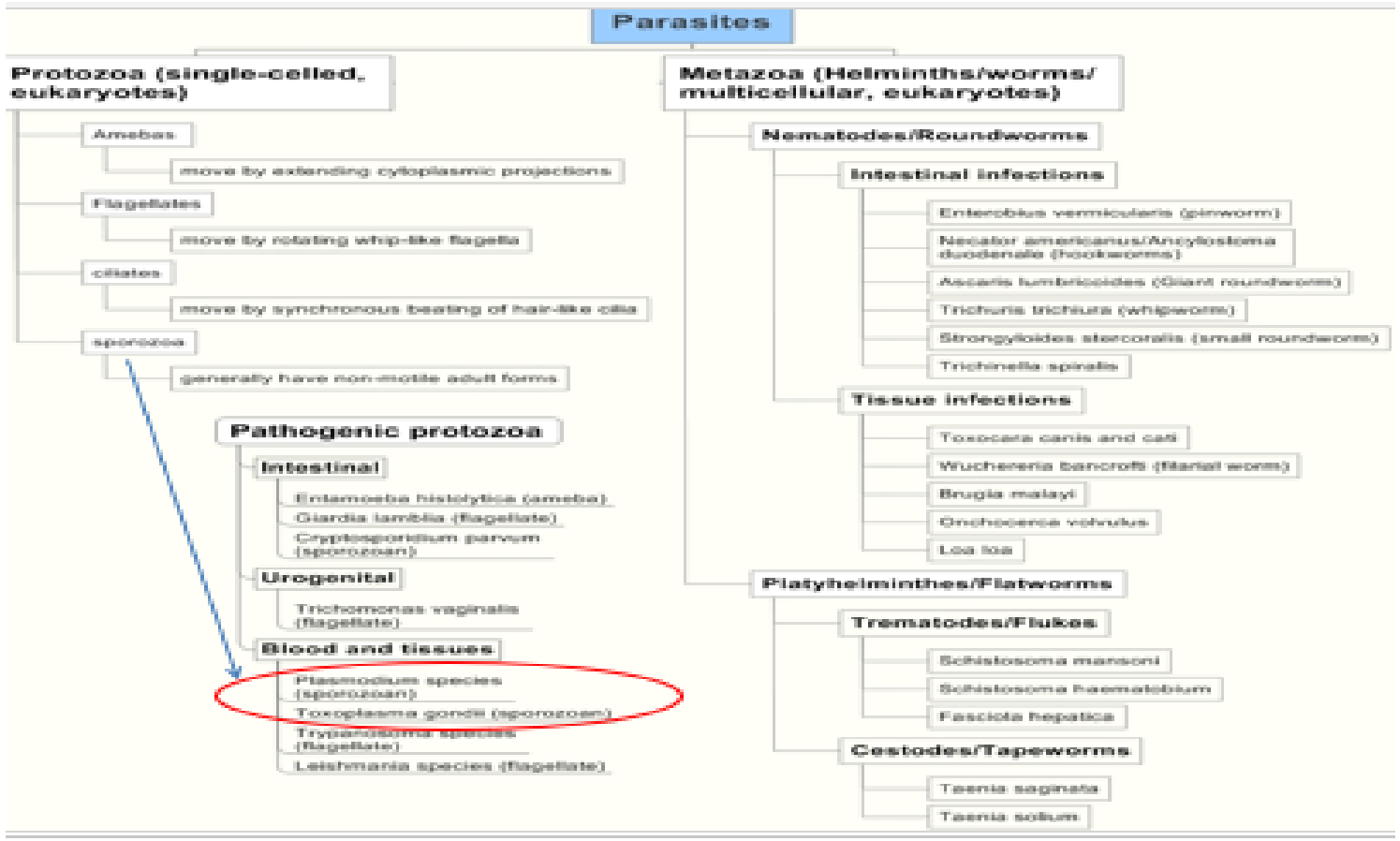
Parasitology II

Toxoplasma

Plasmodium



Toxoplasma gondii – characteristic, terminology

- coccidian parasite, intracellular parasite, and
- animals - including birds and humans
- only one species exists
- reservoir - cat and other felines
- "Toxoplasma" - Greek - crescent shape (bow-shaped)

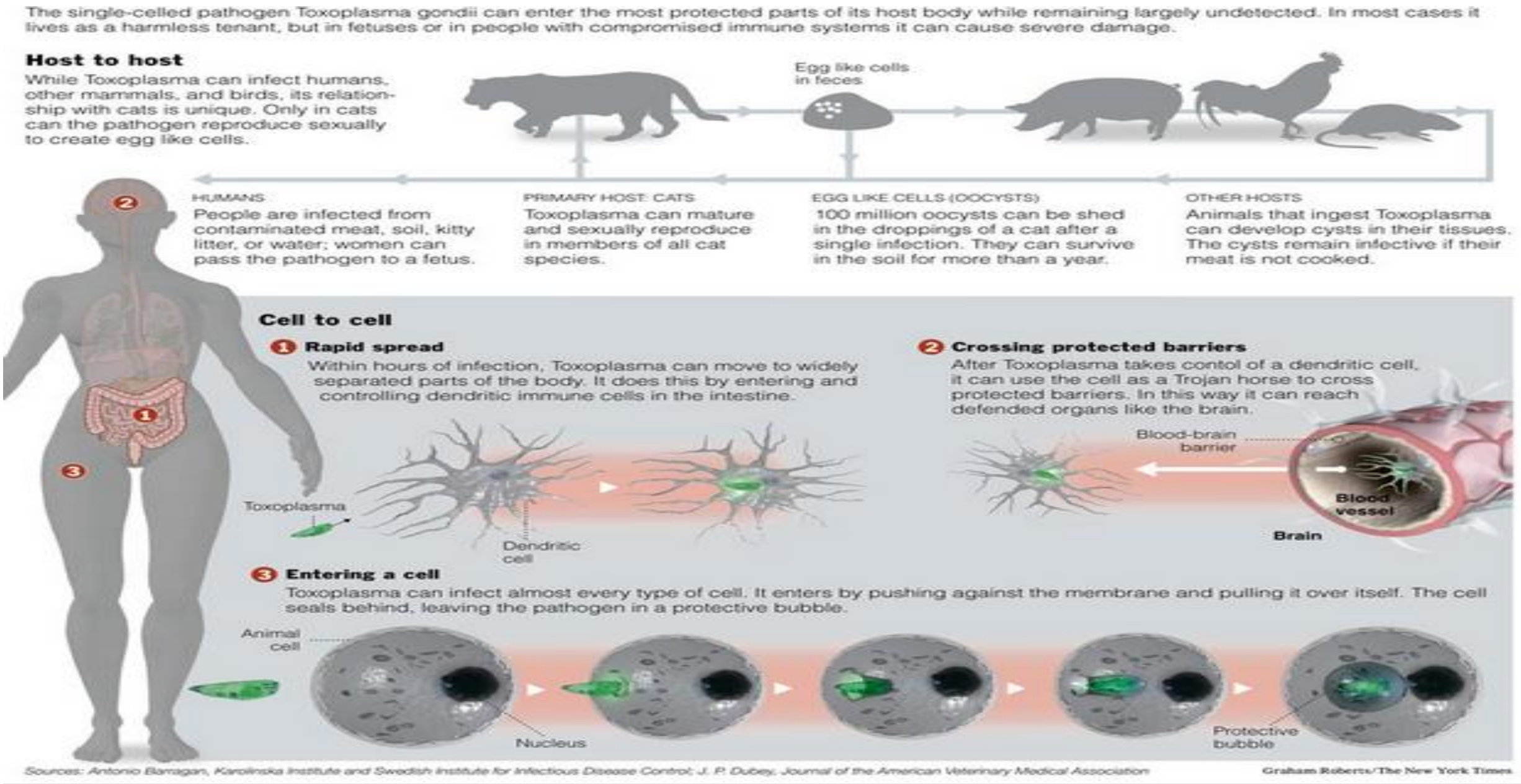
Terminology:

- **Tachyzoites** (tachos = fast) - rapidly growing - also called endozoites or trophozoites
- **Bradyzoites** (brady = slow), also called cystozoites, are the life stage found in the tissue cyst, replicate slowly
- **Sporozoites** develop over the course of several days inside the oocysts that are shed by felids into the external environment
- **Oocysts - environmentally resistant stage of the protozoan parasite *Toxoplasma gondii***

Toxoplasma - physiology and structure

- apical complex - host cell penetration, establishment of intracellular parasitism.
- complex life cycle
- sexual phases - definitive host (felids)
- asexual phases - definitive and intermediate hosts
- sexual reproduction - oocysts - excreted in faeces of felids

Toxoplasmosis biological cycle – transmission pathway



https://sites.google.com/site/parasiticprotozoa/infection-prevention-and-transmission

Toxoplasmosis – developmental stages

- **tachyzoite** -rapid multiplication
  -acute infections

- **bradyzoite** - slow multiplication
  - chronic infection
  - tissue cysts

- **Sporozoite** -only in definitive host
  - during sexual reproduction
  - released in oocysts (felid feces)

Toxoplasmosis in definitive host

- sexual cycle - Felidae family
- feline - ingesting prey with tissue cysts, or oocysts excreted by another feline
- Ingestion - cysts disrupted -releasing bradyzoites or sporozoites
- intestinal epithelial - invaded
- Parasite turn into schizonts (asexual reproduction)

Toxoplasma - life cycle in intermediate host

- **Oocysts - 1–5 days - sporulate (in environment) - become infective**
- Intermediate hosts -infected - ingesting oocysts
- Oocysts - tachyzoites (after ingestion) - neural, muscle tissue - tissue cyst- bradyzoites
- human - tissue cysts - skeletal muscle, myocardium, brain, eyes - throughout the life

Toxoplasmosis – clinical manifestation

- asymptomatic infection
- symptoms - parasite in tissues - intracellular parasite

symptomatic disease

- cell destruction, reproduction of organisms, cyst formation

predilection for:

- lung, heart, lymphoid organs, and CNS, including the eye

Toxoplasmosis – clinical manifestation

- **acute** disease - chills, fever, headaches, myalgia, lymphadenitis, fatigue(infectious mononucleosis like symptoms)

- **chronic** disease - lymphadenitis, hepatitis, encephalomyelitis, myocarditis
- **chorioretinitis** –blindness

- **Congenital infection** - primary infection during pregnancy - infection of the fetus- abortion or congenital disease (mental retardation, blindness)

Toxoplasmosis – laboratory diagnosis

- **Observation of parasites** - **bronchoalveolar lavage** material from immunocompromised patients, **lymph node biopsy**.
- **Isolation** - from **blood** or other body fluids, by intraperitoneal inoculation into mice or tissue culture. The mice should be tested for the presence of *Toxoplasma* organisms in the peritoneal fluid 6 to 10 days post inoculation; if no organisms are found, serology can be performed on the animals 4 to 6 weeks post inoculation.
- **Detection - PCR**, - detecting congenital infections in utero
- **<u>Serologic testing is the routine method of diagnosis</u>**

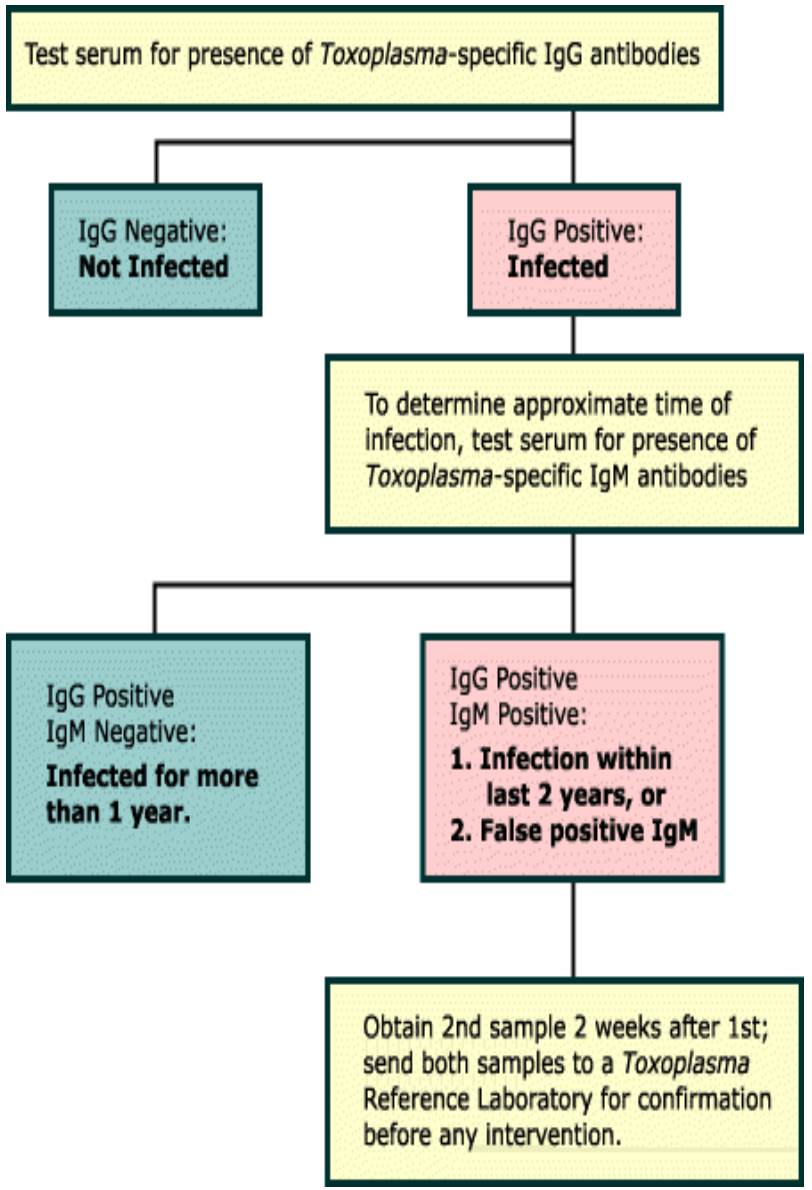
- IFA and EIA tests for IgG and IgM antibodies

- KFR – total antibodies

Toxoplasmosis – interpretation of results

IgG result	IgM result	Report/interpretation for humans*
Negative	Negative	No serological evidence of infection with *Toxoplasma*.
Negative	Equivocal	Possible early acute infection or false-positive IgM reaction. Obtain a new specimen for IgG and IgM testing. If results for the second specimen remain the same, the patient is probably not infected with *Toxoplasma*.
Negative	Positive	Possible acute infection or false-positive IgM result. Obtain a new specimen for IgG and IgM testing. If results for the second specimen remain the same, the IgM reaction is probably a false-positive.
Equivocal	Negative	Indeterminate: obtain a new specimen for testing or retest this specimen for IgG in a different assay.
Equivocal	Equivocal	Indeterminate: obtain a new specimen for both IgG and IgM testing.
Equivocal	Positive	Possible acute infection with *Toxoplasma*. Obtain a new specimen for IgG and IgM testing. If results for the second specimen remain the same or if the IgG becomes positive, both specimens should be sent to a reference laboratory with experience in diagnosis of toxoplasmosis for further testing.
Positive	Negative	Infected with *Toxoplasma* for more than 1 year.
Positive	Equivocal	Infected with *Toxoplasma* for probably more than 1 year or false-positive IgM reaction. Obtain a new specimen for IgM testing. If results with the second specimen remain the same, both specimens should be sent to a reference laboratory with experience in the diagnosis of toxoplasmosis for further testing.
Positive	Positive	Possible recent infection within the last 12 months, or false-positive IgM reaction. Send the specimen to a reference laboratory with experience in the diagnosis of toxoplasmosis for further testing.

*except infants



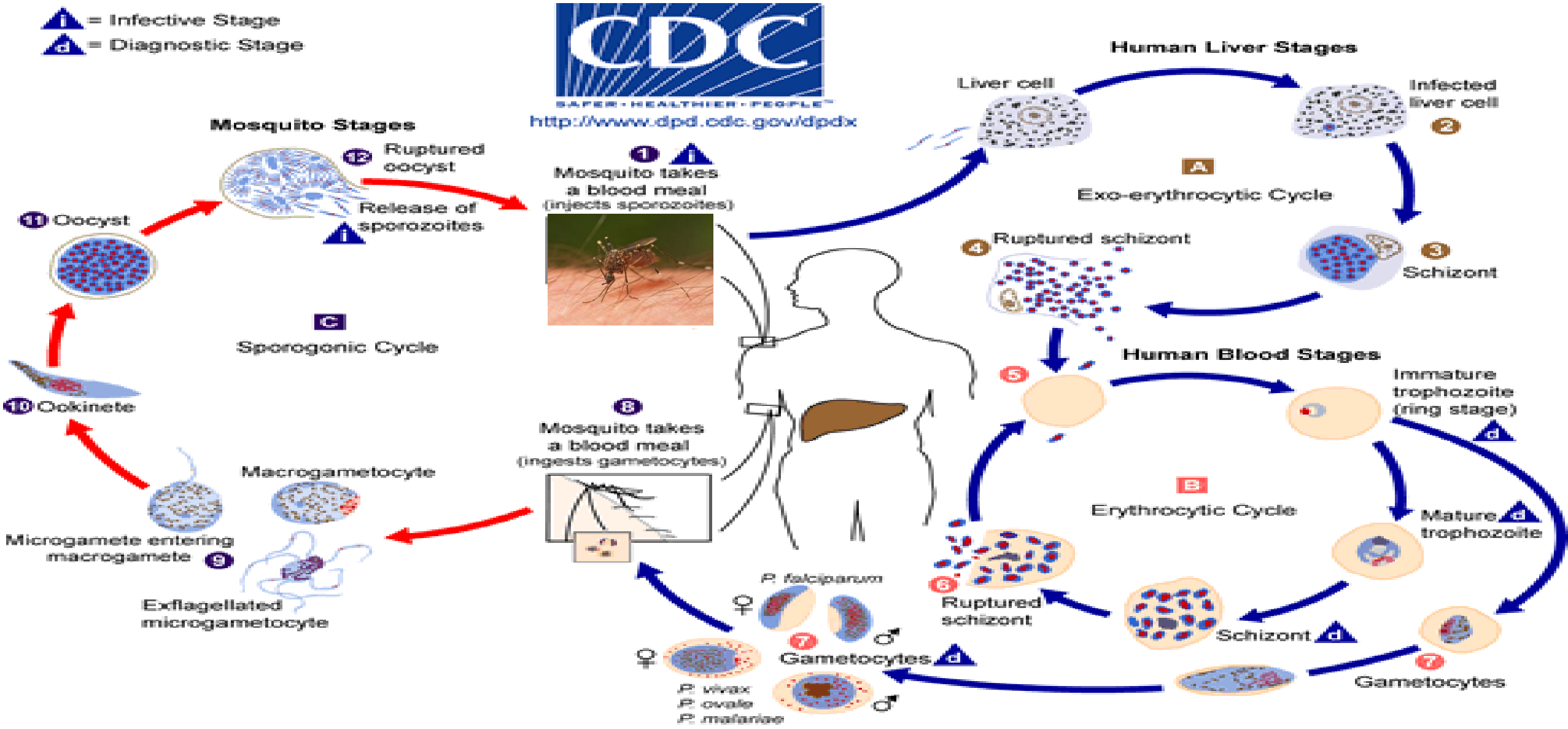
Toxoplasmosis - treatment

- normal hosts - do not require specific therapy
- HIV patients - initial high-dose of pyrimethamine + sulfadiazine, continued on lower doses of both drugs (toxicity - rash, bone marrow suppression) - alternative (Clindamycin + pyrimethamine)
- disseminated or CNS toxoplasmosis - Trimethoprim-sulfamethoxazole - alternative to pyrimethamine-sulfadiazine + corticosteroids (therapy of cerebral edema, ocular infections)
- first trimester of pregnancy – clindamycin, spiramycin
- immunocompromised patients - with positive serologic tests - prophylaxis - Trimethoprim-sulfamethoxazole

Plasmodium - characteristics

- Coccidian and porozoan parasites - red blood cells
- require two hosts:
- mosquito -sexual reproductive stages
- humans (animals) - asexual reproductive stages
- *P. falciparum*,
- *P. vivax*,
- *P. ovale*
- *P. malariae*

Plasmodium – life cycle



Plasmodium –possible ways of transmission

- mosquitos
- blood transfusions - injection drug - needles and syringes -“mainline”malaria
- congenital - rare (congenital malaria)

Plasmodium spp. - malaria types

Table of differences between the various types of parasites that cause malaria				
Plasmodium type	**Type that causes malaria**	**Endemic area**	**Febrile seizures period**	**Involvement and severity**
Falciparum	tropical malaria	In all endemic areas	Irregular Crisis	Very serious It can cause death if not treated quickly and effectively.
Vivax	tertian malaria	South America and Asia	Every 2 days	Grave, but with a delayed onset.
malariae	quartan malaria	South America and Asia	Every 3 days	Moderate, less frequently.
Ovale	tertian malaria	Africa	Every 2 days	Moderate, less frequently.
Knowlesi	It is mistaken with quartan malaria	Malaysia, Thailand and Cambodia	Every 24 hours	It can cause death if not treated quickly and effectively.

Plasmodium falciparum

- no selectivity in host erythrocytes
- invades any (RBC) - any stage of RBC
- multiple merozoites in single erythrocyte - three (four) rings in infected RBC
  - edge or periphery of the cell membrane
- tropical and subtropical regions - co-infection with HIV - risk factor for severe malaria
- incubation period - the shortest (7 to 10 days)
- early influenza-like symptoms
- daily **(quotidian)** chills, fever, nausea, vomiting, diarrhea
- periodicity - becomes **tertian (36 to 48 hours) -** fulminating disease
- **malignant tertian malaria**

Plasmodium knowlesi

- **Old World monkeys** - macaques - *Anopheles leucosphyrus* - forests
- infrequent contact with humans
- relaxed host specificity - permissive in humans (natural and experimental conditions)
- erythrocyte invasion - not restricted to young or old RBCs - high levels of parasitemia
- short life cycle - **24 hours (quotidian) -** nonspecific febrile illness - daily fever and chills - tachypnoe, pyrexia, tachycardia - pulmonary and hepatorenal failure

  (misidentified as *P. falciparum* or *P. malariae* - early trophozoites resemble the ring forms of *P. falciparum* and its later stages mimic those of *P. malariae)*

- Infected **RBCs** - **normal** morphology - **all developmental stages** in peripheral blood

- Malaysia; neighboring countries - natural parasite of macaques throughout the **Southeast Asia region**

Plasmodium vivax

- young, immature erythrocytes - infected RBCs enlarged - pink granules (**Schüffner dots)**
- trophozoite - ring shaped, ameboid in appearance
- mature schizonts - golden-brown **hemozoin** pigment granules **(malarial pigment)**
- incubation period (10 to 17 days) - influenza-like - infection progresses - increased numbers of rupturing erythrocytes - merozoites, toxic cellular debris and hemoglobin in blood - chills, fever, malarial rigors

- **paroxysms** - periodically (every 48 hours) - **"benign tertian malaria,"** - most patients tolerate attacks - survive for years without treatment
- recent evidence - **spectrum of severe, life-threatening syndromes -** delirium, seizures, renal failure, shock, hepatic dysfunction, severe anemia, lung injury, pulmonary edema, acute respiratory distress - untreated, chronic infections - brain, kidney, liver damage

- >80% of clinical cases - South America and Southeast Asia

Plasmodium ovale

- young erythrocytes - enlarged - oval form - Schüffner dots
- mature schizont - ½ number of merozoites (compared w. *P. vivax)*
- malarial pigment - darker brown
- tertian attacks - (benign tertian or ovale malaria) - similar to *P. vivax*
- untreated infections - last only about 1 year
- tropical Africa, Asia, South America

Plasmodium malariae

- only **mature erythrocytes** - parasites conform to the size and shape of the RBC - **no enlargement** or distortion of RBCs
- parasite in host cell - **“band and bar forms”,** compact darkstaining forms
- schizont - eight merozoites - rosette surrounding dark brown central pigment granule
- reddish granules - **Ziemann dots** - in the host cell
- parasite not found in the liver

- incubation period - the longest (18 to 40 days, several months to years) - influenza like - fever periodicity **72 hours (quartan or malarial malaria)** - moderate to severe, last several hours
- untreated - last s 20 years

- subtropical and temperate regions as the other plasmodia - less prevalent

Laboratory diagnosis

- symptoms
- microscopic blood diagnosis , rapid diagnostic tests, molecular methods

Malaria - treatment

- **Chloroquine -** drug of choice for the treatment and prophylaxis - acts against the asexual intra-erythrocytic forms P.*vivax*, *P.ovale* and *P.malariae* - safe for children and in pregnancy
- **Quinine** - alternative in managing a chloroquine-resistant case,
- **Mefloquine, Primaquine, Tafenoquine**

sources

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