How do parasites survive inside an immunocompetent host ?

* **Ectoparasites**  
  Infestation leads to local lesions of minor to moderate importance. This leads only to:
* allergic reactions (itching)
* immunological reactions

None of these reactions really harm the parasite, but do harm the host

* **Intracellular parasites**  
  These parasites try to escape any immunological reactions mounted by the host by hiding themselves inside the host cells where the immune system cannot reach them.  
  Examples are:
  + *Toxoplasma* in lymphocytes,
  + *Plasmodium* in erythrocytes,
  + *Leishmania,* in macrophages,
  + *T.cruzi* in muscle cells.
* **Extracellular parasites**
  + Some parasites cover their cell surface with host serum proteins to avoid recognition by the immune system of the host  
    Examples are:
    - *Schistosoma* worms that cover themselves with host serum albumin
    - Rodent trypanosomes that cover themselves with ablastin (IgE)
  + Antigenic variation in the African trypanosomes that live freely in the bloodstream and body fluids of the host is another effective mechanism of evasion.
  + Cyst formation by *Entamoeba* and other amoeboid parasites

Some morphological/physiological adaptations of parasites inside the host:

* + 1. loss of digestive tract of tapeworms
    2. loss of many sensory structures of nematodes
    3. development and refinement of a TEGUMENT; a living external layer of digenes, cestodes and acanthocephala that allows digestion and other functions across body surface
    4. development of special holdfast organs, including hooks, suckers, teeth, clamps, cutting plates, spines
    5. production of anti-coagulants in hookworms

Harmful effects of the parasite on the host

Many parasites cause harmful effects to their host, but in most cases these effects are not of such importance that the host is being killed.

Such effects comprise:

* **Wasting**   
  African trypanosomiasis and leishmaniasis may lead to severe loss of weight in both animals and man.
* **Superinfections**   
  In the case of mucocutaneous leishmaniasis ulcerations may lead to superinfections with bacteria
* **Production of toxic compounds**   
  It is thought that the African trypanosome, when in the central nervous system, produces aromatic amino-acid analogues that may influence brain function.
* **Immunodepression**   
  Malaria, bilharziasis, etc., lead to a certain degree of immune suppression which renders the infected host more susceptible to other diseases.
* **Allergic reactions**  
  In the case of onchocerciasis (river blindness) the presence of the filarial worms under the skin may lead to depigmentation due to allergic reactions.
* **Anaphylactic shock** may be induced by the sudden release of large amounts of parasite internal antigens into the bloodstream.
  + In malaria this occurs when the merozoites are released in waves from infected erythrocytes.
  + In African trypanosomiasis or sleeping sickness this occurs when the immune response leads to the massive killing and lysis of the circulating parasites.
  + Also drug treatment leading to a massive killing of the parasites may result in anaphylactic shock.
* **Mechanical damage**
  + In the case of malaria the lysis of erythrocytes does lead to haemolysis and anaemia.
  + In the case of *Ascaris* infection the presence of the worms in the small intestine may lead to intestinal occlusions
* **Irritative reflexes** (intestinal contractions: *Ascaris*)
* **Irritation of skin and tissues** by ecto- and endoparasites

Prophylaxis against parasitic infections

**Prophylactic measures against parasitic infections** **and their examples are:**

* **Isolate the parasite reservoir (PR)**  
  In the case of a zoonozis such as leishmaniasis it would be sufficient to remove the infected dogs from the houshold.
* **Sterilize PR**   
  In the case of schistosomiasis the PR can be sterilized either by treatment of the population by chemotherapy with drugs or by hygienic measures such as the placement of latrines in or just outside the villages.
* **Eliminate intermediate host**  
  In the case of schistosomiasis treatment of lakes and rivers with molluscicides would interrupt transmission via the snail as intermediate host.
* **Eliminate vectors**  
  Treatment of surface water with larvicides or the application of insecticides in the house in the case of malaria will reduce or prevent transmission.
* **Isolate vectors**  
  The use of bed nets, impregnated or not, with insecticides is an effective protection against mosquito bites.
* **Carry out chemoprophylaxis**  
  The preventive use of chloroquine for long periods when travelling in areas where malaria is endemic
* **Vaccination**  
  This would be the most efficient protective measure. However, so far there is no vaccine available for any parasitic disease of humans.

Parasite Vaccines

**What does a vaccine do ?**

* + Stimulates normal protective immune response of host to fight invading pathogen.

**Why develop parasite vaccines?**

* Part of a control program

→ Advantages over drugs & disease prevention strategies.

* History of success in other diseases

*→* anti-viral & anti-bacterial vaccines.

**What knowledge is needed to produce a a successful vaccine ?**

1. Understand life cycle of parasite → find best target stage.

2. Understand immune mechanisms stimulated by parasite

→ humoral /cellular response .

**Problems Remaining in Producing Parasite Vaccines**

* Parasites are comparatively complex organisms
* Parasites have complex life cycles
* Poor understanding of the immune mechanisms (cellular or humoral) required to eliminate parasite infections.

**Success with commercial parasite vaccines ?**

1. Conventional approaches

* *Theileria:* attenuated live vaccines.

1. Molecular approaches

* Ticks: recombinant antigen.

**Why limited success in parasite vaccine development ?**

* Parasites avoid, deflect & confuse host immune system.
* Right parasite antigens not identified yet: complicated life cycles.

(maybe 20,000 proteins in nematodes).

* Protective host responses not understood in target species : multi-responses (most research in rodent models).

**Types of Vaccines.**

1. Whole pathogens killed prior to inoculation.

2. Attenuated live or low virulence vaccines.

3. Protein Subunit vaccines.

→ Natural tissue purified proteins.

→ Recombinant protein antigens.

→ Chemical small peptide vaccines.

4. Nucleic acid vaccines.

**Trials with molecular vaccines:**

* Schistosomiasis

Some only reduce egg output not worm burden *–* decreasing pathology.

* Malaria
* Hydatid disease
* Leishmaniasis

**In order to develop a successful vaccine you need to understand:**

* The life cycle of the parasite to identify which is the best target stage.
* The immune mechanisms stimulated by the parasite

https://www.youtube.com/watch?v=ovJ8Pxoo3NM

<https://www.google.com/search?q=parasite+damage+tissues&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjIvfLM2q3JAhWCWxQKHbrOBsAQ_AUIBygB&biw=1262&bih=549#tbm=isch&q=loaloa&imgrc=9yH5N6x9PN-ftM%3A> loa

<https://www.youtube.com/watch?v=JWh-rpCsVQw> final

<https://www.youtube.com/watch?v=J-VEXp3UBR8> mid