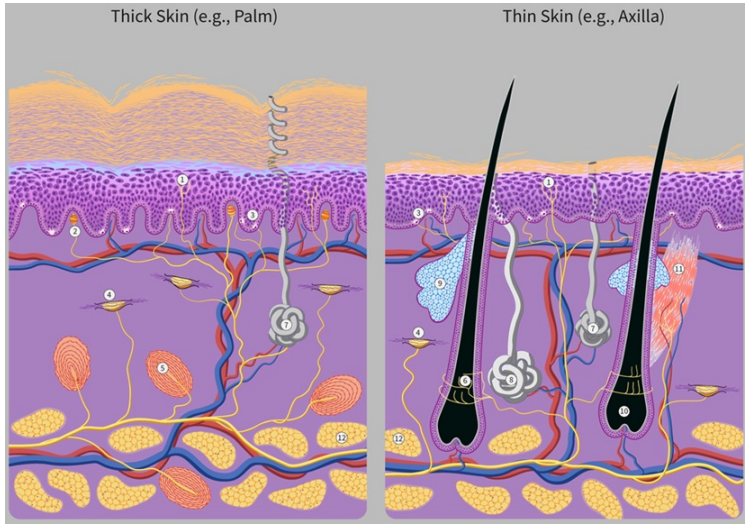
Bacteria transmitted person-to-person by touch often just colonise the skin with no ill effects.

- Can then enter through breaks in the skin- wounds, scratches, athletes foot for example.
- Can cause cellulitis and related conditions- infection in / under the skin.

Colm Anderson

Hair follicles and sweat pores can allow boils, abscesses.

- Bacteria get below the epidermis via hair follicles or sweat glands.
- *Staph. aureus* most common cause.
- Minor cases common and resolve. Severe cases may need surgical drainage and antibiotics.



Guido4/Hegasy / NHS

Staph. aureus can be very serious if it gets into the blood.

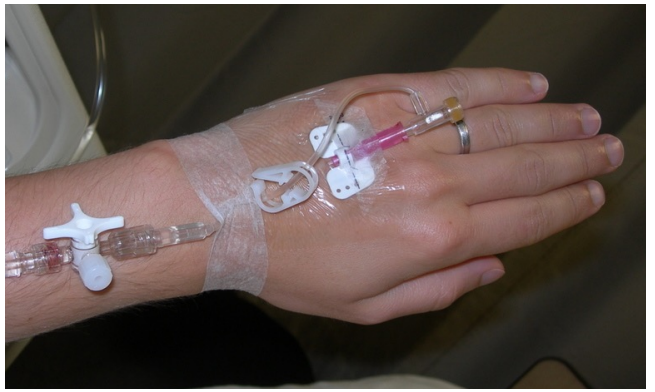
- Abscesses in many organs including lung, brain.
- Heart valves- endocarditis.
- Bones, joints.

Bruce Blaus

Frank Gaillard, Radiopaedia

Hospital is a high risk environment for touch diseases.

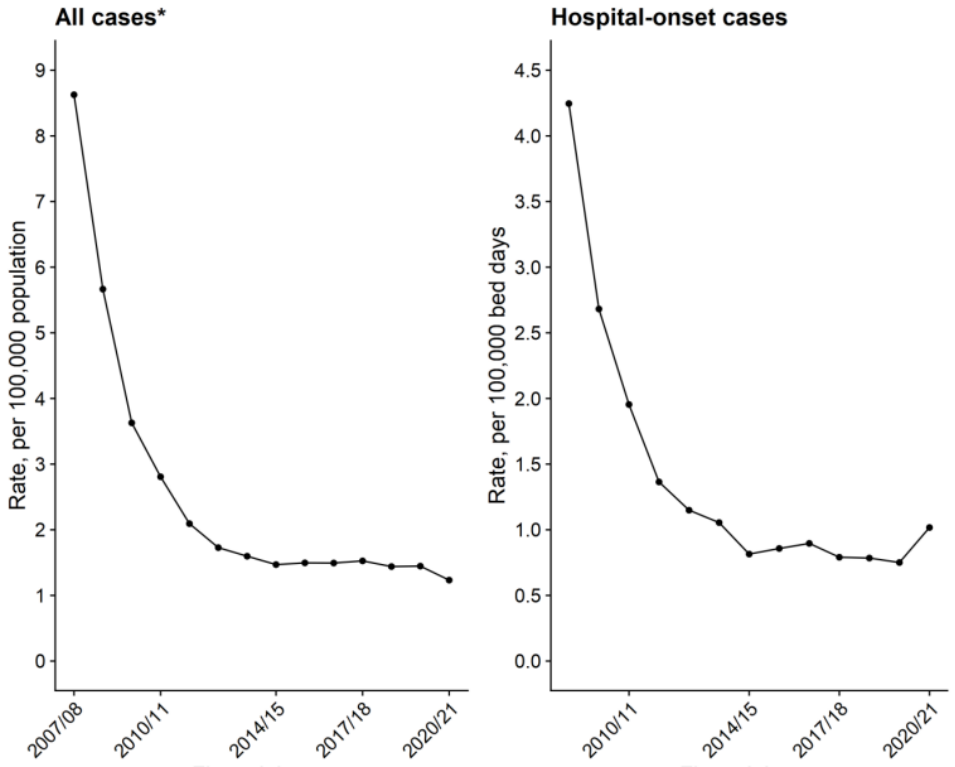
- Touching strangers is part of the process of medicine, nursing and other therapies.
- Intravenous lines and drips potentially an easy way for bacteria to get through the skin.
- Widespread use of antibiotics meaning drug resistant organisms common.



Michaelberry / Peter Rimar / Chitrapa

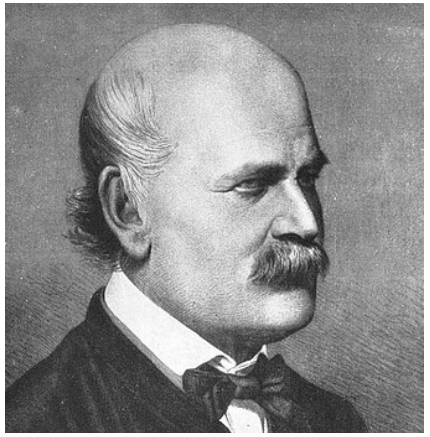
Bacterial skin infections in healthcare settings often antibiotic resistant.

- MRSA an example of a bacterial infection which can be passed person to person by touch.
- Especially common in hospital settings.
- Washing hands key- and if systematic highly effective.

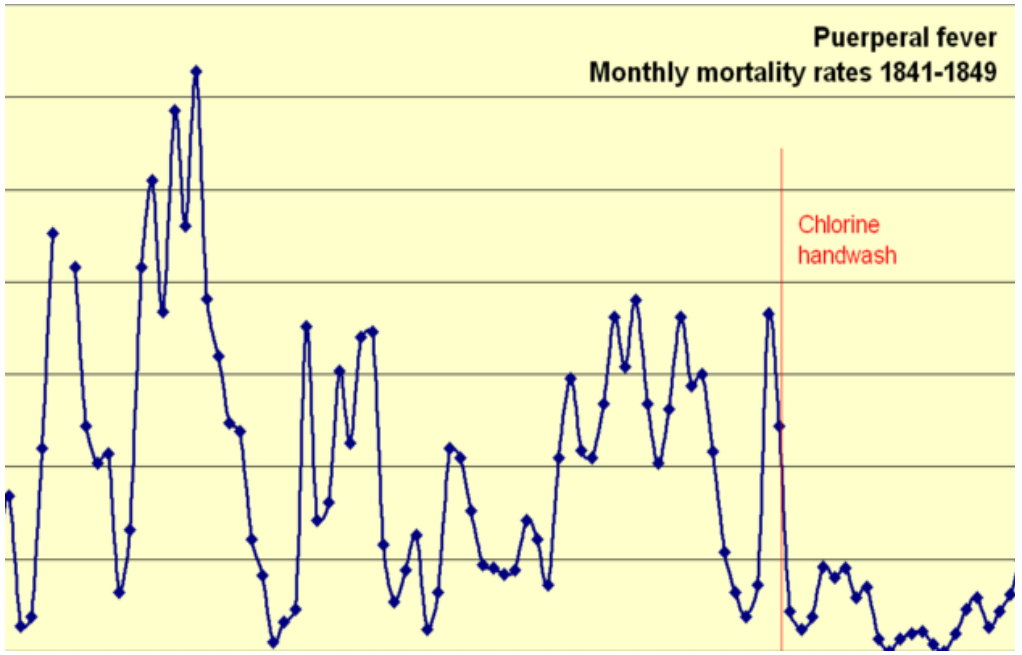


MRSA bacteraemia England 2007-21. PHE

Skin contaminants from medical staff during procedures used to be common, still a risk.

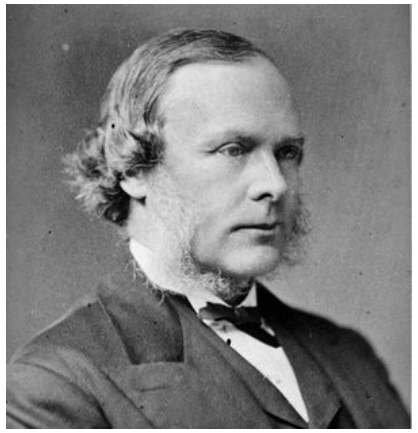


- Puerperal sepsis, bacterial infection soon after birth, was common. Around 10% of women in some hospitals died of it.
- Ignaz Semmelweis, a Hungarian physician demonstrated that hand washing using antiseptic by doctors substantially cut infection rates.
- He was committed to an asylum by his medical peers in 1865, and died 2 weeks later (age 47) of sepsis 2^{ry} to mistreatment.

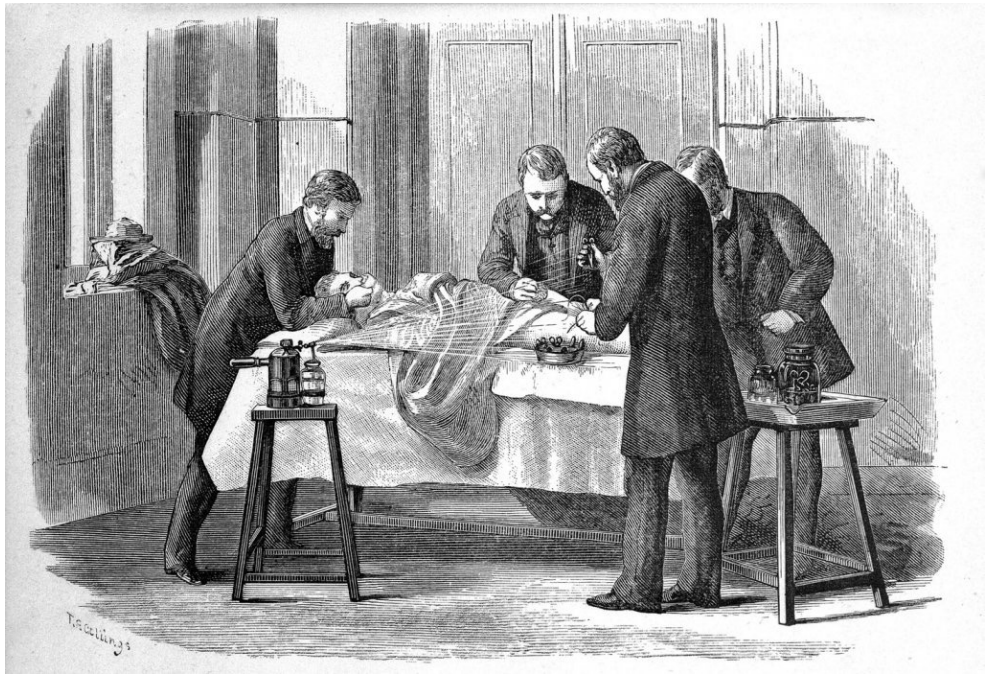


Vienna Maternity Institution 1841–1849

Antisepsis- a key step in surgery.



- Prior to antisepsis patients undergoing surgery were often killed by infections.
- The operation introduced infections by touch of hand/instrument.
- Joseph Lister, following research by Louis Pasteur, introduced antisepsis using carbolic acid. A barrier and a disinfectant for wounds, hands, instruments.
- Initially mocked, but substantially reduced the rates of surgical sepsis.



The antiseptic system using carbolic acid. WW Cheyne/ Wellcome. Above J Lister.

Modern surgery has moved from antisepsis to asepsis.

- Aim to have nothing touching the wound or exposed part of the body which is not sterile.
- Avoid contamination by touch.

Frp17580

Touch the main secondary route for infections transmitted by several respiratory and oral routes.

- Hand to mouth/eyes an important secondary route for many infections.
- Include COVID-19, ‘flu, typhoid, norovirus and others.
- The importance of handwashing extends well beyond touch diseases.

Handwashing with soap is one of the best things we can do to reduce the risk of infections to ourselves and others.

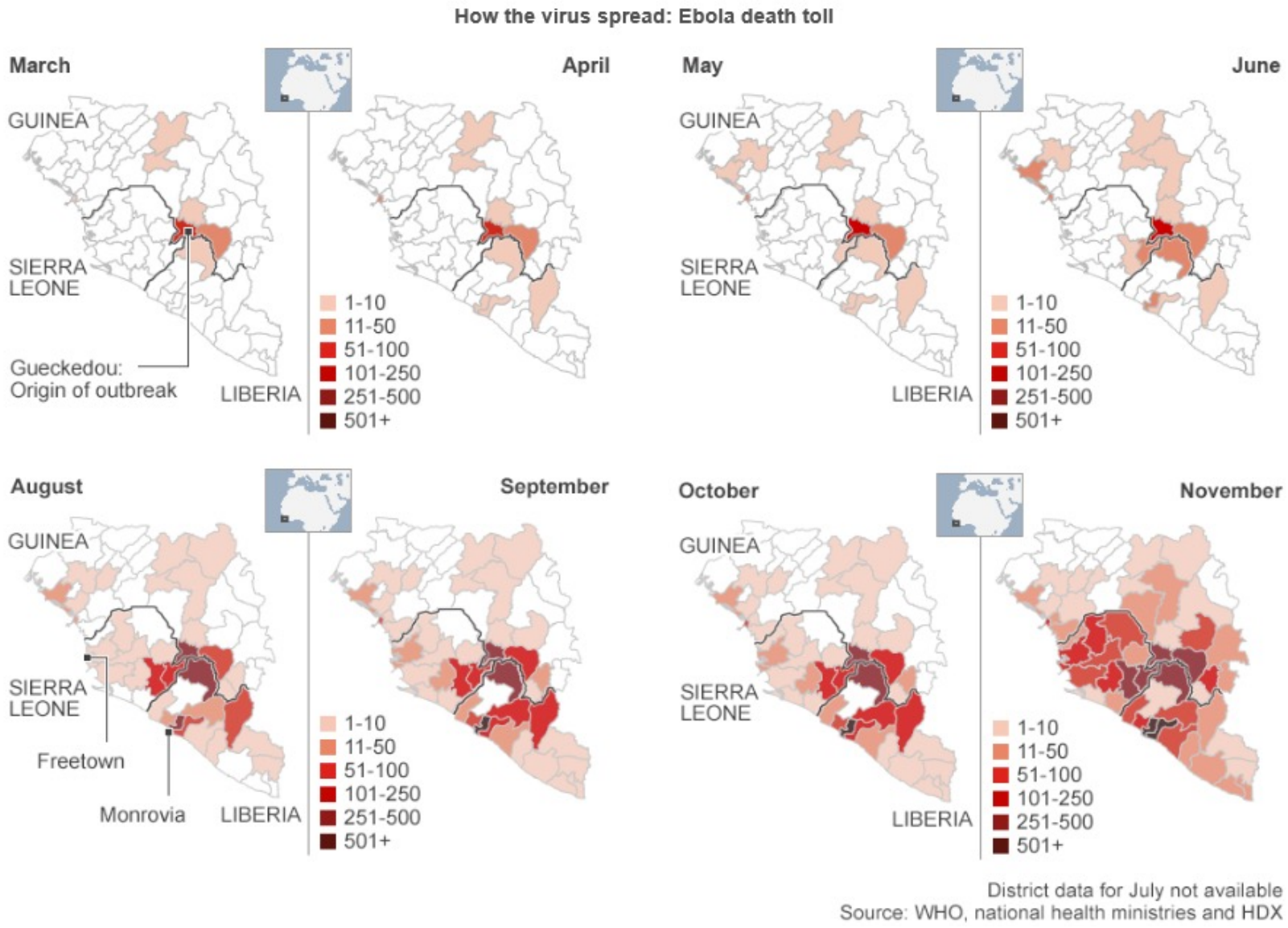
Dante Gabriel Rosetti

The viral haemorrhagic fevers passed person-to-person by touch.

- Ebola, Lassa Fever, Marburg.
- Passed on by direct contact with people or touching their bodily fluids.
- Ebola and Marburg have both led to major outbreaks. Both can have mortality >65% in epidemics.
- Lassa lower mortality but still significant.
- Get their name from the bleeding and internal haemorrhage that can occur late in the disease.
- The West African Ebola epidemic of 2014-16 the largest to date.

Despite being relatively difficult to catch spread fast: April to August 2014.

(adapted from BBC, data from Ministries and WHO).



The R_0 over 1 was driven by three components, all touch.

- Transmission in healthcare settings.
- Transmission during funerals. People highly infectious after death.
- Transmission in the community.

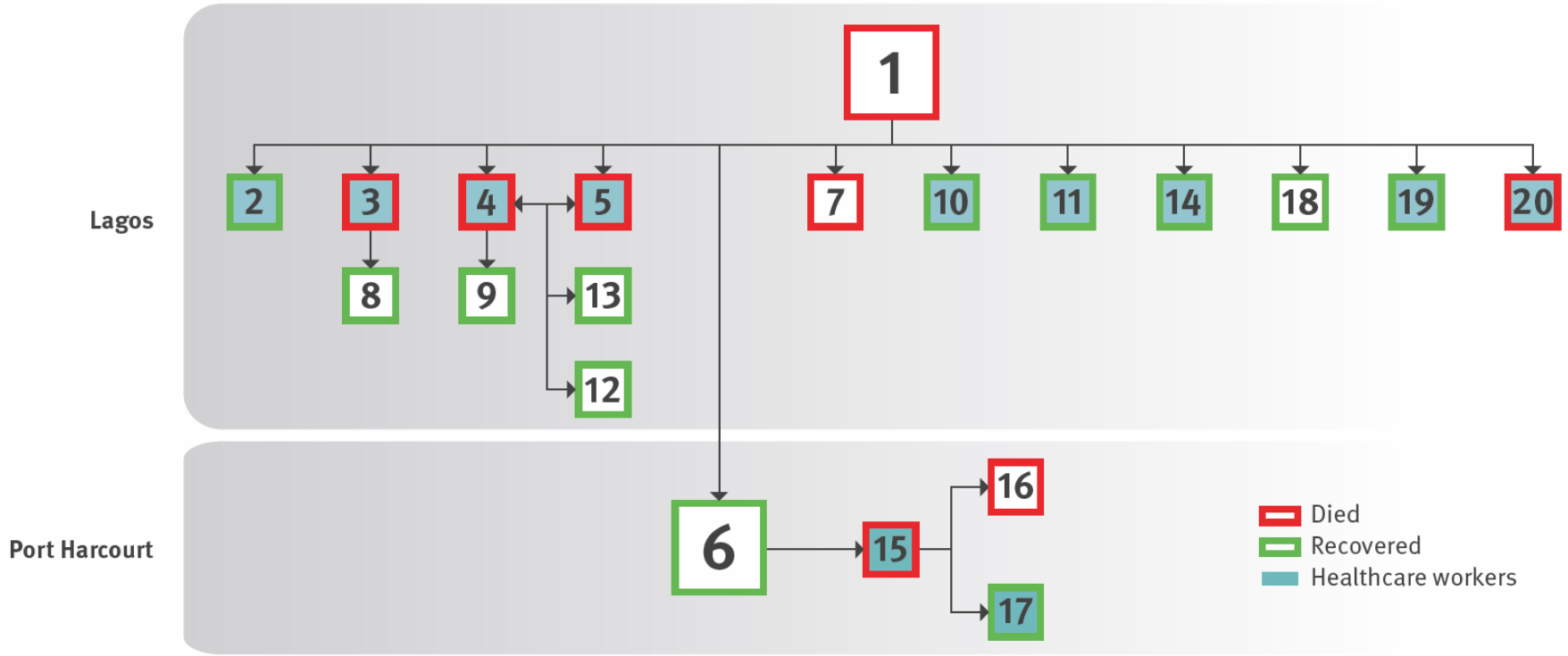
Sylvain Cherkaoui/Cosmos for MSF

The initial incidence of Ebola in HCWs estimated around 8-10% per person year. Over 70% infected died.

Ebola virus disease outbreak in Nigeria, July-Sept 2014

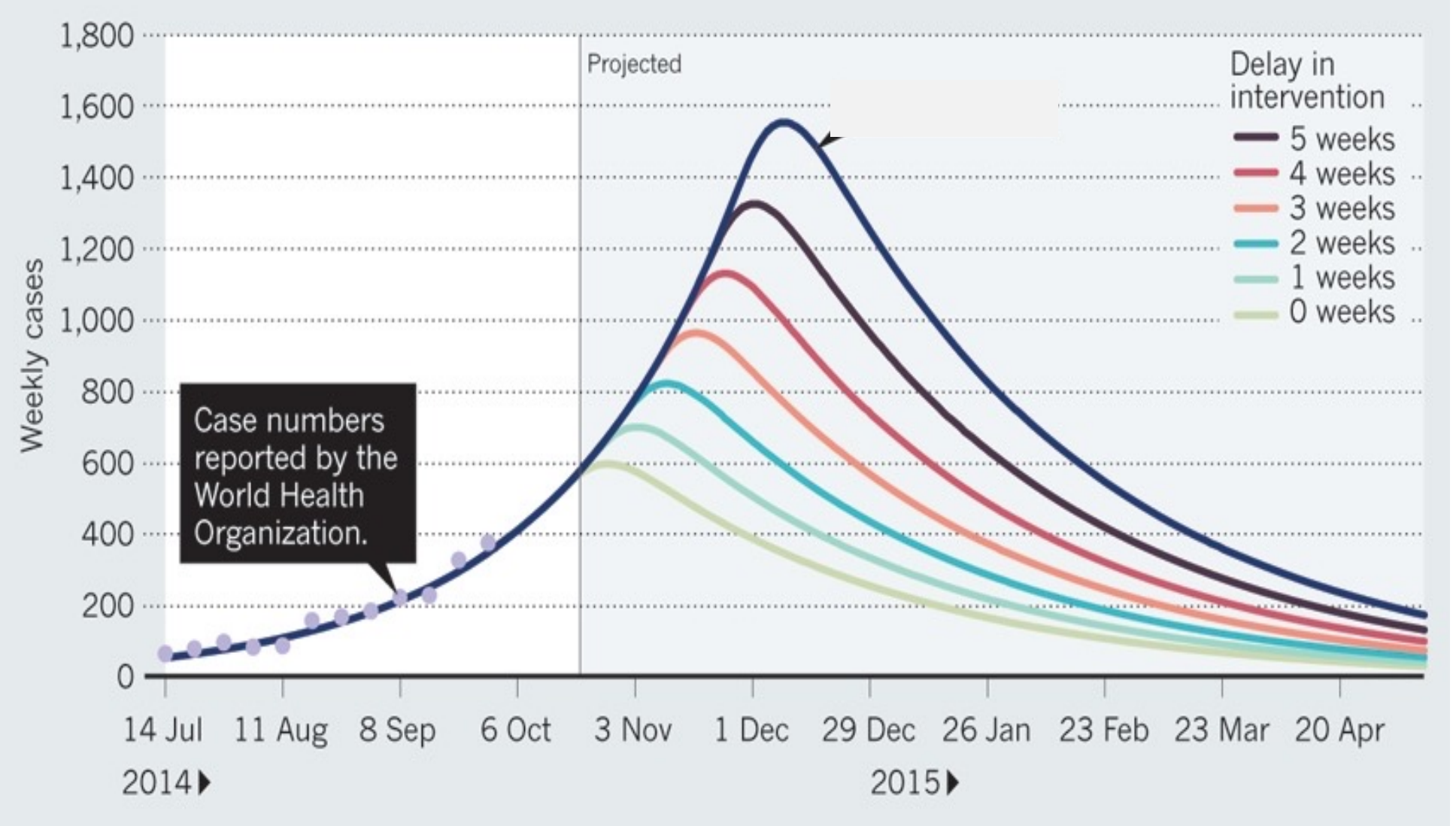
F O Fasina. Eurosurveillance

Transmission tree of the Ebola virus disease outbreak in Nigeria, July–September 2014



The impact of delay in intervention by week in Sierra Leone.

(Whitty et al Nature, analysis by Ferguson et al)



Reducing transmission for funerals and other peri-death rituals.

- Local burials involve washing and touching the body.
- We know how to do medically safe burials.
- The challenge is doing it in a socially acceptable way.
- The importance of social science and local knowledge.
- Funeral rites central to all societies.
- ‘High charisma’ individuals including doctors.

Dr Umar Khan
(*Sierra Leone Telegraph*)

Increasing social distancing in the community.

- Ebola is very difficult to catch in the community- needed to make it even more so.
- Key is rational acceptable and achievable social interventions.
- Many had serious downsides: closing schools, roads, markets. Which had real impact on Ebola?

DFID

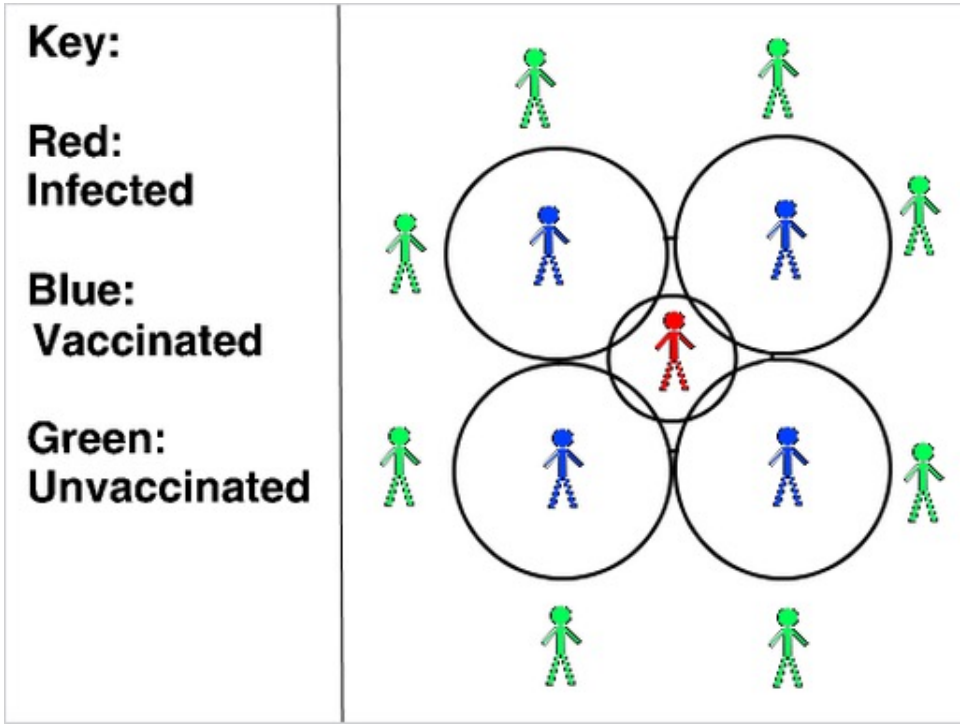
Shortening the interval between first symptoms and isolation by case finding and contact tracing.

- Ebola first symptoms are very non-specific.
- Similar to early malaria, pneumonia, influenza, typhoid, dysentery.
- By the time it is obviously Ebola- highly infectious.
- Community care centres.
- Classical case finding, contact tracing and isolation.

DFID

The move from purely social public health interventions to largely medical countermeasures as science advances.

- The West African Ebola outbreak was ended almost entirely with social and public health interventions.
- Initially whole society, then case finding and contact tracing.
- Rapid diagnostic tests improved targeting.
- Spurred the development of Ebola vaccines. Effective (over 80%).
- Used in ring vaccination. Will reduce the impact of future outbreaks.



Tom Griffin, Alex Szymanski

Infections acquired by humans touching animals.

- Many, but some common or important ones:
- Orf.
- Anthrax of the skin.
- Cowpox, the origin of vaccination.

- We can also pass on, and acquire, drug resistant bacteria from or to animals we touch.

Robert Lawton/Edward Jenner (Sarah Nelmes)/NHS/CDC

Some human parasites have evolved to specialise in transmission from touching soil, sand, mud or swimming in fresh water.

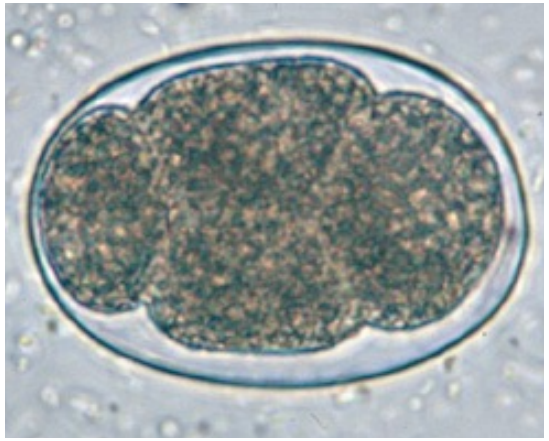
Adam Jones

Micky/wiki

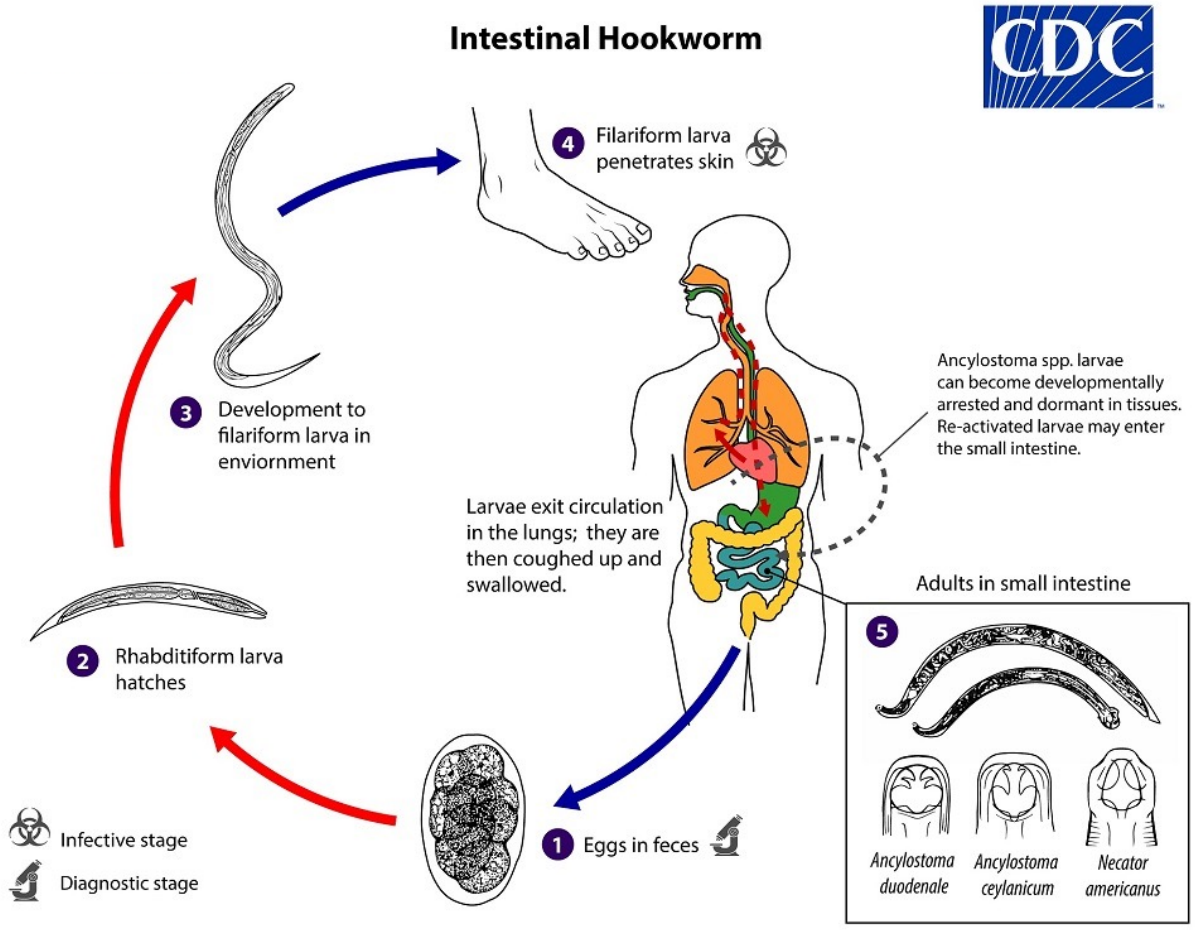
The lifecycle of human worms using soil to transmit by touch.

- Human hookworm.
- Strongyloides.

- Cat and dog hookworm- cutaneous larva migrans.



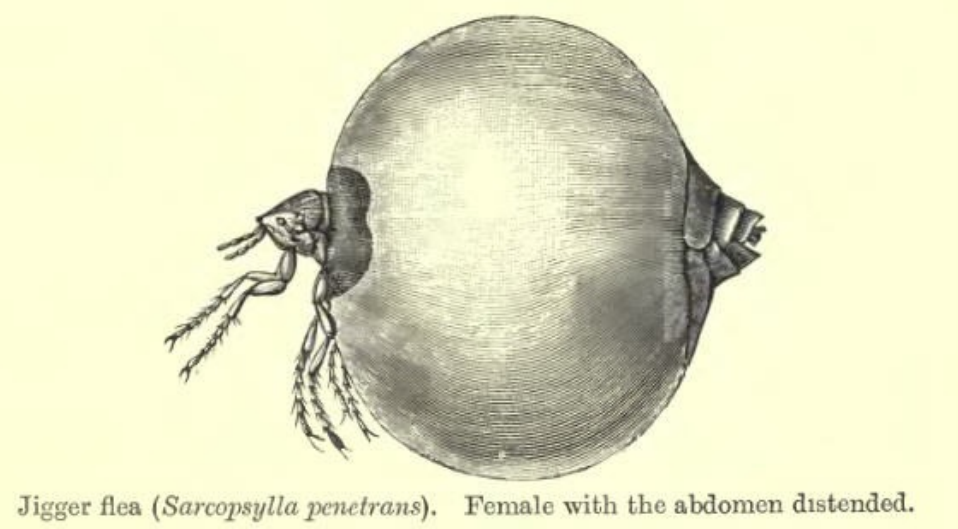
WeisSagung. CLM



CDC

Jigger fleas. Eggs hatch in sand.

The female penetrates skin and swells. The male mates with her in situ.



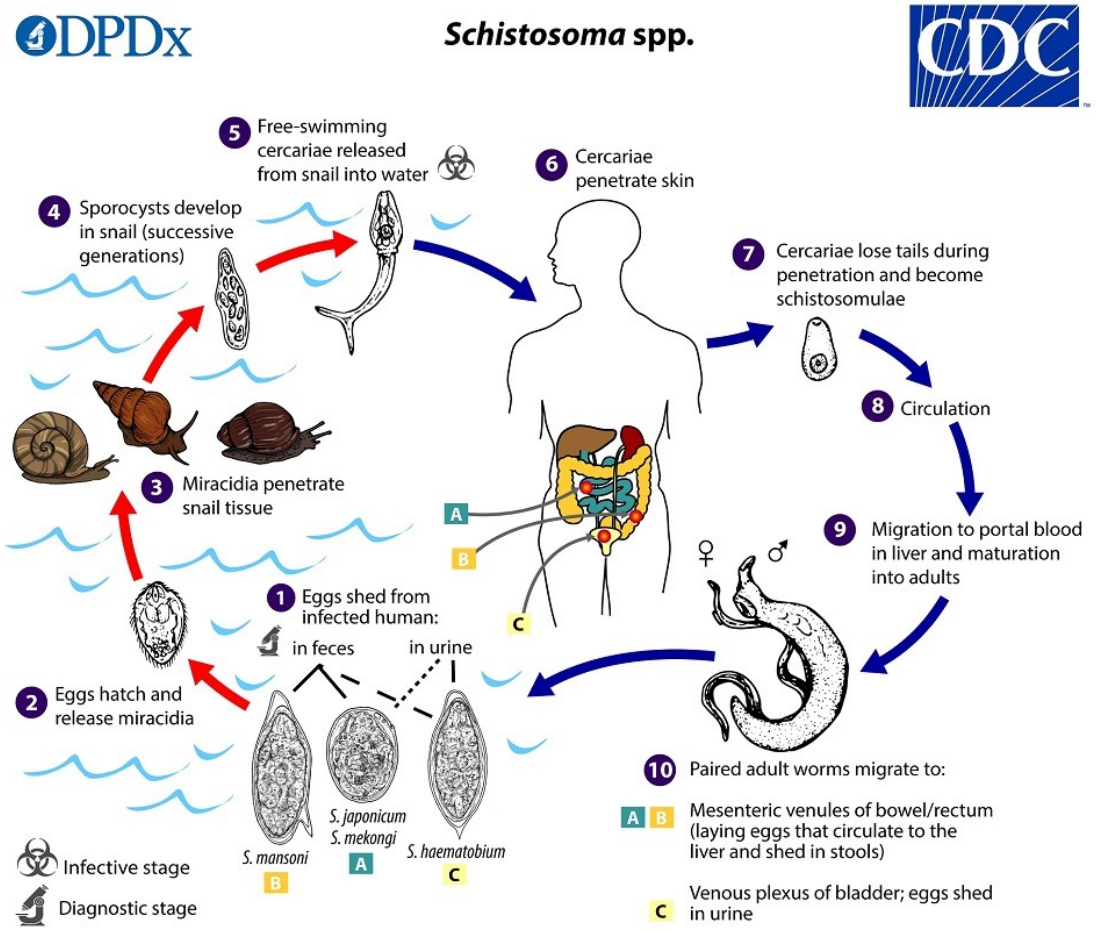
Jigger flea (*Sarcopsylla penetrans*). Female with the abdomen distended.

Natural History Museum

Parasites which penetrate from swimming in fresh water- schistosomiasis.

- A complex lifecycle via snails.
- Can cause bladder cancer (haematobium) or liver fibrosis (mansoni, japonicum).

FA Lewis et al 2008 / CDC



Fungal infections from touching soil or plants, or being scratched. Rare, but can be serious.

- Fungal diseases generally more dangerous in immunosuppressed.
- Depend on where in the world you are. Examples:
- Sporotrichosis (rose gardener's disease). USA and elsewhere.
- Madura foot. Parts of Africa, Asia, Latin America.

Eumycetoma, Sudan.
Dr. Ahmed Fahal.

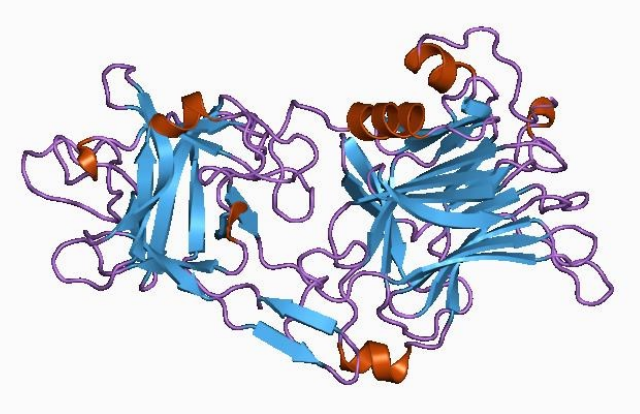
Tetanus following wound or prick- nerve toxin causing spasm.

- *C. tetani* which causes it lives in soil and animal dung. Can infect puncture wounds.
- Agriculture, war, childbirth in non-sterile settings and unclean surgery were common risks.
- Forms a small abscess- often not noticed by the person infected.
- Produces a potent toxin which is the dangerous part.

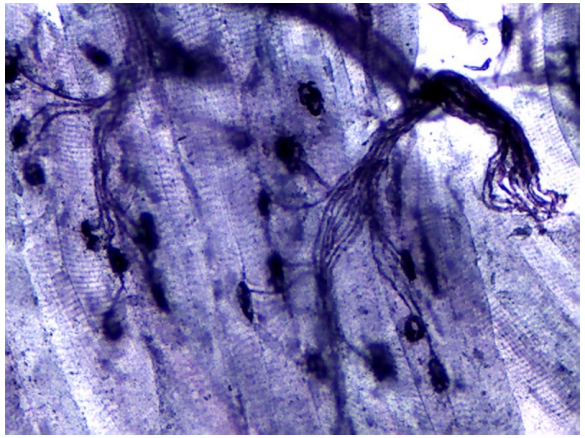
A soldier with tetanus. Sir Charles Bell

Tetanus toxin once circulating causes severe disease.

- The main tetanus toxin, tetanospasmin, is taken up by the nerve motor end plate.
- It is transported up to the spinal cord / central nervous system.
- Binds irreversibly to the inhibitory nerves which balance movements and prevent spasms stopping.
- The result is uncontrollable spasms. High mortality in low-resource settings. Up to 80% in adults, up to 100% in neonates.



Tetanospasmin toxin.



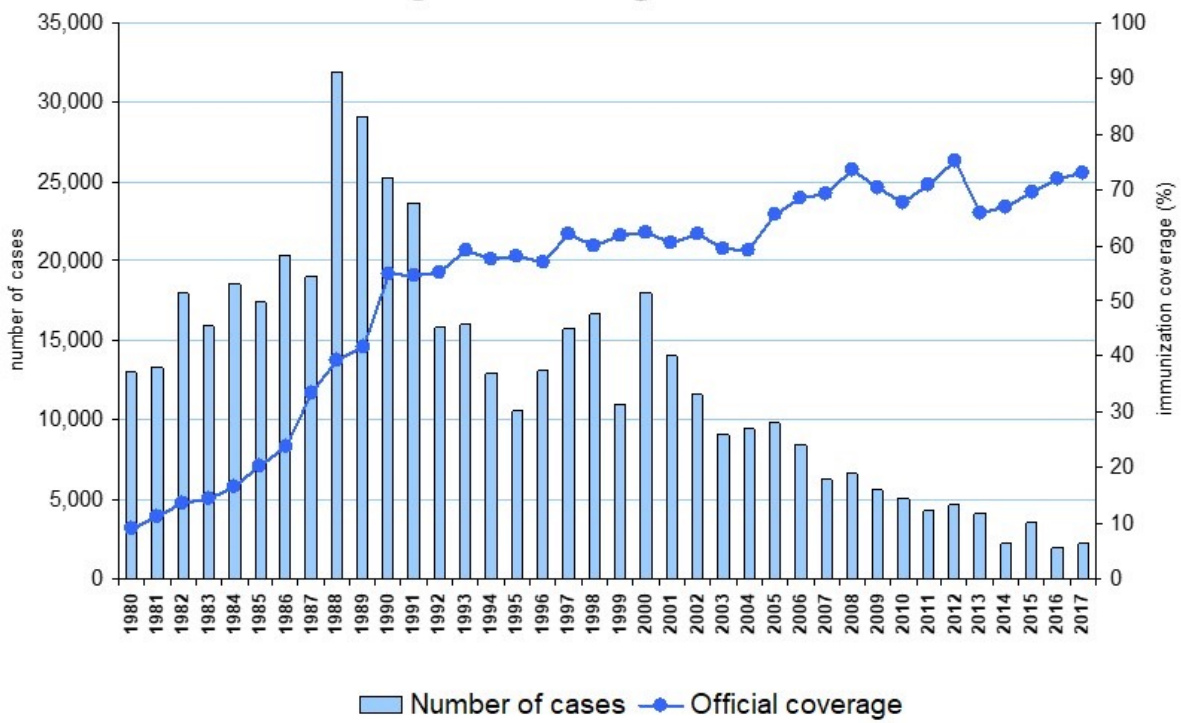
Motor end plates.
Hlj55567516

St Kilda, 1880s.

Neonatal tetanus.

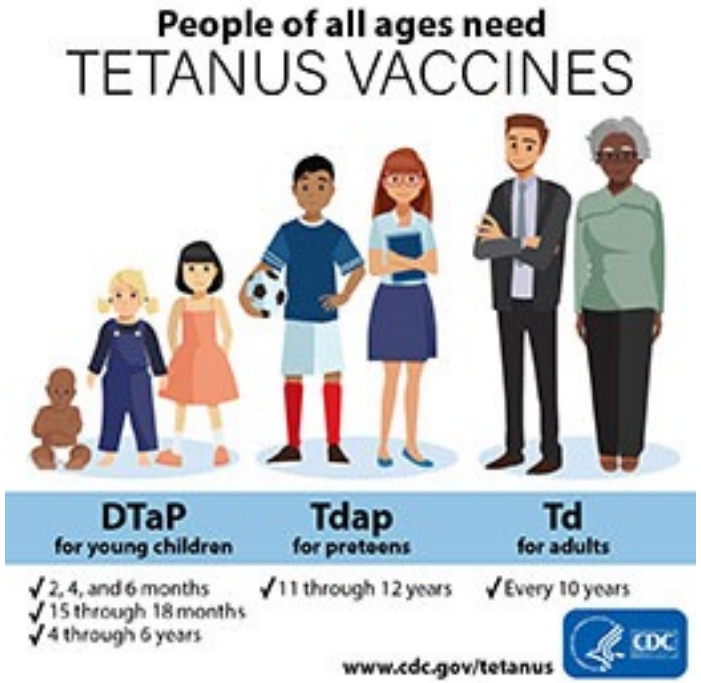
- In rural communities without expert midwifery high infant mortality- up to 50% recorded.
- In some settings tetanus can the the majority of these. Mortality almost 100%.
- Was common in rural UK and USA prior to vaccination.
- Clean childbirth and maternal vaccination almost eliminate it.

Global neonatal tetanus- WHO.



Vaccine for tetanus has transformed the risk.

- The toxin is inactivated (*toxoid*), and then adsorbed. Developed 1938, introduced widely in 1950s.
- Does not stop infection- but stops toxin damage. No herd effect.
- Vaccinate mothers to protect newborns. Good birthing practice also essential.
- Usually given with diphtheria and pertussis vaccine (DTaP).



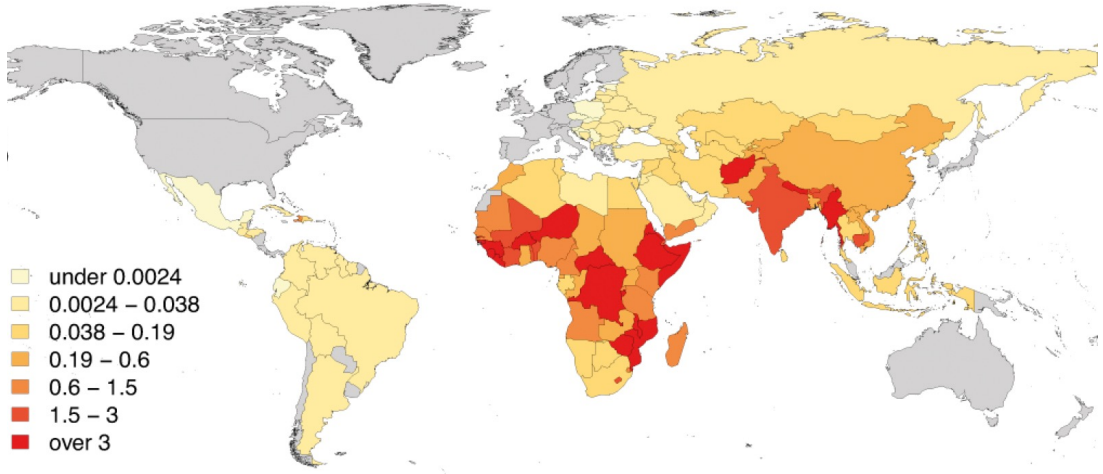
US poster (CDC).

Rabies. Gets through the skin by bite.

- Up to 99% of human cases from dog bites. Globally up to 59,000 cases a year (WHO).
- Bats more important in Americas since dog rabies controlled. Small numbers.
- Death within 10 days of symptoms is virtually inevitable.
- A terrible disease. People die in pain and terror if not sedated.
- The virus causes affected mammals (including humans) to salivate, and become aggressive.

Rabies prevention.

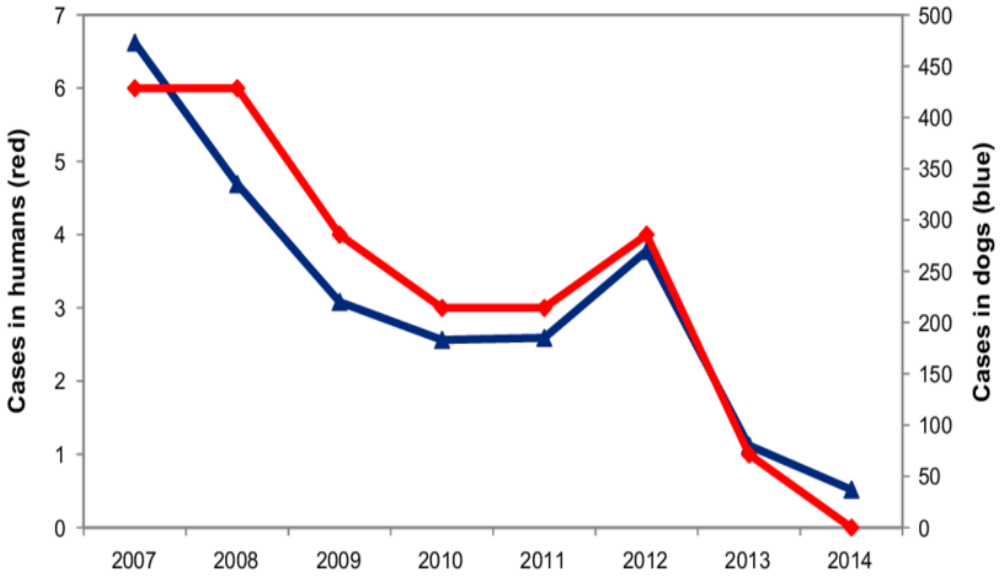
- Rabies vaccination of domestic dogs has reduced rabies to very small numbers in Europe and North America.
- Vaccine on baited foods (eg chicken heads) has helped control rabies in wild mammals.
- Post-bite vaccination (within 10 days) also effective.

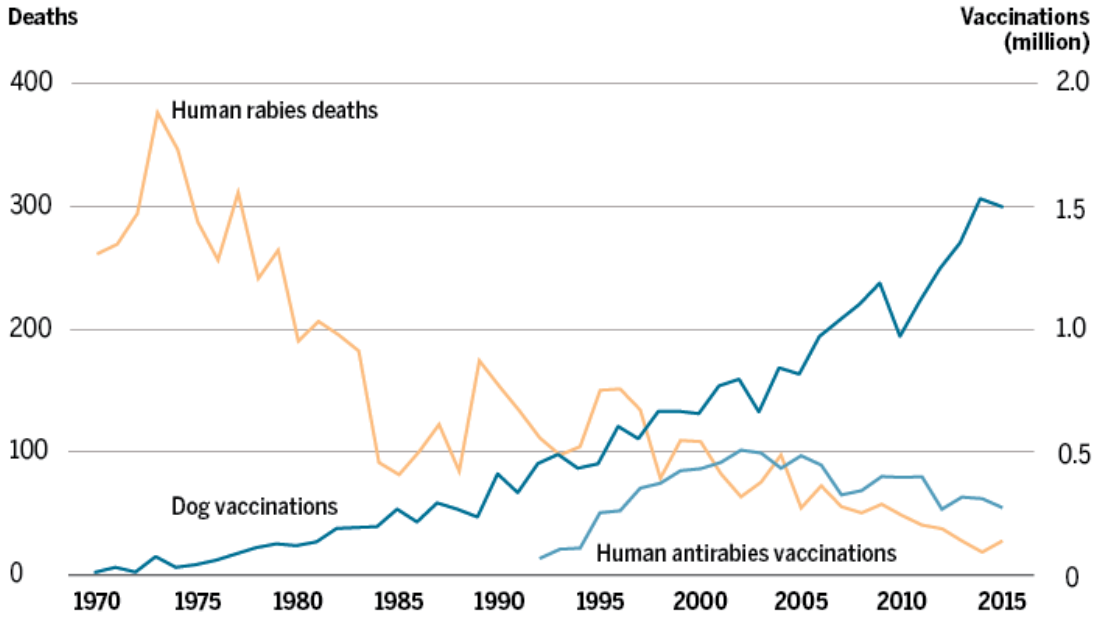


Deaths per 100,000 population.

WHO 2017

Effects of dog vaccination on rabies rates.
KwaZulu Natal (L), Sri Lanka (R).





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- Hospital-acquired infections.
- Secondary route for respiratory and oral infections.
- Touch to mucus membrane. Ebola, Lassa.
- Touching animals.
- Touching soil, sand, water. Several parasites, fungi, bacteria.
- Puncture of skin- wound infections, rabies, tetanus.

Rodin