Common Parasitic Pathogens

Parasitic pathogens

Three types of parasitic pathogen

?  ?  ?
Common Parasitic Pathogens

Parasitic pathogens

Three types of parasitic pathogen

Protozoa  Helminths  Arthropods
Broadly speaking, what are protozoa?
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They are unicellular eukaryotes capable of some form of motility. Protozoa feed on organic material, and many are parasites.
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How do eukaryotes and prokaryotes differ?
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They are unicellular eukaryotes capable of some form of motility. Protozoa feed on organic material, and many are parasites. The term *protozoa* is considered outdated by modern biologists, but it persists in the ophthalmic literature.

How do eukaryotes and prokaryotes differ?
Eukaryotic cells have a three words, whereas prokaryotic cells do not.
Broadly speaking, what are protozoa?
They are unicellular eukaryotes capable of some form of motility. Protozoa feed on organic material, and many are parasites. The term protozoa is considered outdated by modern biologists, but it persists in the ophthalmic literature.

How do eukaryotes and prokaryotes differ?
Eukaryotic cells have a membrane-bound nucleus, whereas prokaryotic cells do not.
Likewise, what are helminths?
Likewise, what are helminths?
Helminths are parasitic worms (or worm-like organisms).
By definition, they live inside the body of their host.
Protozoa

Parasitic pathogens

Helminths

Arthropods

Finally—what are arthropods?
Finally—what are arthropods?

Arthropods are bugs—literally. They have a body, and may have an exoskeleton and/or appendages.
Common Parasitic Pathogens

Parasitic pathogens

Protozoa

Helminths

Arthropods

Four protozoa discussed in one or more of the BCSC books
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths

Arthropods

Four protozoa discussed in one or more of the BCSC books
Acanthamoeba is notorious for causing what sort of ocular infection?

- A devastating, sight-threatening keratitis

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_Acanthamoeba_ exist in two forms (ie, life-cycle stages). What are they?

- The motile _trophozoite_ (infectious)
- The hard-to-kill _cyst_
Acanthamoeba is notorious for causing what sort of ocular infection? A devastating, sight-threatening keratitis.
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-- ?
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Acanthamoeba exist in two forms (ie, life-cycle stages). What are they?

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--?
Common Parasitic Pathogens

Trophozoite form

Acanthamoeba
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--- The motile trophozoite
--- The hard-to-kill cyst
Common Parasitic Pathogens

Acanthamoeba

Trophozoite form

Cyst form
Acanthamoeba is notorious for causing what sort of ocular infection? A devastating, sight-threatening keratitis.

Acanthamoeba exist in two forms (life-cycle stages). What are they? Which form is infectious?
-- The motile **trophozoite** (is infectious?)
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What medium is used when culturing for Acanthamoeba?
Non-nutrient agar with E. coli overlay

When placed on such a culture plate, the motile trophozoite form of the amoeba will respond by grazing its way around the plate, in the process leaving observable trails.
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Which form is infectious?
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What medium is used when culturing for Acanthamoeba?
Non-nutrient agar with E. coli overlay

What constitutes a positive ‘culture’?
When placed on such a culture plate, the trophozoite form of the amoeba will graze, in the process leaving observable trails in the agar
Acanthamoeba: Feeding tracks on non-nutrient agar *E coli* plate
**Common Parasitic Pathogens**

Parasitic pathogens

- **Protozoa**
  - *Acanthamoeba*
  - *Toxoplasma*

- **Helminths**
  - *Microsporidia*
  - *Leishmania*

- **Arthropods**

---

**Acanthamoeba**

- **What is the most common misdiagnosis of early Acanthamoeba keratitis?**
  - HSV keratitis
  - Why HSV?
  - Because early Acanthamoeba keratitis is often dendritic in appearance at the slit lamp

- **What constitutes a positive culture?**
  - When placed on such a culture plate, the motile trophozoite form of the amoeba will respond by grazing its way around the plate, leaving **observable trails** in the agar

- **What medium is used when culturing for Acanthamoeba?**
  - Non-nutrient agar with E. coli overlay

- **Which form is infectious?**
  - The motile **trophozoite** (is infectious!)

- **Exist in two forms (ie, life-cycle stages). What are they?**
  - The hard-to-kill **cyst**
**Common Parasitic Pathogens**

Parasitic pathogens

- Protozoa
  - *Acanthamoeba*
- Helminths
- Arthropods

*Protozoa*

*Microsporidia*

*Leishmania*

*Acanthamoeba* is notorious for causing what sort of ocular infection?

- A devastating, sight-threatening keratitis

*Acanthamoeba* exist in two forms (ie, life-cycle stages). What are they?

- Which form is infectious?
  - The motile *trophozoite* (is infectious!)
  - The hard-to-kill *cyst*

What medium is used when culturing for *Acanthamoeba*?

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What constitutes a positive ‘culture’?

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Acanthamoeba keratitis

Why HSV?

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 Protozoa

 Acanthamoeba

Helminths

Arthropods

**Common Parasitic Pathogens**

**Parasitic pathogens**

Acanthamoeba

A devastating, sight-threatening keratitis

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HSV keratitis

Why HSV?

Because early Acanthamoeba keratitis is often dendritic in appearance at the slit lamp
Common Parasitic Pathogens

Acanthamoeba: (Pseudo)dendrites
Toxoplasma
Parasitic pathogens

Protozoa
Acanthamoeba

Helminths

Arthropods

What is the most common misdiagnosis of early Acanthamoeba keratitis?
Acanthamoeba keratitis?
HSV keratitis

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What medium is used when culturing for Acanthamoeba?
Non-nutrient agar with E. coli overlay

What constitutes a positive ‘culture’?
When placed on such a culture plate, the motile trophozoite forms respond by grazing its way around the plate, leaving observable trails in the agar.

Dendritic in appearance??!! I thought Acanthamoeba was known for having a ring infiltrate. What’s the dealio?
**Common Parasitic Pathogens**

**Parasitic pathogens**

- **Protozoa**
  - Acanthamoeba
  - Toxoplasma

- Helminths

- Arthropods

**Acanthamoeba**

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- Why HSV?
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**What constitutes a positive ‘culture’?**

- When culturing for Acanthamoeba?
  - Non-nutrient agar with E. coli overlay

- Motile trophozoite
  - The motile trophozoite (is infectious!)

- Cyst
  - The hard-to-kill cyst

**When placed on such a culture plate, the motile trophozoite form of the amoeba will respond by grazing its way around the plate, in the process leaving observable trails in the agar.**

**Dendritic in appearance??!! I thought Acanthamoeba was known for having a ‘ring infiltrate.’ What’s the dealio?**

- A devastating, sight-threatening keratitis

- Acanthamoeba exist in two forms (ie, life-cycle stages). What are they?
  - Motile trophozoite
  - Cyst

- Which form is infectious?
  - The motile trophozoite (is infectious!)

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What is the most common misdiagnosis of early Acanthamoeba keratitis?
Acanthamoeba keratitis?
HSV keratitis
Why HSV?
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Dendritic in appearance??!! I thought Acanthamoeba was known for having a ‘ring infiltrate.’ What’s the dealio?
A ring-shaped infiltrate is indeed classic for Acanthamoeba; however, it is a relatively late finding in the dz

When culturing for Acanthamoeba?
Non-nutrient agar with E. coli overlay

What constitutes a positive ‘culture’?
When placed on such a culture plate, the motile trophozoite respond by grazing its way around the plate, leaving observable trails in the agar

Protozoa
Acanthamoeba

Helminths
Arthropods

Parasitic pathogens
Acanthamoeba: Ring-shaped infiltrate
Acanthamoeba is notorious for causing what sort of ocular infection?
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In what key way do the dendrites of Acanthamoeba keratitis differ from those of HSV keratitis?
- HSV dendrites usually have terminal bulbs, whereas Acanthamoeba dendrites don't. Be sure to evaluate all dendrites carefully for the presence of terminal bulbs!
Acanthamoeba is notorious for causing what sort of ocular infection?
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Why HSV?
- Because early Acanthamoeba keratitis is often dendritic in appearance

Dendritic in appearance?!!! That’s actually a ‘ring infiltrate.’ What’s the dealio?
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Common Parasitic Pathogens

Parasitic pathogens

Protozoa

- *Acanthamoeba*

Helminths

Arthropods

Microsporidia

*Leishmania*

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Common Parasitic Pathogens

HSV dendrites: Terminal bulbs (look carefully)
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba

Helminths

Arthropods

Acanthamoeba

What is the most common misdiagnosis of early Acanthamoeba keratitis?

Acanthamoeba keratitis?

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Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba

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In what key way might the presenting complaint of an Acanthamoeba keratitis patient differ from that of an HSV keratitis patient?
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Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths

Arthropods

Acanthamoeba is notorious for causing what sort of ocular infection?
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Why HSV?

Because early Acanthamoeba keratitis is often dendritic in appearance at the slit lamp.

Why is Acanthamoeba keratitis so painful?

Because the bug has a propensity for perineural invasion.

What is the most common misdiagnosis of early Acanthamoeba keratitis?

HSV keratitis

Why HSV?

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Dendritic in appearance??!! I thought Acanthamoeba was known for having a 'ring infiltrate.' What’s the dealio?

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Why is Acanthamoeba keratitis so painful? Because the bug has a propensity for periocular invasion.

The most common misdiagnosis of early Acanthamoeba keratitis is HSV keratitis. Why HSV? Because early Acanthamoeba keratitis is often dendritic in appearance at the slit lamp.

Acanthamoeba dendrites don’t have terminal bulbs. Evaluate all dendrites carefully for the presence of terminal bulbs! A ring-shaped infiltrate is indeed classic for Acanthamoeba keratitis; however, it is a relatively late finding in the disease.
What is the most common misdiagnosis of early *Acanthamoeba* keratitis?

**HSV keratitis**

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Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
to - Microsporidia

Helminths

Arthropods

What is the full name of the causative organism in ocular toxoplasmosis?

Toxoplasma gondii

Everywhere—it has a worldwide distribution
- Yes—it's likely that a billion people are infected worldwide

What animal is its definitive host?
- The cat
Parasitic pathogens

Protozoa

- Acanthamoeba
- Toxoplasma
- Microsporidia

Helminths

Arthropods

Common Parasitic Pathogens

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Common Parasitic Pathogens

Toxoplasma gondii
Parasitic pathogens

Protozoa
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Arthropods

What is the full name of the causative organism in ocular toxoplasmosis?
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*Where in the world can T gondii be found?*

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Common Parasitic Pathogens

Parasitic pathogens

Protozoa

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*Where in the world can T gondii be found? Is it a common human pathogen?*
Everywhere—it has a worldwide distribution
Common Parasitic Pathogens

Parasitic pathogens

Protozoa

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Where in the world can *T* gondii be found? Is it a common human pathogen? Everywhere—it has a worldwide distribution. Yes—it’s likely that a big number of people are infected worldwide.
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Parasitic pathogens

Protozoa
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Common Parasitic Pathogens

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Parasitic pathogens

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Common Parasitic Pathogens

Parasitic pathogens

Protozoa
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Helminths

Arthropods

What is the full name of the causative organism in ocular toxoplasmosis?

Which ocular structures are most commonly involved in Toxoplasma infection?

What animal is its definitive host?
The cat

Everywhere—it has a worldwide distribution
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What animal is its definitive host?
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
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Helminths

Arthropods

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Where in the world can *T. gondii* be found? Is it a common human pathogen?

Everywhere—it has a worldwide distribution

Yes—it's likely that a billion people are infected worldwide

What animal is its definitive host?
The cat

Which ocular structures are most commonly involved in *Toxoplasma* infection?
The retina and choroid

Is toxoplasmosis a common form of infectious posterior uveitis?

It is indeed—in fact, it is the most common
Classic presentation of *Toxoplasma* retinochoroiditis:
An active retinal lesion next to an old inactive scar
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
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Helminths

Arthropods

What is the full name of the causative organism in ocular toxoplasmosis?
Toxoplasma gondii

Where in the world can T gondii be found? Is it a common human pathogen?
Everywhere—it has a worldwide distribution; Yes—it's likely that a billion people are infected worldwide

What animal is its definitive host?
The cat

Which ocular structures are most commonly involved in Toxoplasma infection?
The retina and choroid

Is toxoplasmosis a common form of infectious posterior uveitis?

What animal is its definitive host?
The cat
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
  - Acanthamoeba
  - Toxoplasma
  - Microsporidia

Helminths

Arthropods

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Parasitic pathogens

Protozoa

Helminths

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Is toxoplasmosis a common form of infectious posterior uveitis? It is indeed—in fact, it is the most common.

What are the three common means of catching the toxo bug?

---

- Ingestion of undercooked meat (number one type: pork) that harbors toxo cysts
- Ingestion of cysts directly from cat feces (well, not directly)

What animal is its definitive host?
The cat
Parasitic pathogens

Protozoa

Helminths

Arthropods

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Parasitic pathogens

**Common Parasitic Pathogens**

- Acanthamoeba
- **Toxoplasma**
- Microsporidia

**Toxoplasmosis** has its own slide-set (U7); see it for more detail re this very important bug!

---

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Parasitic pathogens

- Protozoa
  - Acanthamoeba
  - Toxoplasma
  - Microsporidia
  - Leishmania

- Helminths

- Arthropods

Note: The *Cornea* book mentions that there is evidence suggesting *Microsporidia* might actually be a fungus, but for now it is still classified (by the book) as a protozoan.
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths

Arthropods

Note: The Cornea book mentions that there is evidence suggesting Microsporidia might actually be a fungus, but for now it is still classified (by the book) as a protozoan.
What sort of ocular infection is caused by Microsporidia?

AIDS patients

Topical fumagillin
What sort of ocular infection is caused by Microsporidia?

Keratitis

Who (ie, what pt population) gets Microsporidia keratitis?

AIDS patients

How is Microsporidia keratitis diagnosed?

Electron microscopy of corneal scrapings

What is the treatment for Microsporidia keratitis?

Topical fumagillin
What sort of ocular infection is caused by Microsporidia?
Keratitis

Who (ie, what pt population) gets Microsporidia keratitis?
AIDS patients

What is the treatment for Microsporidia keratitis?
Topical fumagillin

Common Parasitic Pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- *Microsporidia*
- Leishmania
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- **Microsporidia**
- Leishmania

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**Common Parasitic Pathogens**

**Parasitic pathogens**

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- Toxoplasma
- *Microsporidia*
- Leishmania

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What is the treatment for Microsporidia keratitis? Topical fumagillin
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths

Arthropods

What ophthalmic condition is associated with Leishmania?
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths

Arthropods

What ophthalmic condition is associated with Leishmania?
An eyelid ulcer as a manifestation of cutaneous leishmaniasis
(the general term for the condition caused by this protozoan)
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

What ophthalmic condition is associated with Leishmania?
An eyelid ulcer as a manifestation of cutaneous leishmaniasis (the general term for the condition caused by this protozoan)

What is the mechanism by which humans become infected?
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
  - Acanthamoeba
  - Toxoplasma
  - Microsporidia
  - Leishmania

Helminths

Arthropods

What ophthalmic condition is associated with Leishmania?
An eyelid ulcer as a manifestation of cutaneous leishmaniasis (the general term for the condition caused by this protozoan)

What is the mechanism by which humans become infected?
Via a bite by the (female) sandfly
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- ?
- ?
- ?

Arthropods

Three worms addressed in the BCSC
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

Three worms addressed in the BCSC
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca

Arthropods

Toxocara has its own slide-set (U22)
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

The three helminths implicated in DUSN are covered in slide-set R15
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

What does DUSN stand for in this context?

The three helminths implicated in DUSN are covered in slide-set R15
Parasitic pathogens

Protozoa
- *Acanthamoeba*
- *Toxoplasma*
- *Microsporidia*
- *Leishmania*

Helminths
- *Toxocara*
- *Onchocerca*
- *Loa Loa*

Arthropods

*What does DUSN stand for in this context?*
*Diffuse unilateral subacute neuroretinitis*

*The three helminths implicated in DUSN are covered in slide-set R15*
The three helminths implicated in DUSN are...?
are covered in slide-set R15
The three helminths implicated in DUSN are…?
are covered in slide-set R15
Parasitic pathogens

- Protozoa
  - Acanthamoeba
  - Toxoplasma
  - Microsporidia
  - Leishmania

- Helminths
  - Toxocara
  - Onchocerca
  - Loa Loa

Re helminthic ocular conditions…
Which causes a condition known as river blindness?
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Re helminthic ocular conditions...
Which causes a condition known as river blindness? Onchocerca
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

Re helminthic ocular conditions...
Which causes a condition known as *river blindness*? *Onchocerca*
Which is transmitted via the bite of the blackfly?
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Re helminthic ocular conditions...
Which causes a condition known as river blindness? Onchocerca
Which is transmitted via the bite of the blackfly? Onchocerca
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

Re helminthic ocular conditions...

Take note, and don’t get them confused!
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

Re helminthic ocular conditions...
Which causes a condition known as river blindness? Onchocerca
Which is transmitted via the bite of the blackfly? Onchocerca
Which can be observed moving beneath the conjunctiva?
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

Re helminthic ocular conditions...
Which causes a condition known as river blindness? *Onchocerca*
Which is transmitted via the bite of the blackfly? *Onchocerca*
Which can be observed moving beneath the conjunctiva? *Loa Loa*
Common Parasitic Pathogens

Loa Loa. Yikes
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

Re helminthic ocular conditions...
Which causes a condition known as river blindness? Onchocerca
Which is transmitted via the bite of the blackfly? Onchocerca
Which can be observed moving beneath the conjunctiva? Loa Loa
Which can be observed swimming in the AC?
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Re helminthic ocular conditions...
Which causes a condition known as river blindness? Onchocerca
Which is transmitted via the bite of the blackfly? Onchocerca
Which can be observed moving beneath the conjunctiva? Loa Loa
Which can be observed swimming in the AC? Onchocerca
Common Parasitic Pathogens

*Onchocerca* swimming in the AC (the video is more impressive)

https://www.youtube.com/watch?v=_xljzQAstaM
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Re helminthic ocular conditions...
Which causes a condition known as river blindness? Onchocerca
Which is transmitted via the bite of the blackfly? Onchocerca
Which can be observed moving beneath the conjunctiva? Loa Loa
Which can be observed swimming in the AC? Onchocerca
Which is a resident parasite in dogs?
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- *Toxocara*
- *Onchocerca*
- *Loa Loa*

Arthropods

Re helminthic ocular conditions...
Which causes a condition known as river blindness? *Onchocerca*
Which is transmitted via the bite of the blackfly? *Onchocerca*
Which can be observed moving beneath the conjunctiva? *Loa Loa*
Which can be observed swimming in the AC? *Onchocerca*
Which is a resident parasite in dogs? *Toxocara*
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods

Is onchocerciasis a serious condition?

Indeed it is (it ain't called river blindness for nothing!)

Yep—it's among the most common causes of infectious visual morbidity

While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it's sometimes called African river blindness.
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods

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Parasitic pathogens

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  - Acanthamoeba
  - Toxoplasma

- Helminths
  - Toxocara
  - Onchocerca

- Arthropods

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Is it common?
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods

Is onchocerciasis a serious condition?
Indeed it is (it ain’t called river blindness for nothing!)

Is it common?
Yep—it’s the second most common cause of infectious visual morbidity
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods

Is onchocerciasis a serious condition?
Indeed it is (it ain’t called river blindness for nothing!)

Is it common?
Yep—it’s the second most common cause of infectious visual morbidity

What’s the most common cause of infectious visual morbidity?
(You know this one!)
Parasitic pathogens

Protozoa
- *Acanthamoeba*
- *Toxoplasma*

Helminths
- *Toxocara*
- *Onchocerca*
- *Loa Loa*

Arthropods

*Is onchocerciasis a serious condition?*
Indeed it is (it ain’t called river blindness for nothing!)

*Is it common?*
Yep—it’s the **second most common cause** of infectious visual morbidity

What’s the most common cause of infectious visual morbidity?
(You know this one!)
*Trachoma* (told ya!)
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods

Is onchocerciasis a serious condition? Indeed it is (it ain’t called river blindness for nothing!)

OK fair, I get the ‘blindness’ part of the name now. But why is it called river blindness?

Is onchocerciasis common? Yep—it’s among the most common causes of infectious visual morbidity

Where in the world is it found? While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it’s sometimes called African river blindness.

OK fair, I get the ‘blindness’ part of the name now. But why is it called river blindness? The blackfly lives only near fast-flowing rivers, so cases tend to cluster around them.
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

Is onchocerciasis a serious condition? Indeed it is (it ain’t called river blindness for nothing!)

OK fair, I get the ‘blindness’ part of the name now. But why is it called river blindness? The blackfly lives only near fast-flowing rivers, so cases tend to cluster around them.

Is onchocerciasis a common condition? Yep—it’s among the most common causes of infectious visual morbidity.

Where in the world is it found? While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it’s sometimes called African river blindness.

African river blindness?

But why is it called river blindness?

The blackfly lives only near fast-flowing rivers, so cases tend to cluster around them.
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods

Is onchocerciasis a serious condition?
Indeed it is (it ain’t called river blindness for nothing!)

Is it common?
Yep—it’s the second most common cause of infectious visual morbidity

Where in the world does it occur?
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods

Is onchocerciasis a serious condition?
Indeed it is (it ain’t called river blindness for nothing!)

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Yep—it’s the second most common cause of infectious visual morbidity

Where in the world does it occur?
While it can be found in both Latin America and the Middle East, the locale where it is really a problem is

African river blindness.
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
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Arthropods

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Arthropods

- Loa Loa

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Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

Is *onchocerciasis* a serious condition?
Indeed it is (it ain’t called river *blindness* for nothing!)

Is it common?
Yep—it’s the second most common cause of infectious visual morbidity

Where in the world does it occur?
While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa.

What proportion of cases are in Africa?
99%

*sub-Saharan Africa*
Common Parasitic Pathogens

Onchocerciasis distribution
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods

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Where in the world does it occur?
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Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Toxocara

Arthropods
- Onchocerca

How do humans acquire the worm?

Is onchocerciasis a serious condition? Indeed it is (it ain't called river blindness for nothing!)

Is it common? Yep—it's among the most common causes of infectious visual morbidity

Where in the world does it occur? While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it's sometimes called African river blindness.

How do humans acquire the worm? They are bitten by a blackfly (you knew that already) carrying the microfilariae form of the worm, which is transmitted by the bite

What do the microfilariae do upon entering a host? They form the subcutaneous nodules that are classic for the condition. Over the course of the next year they grow into the adult form of the worm. The adults then start cranking out microfilariae by the millions, which disseminate throughout the body, including the eye
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
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Protozoa
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Helminths
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Arthropods

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Where in the world does it occur?
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Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

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They are bitten by a blackfly (you knew that already) carrying the microfilariae form of the worm, which is transmitted by the bite.

What do the microfilariae do upon entering a host?
They form the subcutaneous nodules that are classic for the condition. Over the course of the next year they grow into the adult form of the worm.
Onchocerciasis: Skin nodules
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods

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Where in the world does it occur?
While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it's sometimes called African river blindness.

How do the microfilariae disseminate throughout the body?
The adults start cranking out microfiliariae by the millions, which disseminate throughout the body, including the eye.
Common Parasitic Pathogens

Uterus of an adult female worm chock-full of microfilariae
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

How do humans acquire the worm?
They are bitten by a blackfly (you knew that already) carrying the microfilariae form of the worm, which is transmitted by the bite.

What do the microfilariae do upon entering a host?
They form the subcutaneous nodules that are classic for the condition. Over the course of the next year they grow into the adult form of the worm. The adults then start cranking out microfilariae by the millions, which disseminate throughout the body, including the eye.

How big is the microfilariae form of the worm?
About a third of a millimeter

Is onchocerciasis a serious condition?
Indeed it is (it ain’t called river blindness for nothing!)

Is it common?
Yep—it’s among the most common causes of infectious visual morbidity.

Where in the world does it occur?
While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it’s sometimes called African river blindness.

How do humans acquire the worm?
They are bitten by a blackfly (you knew that already) carrying the microfilariae form of the worm, which is transmitted by the bite.

What do the microfilariae do upon entering a host?
They form the subcutaneous nodules that are classic for the condition. Over the course of the next year they grow into the adult form of the worm. The adults then start cranking out microfilariae by the millions, which disseminate throughout the body, including the eye.

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Yep—it’s among the most common causes of infectious visual morbidity.

Where in the world does it occur?
While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it’s sometimes called African river blindness.
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

How do humans acquire the worm?
They are bitten by a blackfly (you knew that already) carrying the microfilariae form of the worm, which is transmitted by the bite.

How big is the microfilariae form of the worm?
About a third of a millimeter

What do the microfilariae do upon entering a host?
They form the subcutaneous nodules that are classic for the condition. Over the course of the next year they grow into the adult form of the worm. The adults then start cranking out microfilariae by the millions, which disseminate throughout the body, including the eye.

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Indeed it is (it ain't called river blindness for nothing!)

Is it common?
Yep—it's among the most common causes of infectious visual morbidity

Where in the world does it occur?
While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it's sometimes called African river blindness.

How do they get into the eye?
The microfilariae are transmitted to the eye via the conjunctiva. Loa Loa is also transmitted to the eye via the conjunctiva.

The microfilariae can cause blindness? Onchocerca can cause blindness. Toxocara can cause blindness. Loa Loa can cause blindness in the eye.
Common Parasitic Pathogens

*Onchocerca*: Microfilariae
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

Common Parasitic Pathogens

How do humans acquire the worm? They are bitten by a blackfly (you know, the one that carries the microfilariae form of the worm, which they transmit to the human host).

What do the microfilariae do upon entering a host? They form the subcutaneous nodules that are classic for the condition. Over the course of the next year, they grow into the adult form of the worm. The adults then start cranking out millions of microfilariae, which disseminate throughout the body, including the eye.

How big is the microfilariae form of the worm? About a third of a millimeter.

How big is the adult form of the worm? About a meter.

Is onchocerciasis a serious condition? Indeed it is (it ain't called river blindness for nothing!)

Is it common? Yep—it's among the most common causes of infectious visual morbidity.

Where in the world does it occur? While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it's sometimes called African river blindness.

How do humans acquire the worm? They are bitten by a blackfly.

What do the microfilariae do upon entering a host? They form subcutaneous nodules.

How big is the microfilariae form of the worm? About a third of a millimeter.

How big is the adult form of the worm? About a meter.

Is onchocerciasis a serious condition? Indeed it is (it ain't called river blindness for nothing!).

Is it common? Yep—it's among the most common causes of infectious visual morbidity.

Where in the world does it occur? While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it's sometimes called African river blindness.

How do humans acquire the worm? They are bitten by a blackfly.

What do the microfilariae do upon entering a host? They form subcutaneous nodules.

How big is the microfilariae form of the worm? About a third of a millimeter.

How big is the adult form of the worm? About a meter.
Parasitic pathogens

Helminths

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca
- Loa Loa

How do humans acquire the worm?
They are bitten by a blackfly (you knew that already) carrying the microfilariae form of the worm, which is transmitted by the bite.

What do the microfilariae do upon entering a host?
They form the subcutaneous nodules that are classic for the condition. Over the course of the next year, they grow into the adult form of the worm. The adults then start cranking out microfilariae by the millions, which disseminate throughout the body, including the eye.

How big is the microfilariae form of the worm?
About a third of a millimeter

How big is the adult form of the worm?
Up to a meter

Is onchocerciasis a serious condition?
Indeed it is (it ain't called river blindness for nothing!)

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Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods
- Loa Loa

How do humans acquire the worm?
They are bitten by a blackfly (you knew that already), carrying the microfilariae form of the worm, which enters the host.

What do the microfilariae do upon entering a host?
They form the subcutaneous nodules that are classic for the condition. Over the course of the next year, they grow into the adult form of the worm. The adults then start cranking out microfilariae by the millions, which disseminate throughout the body, including the eye.

How big is the microfilariae form of the worm?
About a third of a millimeter

How big is the adult form of the worm?
Up to a meter

No, seriously—how big is it?
I'm not even kidding—the adult female can be up to a meter long.

Is onchocerciasis a serious condition?
Indeed it is (it ain't called river blindness for nothing!)

Is it common?
Yep—it's among the most common causes of infectious visual morbidity.

Where in the world does it occur?
While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it's sometimes called African river blindness.

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How big is the microfilariae form of the worm?
About a third of a millimeter

How big is the adult form of the worm?
Up to a meter

No, seriously—how big is it?
I'm not even kidding—the adult female can be up to a meter long.

Common Parasitic Pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods
- Loa Loa
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

How do humans acquire the worm?
They are bitten by a blackfly (you know, the one that causes river blindness) carrying the microfilariae form of the worm, which is transmitted by the bite.

What do the microfilariae do upon entering a host?
They form the subcutaneous nodules that are classic for the condition. Over the course of the next year, they grow into the adult form of the worm. The adults then start cranking out microfilariae by the millions, which disseminate throughout the body, including the eye.

How big is the microfilariae form of the worm?
About a third of a millimeter.

How big is the adult form of the worm?
Up to a meter.

No, seriously—how big is it?
I’m not even kidding—the adult female can be a meter long.

Is onchocerciasis a serious condition?
Indeed it is (it ain’t called river blindness for nothing!)

Is it common?
Yep—it’s among the most common causes of infectious visual morbidity.

Where in the world does it occur?
While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it’s sometimes called African river blindness.
Common Parasitic Pathogens

*Onchocerca*: Three adult males, and a female
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

How do humans acquire the worm?
They are bitten by a blackfly (you knew that already) carrying the microfilariae form of the worm, which is transmitted by the bite.

What do the microfilariae do upon entering a host?
They form the subcutaneous nodules that are classic for the condition. Over the course of the next year, they grow into the adult form of the worm. The adults then start cranking out microfilariae by the millions, which disseminate throughout the body, including the eye.

Which ophthalmic structures can be affected by the worm?
- Sclerosing keratitis
- Glaucoma
- Uveitis
- Cataracts
- Chorioretinitis with late optic atrophy

Is onchocerciasis a serious condition?
Indeed it is (it ain't called river blindness for nothing!)

Is it common?
Yep—it's among the most common causes of infectious visual morbidity.

Where in the world does it occur?
While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it's sometimes called African river blindness.

Which can be observed swimming in the AC?
Parasitic pathogens

Helminths

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca

Arthropods
- Loa Loa

How do humans acquire the worm?
They are bitten by a blackfly (you knew that already) carrying the microfilariae form of the worm, which is transmitted by the bite.

What do the microfilariae do upon entering a host?
They form the subcutaneous nodules that are classic for the condition. Over the course of the next year, they grow into the adult form of the worm. The adults start cranking out microfilariae by the millions, which disseminate throughout the body, including the eye.

Which ophthalmic structures can be affected by the worm?
Any of them, from the lids to the retina.

Is onchocerciasis a serious condition?
Indeed it is (it ain’t called river blindness for nothing!)

Is it common?
Yep—it’s among the most common causes of infectious visual morbidity.

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While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it’s sometimes called African river blindness.

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Which ophthalmic structures can be affected by the worm?
Any of them, from the lids to the retina.
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca
- Microsporidia
- Leishmania

Arthropods
- Loa Loa

How do humans acquire the worm? They are bitten by a blackfly (you knew that already) carrying the microfilariae form of the worm, which is transmitted by the bite.

What do the microfilariae do upon entering a host? They form the subcutaneous nodules that are classic for the condition. Over the course of the next year, they grow into the adult form of the worm. The adult worms disseminate throughout the body, including the eye.

Which ophthalmic structures can be affected by the worm? Any of them, from the lids to the retina, including the eye.

In what specific ways can onchocerciasis cause blindness?

Indeed it is (it ain't called river blindness for nothing!)

Is it common? Yep—it's among the most common causes of infectious visual morbidity.

Where in the world does it occur? While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it's sometimes called African river blindness.
Parasitic pathogens

Common Parasitic Pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

How do humans acquire the worm? They are bitten by a blackfly (you knew that already) carrying the microfilariae form of the worm, which is transmitted by the bite.

What do the microfilariae do? They form the subcutaneous condition. Over the course of the next year they grow into the adult form of the worm. The adults then start cranking out microfilariae by the millions, which disseminate throughout the body, including the eye.

Which ophthalmic structures can be affected by the worm? Any of them, from the lids to the retina.

In what specific ways can onchocerciasis cause blindness?
- Sclerosing keratitis
- Glaucoma
- Uveitis
- Cataracts
- Chorioretinitis with late optic atrophy

Is onchocerciasis a serious condition? Indeed it is (it ain't called river blindness for nothing!)

Is it common? Yep—it's among the most common causes of infectious visual morbidity.

Where in the world does it occur? While it can be found in both Latin America and the Middle East, the locale where it is really a problem is sub-Saharan Africa. In fact, it's sometimes called African river blindness.

Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

How do humans acquire the worm?
They are bitten by a blackfly (you knew that already) carrying the microfilariae form of the worm. They are transmitted via the bite of the blackfly. The microfilariae form of the worm is transmitted by the bite of the blackfly.

What do the microfilariae do upon entering a host?
They form the subcutaneous nodules that are classic for the condition. Over the course of the next year they grow into the adult form of the worm. The adult forms then start cranking out microfilariae by the millions, which disseminate throughout the body, including the eye.

Which ophthalmic structures can be affected by the worm?
Any of them, from the lids to the retina.

In what specific ways can onchocerciasis cause blindness?
- Sclerosing keratitis
- Glaucoma
- Uveitis
- Cataracts
- Chorioretinitis with late optic atrophy

All this being said, onchocerciasis appears in only two BCSC books: Cornea and Uveitis, and gets more love in the Cornea book. Thus, if you remember nothing else about it, remember that it can cause a severe sclerosing keratitis!
Onchocerciasis: Sclerosing keratitis
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods

Two bugs addressed in the BCSC
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods
- Phthirus
- Demodex

Two bugs addressed in the BCSC
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca

Arthropods
- Phthirus
- Demodex

What is the common name of Phthirus pubis?

The crab louse

If it takes hold in the lashes, blepharoconjunctivitis will result
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca

Arthropods
- Phthirus
- Demodex

What is the common name of Phthirus pubis?
The crab louse—'crabs' for short
Hi there!
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca

Arthropods
- Phthirus
- Demodex

What is the common name of Phthirus pubis?
The crab louse—‘crabs’ for short

What ophthalmic condition does it cause?
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca

Arthropods
- Phthirus
- Demodex

**What is the common name of Phthirus pubis?**
The crab louse—‘crabs’ for short

**What ophthalmic condition does it cause?**
If it takes hold in the lashes, blepharoconjunctivitis will result
Phthirius pubis on the eyelid
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca

Arthropods
- Phthirus
- Demodex

What is the common name of Phthirus pubis?
The crab louse—‘crabs’ for short

What ophthalmic condition does it cause?
If it takes hold in the lashes, blepharoconjunctivitis will result

How is Phthirus infestation of the lashes and eyebrows acquired?
Common Parasitic Pathogens

Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca

Arthropods
- Phthirus
- Demodex

What is the common name of Phthirus pubis?
The crab louse—‘crabs’ for short

What ophthalmic condition does it cause?
If it takes hold in the lashes, blepharoconjunctivitis will result

How is Phthirus infestation of the lashes and eyebrows acquired?
It's a venereal disease. Use your imagination.
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods
- Phthirus
- Demodex

Awkward. How about Demodex—is it acquired in like manner?
Parasitic pathogens

- Protozoa
  - Acanthamoeba
  - Toxoplasma
  - Microsporidia
  - Leishmania

- Helminths
  - Toxocara
  - Onchocerca
  - Loa Loa

- Arthropods
  - Phthirius

- Demodex

Awkward. How about Demodex—is it acquired in like manner? No, it’s part of the normal fauna of the lashes and adnexa.
Common Parasitic Pathogens

Demodex
Parasitic pathogens

- Protozoa
  - Acanthamoeba
  - Toxoplasma
  - Microsporidia
  - Leishmania

- Helminths
  - Toxocara
  - Onchocerca
  - Loa Loa

- Arthropods
  - Phthirus

- Demodex

Awkward. How about Demodex—is it acquired in like manner? No, it’s part of the normal fauna of the lashes and adnexa

How common is Demodex infestation?
Awkward. How about Demodex—is it acquired in like manner? No, it’s part of the normal fauna of the lashes and adnexa.

How common is Demodex infestation? Very (it approaches 100% in the elderly)
Parasitic pathogens

Protozoa
- Acanthamoeba
- Toxoplasma
- Microsporidia
- Leishmania

Helminths
- Toxocara
- Onchocerca
- Loa Loa

Arthropods
- Phthirius
- Demodex

Awkward. How about Demodex—is it acquired in like manner? No, it’s part of the normal fauna of the lashes and adnexa.

How does Demodex infestation manifest clinically?
Parasitic pathogens

- **Protozoa**
  - Acanthamoeba
  - Toxoplasma
  - Microsporidia
  - Leishmania

- **Helminths**
  - Toxocara
  - Onchocerca
  - Loa Loa

- **Arthropods**
  - Phthirus
  - Demodex

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**Awkward. How about Demodex—is it acquired in like manner?**

No, it's part of the normal fauna of the lashes and adnexa.

**How does Demodex infestation manifest clinically?**

As waxy sleeves on the proximal lashes.
Common Parasitic Pathogens

Demodex: Eyelash sleeves
These are *Demodex* mites next to an eyelash within the follicle opening. Note their size.
These are *Demodex* mites next to an eyelash within the follicle opening. Note their size.

Take-home point: *Demodex* are NOT visible at the slit lamp. The only slit-lamp sign of *Demodex* is sleeving of the lash base.
Awkward. How about Demodex—is it acquired in like manner?

No, it's part of the normal fauna of the lashes and adnexa

How does Demodex infestation manifest clinically?

As waxy sleeves on the proximal lashes

What ophthalmic condition does it cause?
Parasitic pathogens

**Common Parasitic Pathogens**

- Protozoa
  - Acanthamoeba
  - Toxoplasma
  - Microsporidia
  - Leishmania
- Helminths
  - Toxocara
  - Onchocerca
  - Loa Loa
- Arthropods
  - *Phthirus*
  - **Demodex**

- **Awkward. How about Demodex—is it acquired in like manner?**
  - No, it's part of the normal fauna of the lashes and adnexa

- **How does Demodex infestation manifest clinically?**
  - As waxy sleeves on the proximal lashes

- **What ophthalmic condition does it cause?**
  - Blepharoconjunctivitis