Pharmaceutical care in the prevention and treatment of the most common Helminthiasis
Helminthiasis

The wise man will avoid diseases, Instead choose medicine for them
То ма том Morr

1. The relevance of worm invasions
2. Who are the causative agents of parasitic diseases?
3. The spread of helminthic infections
4. Symptoms and syndromes of the diseases
5. Diagnostics
6. The main directions of therapy
7. The advantages and disadvantages of antihelmintic drugs
8. Pharmaceutical care
According to WHO, there are more than 4.5 billion people with parasitic infections in the world.

Every third resident affected by worms in Europe.

During the life, almost everyone suffers from a parasitic disease.

Human can infect up to 15 species of pathogenic protozoa and over 250 species of helminths.

89% of all parasitic infections accounted for helminthiasis.

20% of children attending kindergartens each year get helminthiasis.

The cause of death of 16 million people per year are infectious and parasitic diseases.
Actuality of the problem of parasitic invasions

- Pinworms are one of the most immunosuppressive human body helminths
- Opisthorchiasis is the most dangerous disease from helminthiasis now
- Causative agent of opisthorchiasis classified by the International Agency for Research of Cancer to the first group of the human carcinogen
- Opisthorchosis worm live 20-40 years in the human body
## Classification of helminthes

### 1. Nematodes (Type Roundworms)

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<thead>
<tr>
<th>Nematodes (Roundworms)</th>
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<tbody>
<tr>
<td>intestinal</td>
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<tr>
<td>Enterobius vermicularis</td>
<td>Trichinella spiralis</td>
<td>Trichinella spiralis</td>
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<tr>
<td>Ascaris lumbricoides</td>
<td>Filarioidea</td>
<td>Filarioidea</td>
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<tr>
<td>Trichocephalus trichiurus</td>
<td>Toxocara cants</td>
<td>Toxocara cants</td>
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<tr>
<td>Ancylostoma duodenale</td>
<td>Onchocerca volvulus</td>
<td>Dracunculus medinensis</td>
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<tr>
<td>Necator americanus</td>
<td>Dracunculus medinensis</td>
<td>Dracunculus medinensis</td>
</tr>
<tr>
<td>Stronguloides stercoralis</td>
<td>Cutaneos larva migrans</td>
<td>Cutaneos larva migrans</td>
</tr>
</tbody>
</table>

- [Enterobius vermicularis](https://en.wikipedia.org/wiki/Enterobius_vermicularis)
- [Ascaris lumbricoides](https://en.wikipedia.org/wiki/Ascaris_lumbricoides)
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- [Ancylostoma duodenale](https://en.wikipedia.org/wiki/Ancylostoma_duodenale)
- [Dracunculus medinensis](https://en.wikipedia.org/wiki/Dracunculus_medinensis)
- [Angiostrongylus costaricensis](https://en.wikipedia.org/wiki/Angiostrongylus_costaricensis)
- [Trichocephalus trichiurus](https://en.wikipedia.org/wiki/Trichocephalus_trichiurus)
- [Toxocara canis](https://en.wikipedia.org/wiki/Toxocara_cani)
- [Filarioidea](https://en.wikipedia.org/wiki/Filarioidea)
- [Onchocerca volvulus](https://en.wikipedia.org/wiki/Onchocerca_volvulus)
- [Cutaneos larva migrans](https://en.wikipedia.org/wiki/Cutaneos_larva_migrans)
Classification of helminthes

1. Nematodes (Type Roundworms)
2. Cestodes (tapeworms)
   Type Flatworms

<table>
<thead>
<tr>
<th>Cestodes (tapeworms)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Diphyllobothrium latum</em> (broad tapeworm)</td>
</tr>
<tr>
<td><em>Tenia saginatus</em> (bovine tapeworm)</td>
</tr>
<tr>
<td><em>Tenia solium</em> (pork tapeworm)</td>
</tr>
<tr>
<td><em>Hymenolepis nana</em> (dwarf tapeworm)</td>
</tr>
<tr>
<td><em>Echinococcus granulosus</em></td>
</tr>
<tr>
<td><em>Echinococcus multilocularis</em></td>
</tr>
</tbody>
</table>
Classification of helminthes

1. Nematodes (Type Roundworms)
2. Cestodes (tapeworms)
3. Trematoda (flukes)

Type Flatworms

Trematoda (flukes)
- Opisthorchis felineus
- Opisthorchis viverrini
- Clonorchis sinensis
- Fasciola hepatica (liver fluke)
- Fasciola gigantica

Fasciola gigantica

Opisthorchis felineus

Opisthorchis viverrini

Fasciola hepatica
The general scheme of the life cycle of worms

The final owner
(Adult worms lives)

Helminth eggs or larvae

Further development of the egg is determined by to which group includes worms:
GEOGELMINTY, BIOGELMINTY, CONTACT HELMINTHS

Belonging to these groups is determined by the biological characteristics of worms and pathways

Geogelminty: roundworm, whipworm
Contact worms: dwarf tapeworm, pinworm
Biogelminty: chain, tapeworms, flukes
Helminths get into the body in case of:

**EATING**
- unwashed vegetables, fruits and berries
- unboiled water from stagnant sources
- raw, not enough salted and dried fish, caviar of pike
- meat of domestic and wild animals that have not been monitoring the sanitary epidemiological service
- exotic dishes with unknown components in Asia and Africa

**DIRTY HANDS** not only his own, but the sellers

The presence of constant contact with **PETS**

**SWIMMING** in open water in the area of infection

**WORKS** related to the constant contact with the animals, the soil, travel to exotic countries, children and military groups, in the mine

**PRESENCE OF HOBBY** : hunting, fishing, football, beach volleyball
(walking barefoot and lying on the ground without litter in areas of hookworm)

**FERTILIZER BY FECES** of soil of the gardens, orchards, berry fields, greenhouses
The impact of parasites on the body

**GENERAL TOXICITY**

- Chronic intoxication products of vital activity
- Immune dysfunction and allergization of the organism
- Dyspepsia
- Pulmonary syndrome
- Lymphadenopathy
- Myalgia
- Iron deficiency anemia
- Carcinogenesis

**MECHANICAL**

- Blockage of the bile and pancreatic duct
- Abscess (purulent focus) of the liver and pancreas
- Ileus (intestinal obstruction)
- Appendicitis
- Perforations (rupture) of the intestine
- Peritonitis
The clinical manifestation in intestinal nematodes

<table>
<thead>
<tr>
<th>COMPLAINTS</th>
<th>% of total number</th>
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<tbody>
<tr>
<td>Allergic reactions</td>
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<tr>
<td>Gastrointestinal dysfunction</td>
<td>75,3</td>
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<tr>
<td>Abdominal pain syndrome</td>
<td>40</td>
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<tr>
<td>Appetite disorders</td>
<td>44</td>
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<tr>
<td>Bruxism (teeth grinding)</td>
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<tr>
<td>Insomnia</td>
<td>54</td>
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<tr>
<td>Anal escoriation and / or itching</td>
<td>36</td>
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<tr>
<td>Signs of suppression of immune system</td>
<td>19,3</td>
</tr>
<tr>
<td>Ether symptoms</td>
<td>32,7</td>
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</tbody>
</table>
Diagnosis of helminth infections

- Biological materials for testing in presence of helminths, and their fragments, larvae and eggs are the feces, urine, bile, phlegm, mucus rectum, blood, muscle tissue.

- IT IS NECESSARY to analyze of three stool samples taken sequentially at intervals of 1 day, or, to save time, for straight 3 days.
Diagnosis of helminth infections

- Eggs and larvae of worms, parasites in the liver, biliary tract, pancreas and duodenum are found in BILE and DUODENAL CONTENTS

- For the diagnosis of filariasis examine BLOOD, for onchocerciasis use SECTIONS OF THE SKIN
The simplest (Protozoa)

Type Sarcomastigophora
Subtype Zoomastigophora (flagellates)
Subtype Sarcodina (amoeboid)

- Most Protozoa have a generation time (from multiplication to multiplication) from 6 to 24 hours
- Reproduction in the host organism is accompanied by an exponential increase in the size of their population
- One parasitic organism can after multiply to cause the death of the owner.
Protozoal diseases: Amebiasis

Subtype Sarcodina (amoeboid)  Genus *Amoebia*

- **Amebiasis (amebic dysentery)** - Shigellosis like disease with characteristic frequent watery diarrhea, sometimes with blood and mucus, abdominal pain, fever, and dehydration

- The most frequent complications is massive gastrointestinal bleeding and perforation of the wall of the intestine, liver abscess

Amoebiasis is a disease of tropical and subtropical countries (incidence is 50%, including southern Spain, the Balkans, European Turkey).

In Vietnam, India, the prevalence of 60-80%.

In European countries now observed some sporadic cases, usually Imported.
Protozoal diseases: Leishmaniasis

Subtype Zoomastigophorophora (flagellates)

Mastigophora Genus Leishmania

• **The incubation period** lasts from 2 weeks up to 5 months

• After the incubation period, on the skin forms a node enlarged to fill the hazelnut
  
  – Papules are ulcerate, lesions may form subsidiaries

  – Depending on the pathogen observed the formation of "dry" *(L. tropica major)* or "wet" *(L. tropica tropica)* painless ulcers

• After 3-12 months of spontaneous cure to form a rough pigmented scar ("seal the devil")
Protozoal diseases: Leishmaniasis

- Transmitted by mosquitoes Genus Lutzomyia

Prevention:
- destruction of animal carriers leishmaniasis (wild rodents) in the areas surrounding to populated areas
- action of protection from bites (repellents, mosquito nets)
Protozoal diseases: Lambliosis

Subtype Zoomastigophora (flagellates)  Genus Lamblia

• Giardiasis (lambliosis) is parasitic invasion occurring in the form of latent carriers of the parasite and the clinical forms, mainly in the form of intestinal dysfunction

• It has been discovered by D.F. lamblia in 1859
Protozoal disease: Lambliosis

- Pathogens are **widespread**, especially in regions with a low sanitary culture.
- **The main mechanism of infection is the fecal-oral way** by the polluted arms, food and water.
- The disease is registered in all age groups, but the main contingent is pre-school children.
- **Cysts are resistant** to different influences, particularly in water. For removal of Giardia from water it is needed to stand her because they are resistant to chlorination.
MALABSORPTION SYNDROME

• The state with the various manifestations: diarrhea, fatigue, edema, lethargy, weight loss, decreased appetite, pallor, bleeding tendency, paresthesia and muscle twitching

GIARDIASIS usually asymptomatic, but in massive infection may develop enterocolitis with catarrhal symptoms that appear 1-3 weeks after infection
General principles of treatment of worm invasion

- **THE MAIN COMPONENT** of the antihelmintic therapy is a specific treatment, that is the prescription of **ANTHELMINTIC DRUGS**

- Acceptance of antihelmintic drugs must be based on the **PARASITE SPECIES**

- **THERAPY** must be **COMPLEX** and not just aimed at the destruction of worms, but also to eliminate the impact of their life (allergy, anemia, biliary dyskinesia, etc.)

- Treatment should be **MONITORED** (parasitological methods)
General principles of treatment of worm invasion

- Benchmark analysis should be conducted not earlier than 2 weeks after treatment has finished
- **ANTIBIOTICS, CONTRAST AGENTS, LAXATIVES OR ANTACIDS** difficult to identify parasites or reduce their numbers in the feces to undetectable levels
- If you are receiving these drugs analysis of feces conducted a few weeks later, when these substances from the body would be displayed
The market structure of anthelmintic drugs

**Medicine used in trematodosis** _P 02 B_

- Biltricid (Praziquantel), Bayer

**Medicine used in nematodes** _P 02 C_

- P 02 CA Benzimidazole derivatives
  - Vermox
  - Vormil
  - Nemozol

- P 02 CB Piperazine and its derivatives
  - Piperazine Adipinate

- P 02 CC Derivative of Tetrohydropyrimidine
  - Helmintonx
  - Nemocid
  - Pyrantelum

**Medicine used in cestodiasis** _P 02 D_

- Flores tanaceti vulgaris (The flowers of tansy)

- P 02 CE Derivative of imidazothiazoles
  - Levamisol
<table>
<thead>
<tr>
<th>Drug</th>
<th>Albendazole №3 400 mg</th>
<th>Mebendazole №6 400 mg</th>
<th>Praziquantel №6 600 mg</th>
<th>Piperazine adipinate №10 500 mg</th>
<th>Pyrantel №3 250 mg</th>
<th>Levamisole hydrochloride №1 150 mg</th>
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</table>
The main criteria in choosing an anthelmintic drug

- The active substance
- Reliability - the lowest percentage of required re-treatment
- Broad spectrum of activities - preference to those that destroy all the worms at different stages of development and/or different location
- Safety
- Reasonable price
- The efficiency and fast treatment
- Ease of dosing and comfort of receiving
- European quality product
Albendazole (Vormil)

<table>
<thead>
<tr>
<th>Features of pharmacokinetics</th>
<th>Advantages of the drug</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sparingly soluble in the water → slight absorption in the digestive tract → the optimum concentration of the drug in the digestive tract</td>
<td>high therapeutic activity</td>
</tr>
<tr>
<td>Rapidly metabolized in the liver during the first pass</td>
<td>low toxicity (the main metabolite - sulfate albendazole retains $\frac{1}{2}$ pharmacological activity of the primary substance)</td>
</tr>
<tr>
<td>It is excreted mainly with the bile after it again reabsorbs in the gastrointestinal tract</td>
<td>purposeful action on the helminth parasites in the liver and bile ducts</td>
</tr>
<tr>
<td>Drug accumulation in organs and tissues of worms (30-45 days)</td>
<td>high activity against eggs, larvae and adults of cysts of the parasite</td>
</tr>
<tr>
<td>The mechanism of action based on inhibition of two biological processes in the helminth body</td>
<td>broad spectrum of activity and high efficacy of the drug</td>
</tr>
<tr>
<td>Features of pharmacokinetics</td>
<td>Advantages of the drug</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
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</tr>
<tr>
<td>slightly absorbed in the digestive tract</td>
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<tr>
<td>the optimum concentration of the drug in the digestive tract</td>
<td></td>
</tr>
<tr>
<td>Rapidly metabolized in the liver during the first pass</td>
<td>low toxicity (in this case it is formed inactive metabolites)</td>
</tr>
<tr>
<td>It is excreted mainly with the faeces (small part with the bile)</td>
<td>low activity against helminth parasites in the liver and bile ducts</td>
</tr>
<tr>
<td>Rapidly excreted from the body (within 24-48 hours)</td>
<td>high activity against only adult parasite</td>
</tr>
<tr>
<td>The mechanism of action based on inhibition of only one biological process in helminth’s body</td>
<td>less broad spectrum of action and less efficacy than albendazole</td>
</tr>
</tbody>
</table>
Mechanisms of action

**Albendazole**
- INHIBITION of fumarate reductase in muscle tissue
- VIOLATION of ATP synthesis in mitochondria
- VIOLATION of the glucose synthesis and utilization
- VIOLATION of the cytoskeleton

**Mebendazole**
- INHIBITION of tubulin protein synthesis
- VIOLATION of microtubule structure cells of the intestinal epithelium
- BREAKING connections between the membrane and organelles
- VIOLATION of transport processes inside the cell

THE DEATH OF HELMINTHES
Mechanisms of action

**Praziquantel**
- Opening of Ca2+ channels of the cell membranes
- Hypertonus helminth’s muscle
- vacuolization and disintegration external covers

**Piperazine, Pyrantel**
- blockade of acetylcholine transmission in the neuromuscular junction
- paralysis of the worm’s muscles

**levamisole**
- INHIBITION of fumarate reductase in muscle tissue
- VIOLATION of ATP synthesis in mitochondria
- VIOLATION of the glucose synthesis and utilization

The death of the helminth
The expulsion of the helminth from the body
The death of the helminth
# Pharmacoeconomic analysis

<table>
<thead>
<tr>
<th>Drug</th>
<th>Drug form</th>
<th>Manufactured</th>
<th>Price, $</th>
<th>The amount of packaging</th>
<th>The cost of 1 tablet, $</th>
<th>The cost of treatment of enterobiosis, $</th>
<th>The cost of treatment of ascaridosis, $</th>
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</thead>
<tbody>
<tr>
<td>Biltricid</td>
<td>C. tab. 600mg # 6</td>
<td>Bayer</td>
<td>18,38</td>
<td>6</td>
<td>3,06</td>
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<td>Vermox</td>
<td>Tab. 100 mg # 6</td>
<td>Cedeon Richter</td>
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<td>6</td>
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<tr>
<td>Vermox</td>
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<td>Janssen-Cilag</td>
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<td>Piperazine Adipinate</td>
<td>Tab. 200 mg, 500 mg # 10</td>
<td>Darnitsa, Borshagovka, Lugansk, Halichpharm, Agrofarm (UA), Borisov Pharm.</td>
<td>0,08</td>
<td>10</td>
<td>0,01</td>
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<tr>
<td>Pyrantelum</td>
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<td>Genom Biotech</td>
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<td>0,52</td>
<td>1,56</td>
<td>1,56</td>
</tr>
</tbody>
</table>

* Calculation of an adult patient weighing 60 kg
### Pharmacoeconomic analysis

<table>
<thead>
<tr>
<th>Drug</th>
<th>Drugs Form</th>
<th>Manufactured</th>
<th>Price, $</th>
<th>The amount of packaging</th>
<th>The cost of treatment of enterobiosis, $</th>
<th>The cost of treatment of ascaridosis, $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vermox</td>
<td>Oral susp. vial 20 mg/ml # 1</td>
<td>Janssen-Cilag</td>
<td>2,2</td>
<td>30</td>
<td>0,073</td>
<td>0,367</td>
</tr>
<tr>
<td>Pyrantelum</td>
<td>Susp. vial 750 mg/15 ml # 1</td>
<td>Genom Biotech</td>
<td>0,83</td>
<td>15</td>
<td>0,055</td>
<td>0,208</td>
</tr>
<tr>
<td>Nemocid</td>
<td>Susp. vial 50 mg/ ml - 10 ml</td>
<td>IPSA Laboratories</td>
<td>0,76</td>
<td>10</td>
<td>0,076</td>
<td>0,285</td>
</tr>
<tr>
<td>Helmintox</td>
<td>Susp. vial 50 mg/ ml - 15 ml</td>
<td>Innotech International</td>
<td>2,11</td>
<td>15</td>
<td>0,141</td>
<td>0,528</td>
</tr>
<tr>
<td>Pyrantelum</td>
<td>Susp. vial 750 mg/15 ml # 1</td>
<td>Terpol Works Pharm</td>
<td>1,08</td>
<td>15</td>
<td>0,072</td>
<td>0,270</td>
</tr>
<tr>
<td>Vormil</td>
<td>Susp. vial 200 mg/ 5 ml - 10 ml</td>
<td>Mili Healthcare</td>
<td>2,2</td>
<td>10</td>
<td>0,220</td>
<td>1,100</td>
</tr>
</tbody>
</table>

* - Payment for a child age 2 years (15 kg)
The algorithm of the conversation of pharmacist with the visitor of pharmacy

The visitor come to the pharmacy with complaints of fatigue, weakness, nausea, decreased appetite, irritability, insomnia

- Do you have a chronic disease of the digestive tract, hemorrhoids?
- Are you taking any medications nowadays?
- Do you have contact with toxic substances in your job?
- Have you had recently an infection (odds dysbiosis)?
- Are you pregnant?

yes  no

You should consult in your doctor to receive prescription of therapy

Have you received appropriate antiparasitic treatment?

yes  no

You might have helminthes reinvasion or autoreinvasion You might have helminthes invasion

Is any member of your family who suffers from helmintosis?

yes  no

You might have helminthes reinvasion or autoreinvasion You might have helminthes invasion
You should start antihelmintic therapy with drugs that are specific to a particular agent or drug broad spectrum anthelmintic activity.

Have you previously had an allergic reaction when you were receiving anthelmintic drugs?

- **Yes**: You should consult with your doctor to receive a prescription for therapy.
- **No**: You might have helminthes reinvasion or autoreinvasion. You might have helminthes invasion.
The algorithm of the conversation of pharmacist with the visitor of pharmacy

Is any member of your family who suffers from helmintosis?

Do you have any pets?

Do you neglect rules of personal hygiene, break the cooking conditions of fruits, vegetables, meat and fish products?

Do you buy food at disaster markets or from private individuals?

Do you work in the food industry or in the food sector?

Have you was swimming recently in stagnant freshwater?

You might have helminthes invasion

You should consult in your doctor to receive prescription of therapy
Threatening symptoms that require going to a doctor

- The development of symptoms of the disease, not related to act of damaging factors (e.g., symptoms of SARS in the summer, dyspeptic symptoms without previous errors in the diet);

- Symptoms of disease in the presence of constant contact with pets;

- Appearance of the symptoms after being in the countryside, where widespread infestation of specific helminth;

- The appearance of symptoms after eating unwashed vegetables and fruits, raw, undercooked or not enough roasted meat and fish;

- High levels of eosinophils in the clinical analysis of blood;

- Detection of eggs or segments of worms in stool
Pharmaceutical Care

- Successful dehelminthization (especially in enterobiosis) is possible only with simultaneous treatment of all family members and observing sanitary rules.
- Each family member must have an individual bath and bedding.
- During making the bed after sleeping you should not shake it; sheets and its accessories must be ironed.
- You should conduct daily wet cleaning.
- You should regularly disinfect toilet seats and pots.
- You should put on a night-fitting underwear.
- It is necessary to iron underwear after washing.
- After each act of defecation make toilet perianal area.
It is advisable to prescribe antihelminthic medication combined with multivitamins, tonic drugs and non-specific immune stimulators to restore violated metabolism caused by the vital activity of worms.

After 14 days of finishing of treatment it is recommended to conduct laboratory testing to confirm the cure.

Choosing an antihelmintic drug for children up to 2 years old, pregnant and breastfeeding women should consult a doctor.

If you have pets it is advisable to conduct regular preventive antihelmintic treatment every six months.
Thank you for attention!