

Contents

Foreword	IX
Preface	X
Authors and Contributors	XI
Glossary of Terms	XIV
Abbreviations	XVII
Chapter 1: Aetiology: parasites and life-cycles	1
Summary	1
1.1. Introduction and terminology	1
1.2. General morphology	1
1.3. General life-cycles.....	3
1.4. Specific life-cycle patterns.....	7
1.4.1. <i>Echinococcus granulosus</i>	9
1.4.2. <i>Echinococcus multilocularis</i>	9
1.4.3. <i>Echinococcus oligarthrus</i>	9
1.4.4. <i>Echinococcus vogeli</i>	10
1.5. Species of the genus <i>Echinococcus</i>	10
1.5.1. <i>Echinococcus granulosus</i>	10
1.5.2. <i>Echinococcus multilocularis</i>	11
1.5.3. <i>Echinococcus vogeli</i>	11
1.5.4. <i>Echinococcus oligarthrus</i>	12
1.6. Variation in <i>Echinococcus</i>	12
1.6.1. Variation in <i>Echinococcus granulosus</i>	12
1.6.2. Epidemiological significance of <i>Echinococcus granulosus</i> strains.....	14
1.6.3. Variation in <i>Echinococcus multilocularis</i>	15
References	15
Annex 1.1.: Principles of molecular techniques for the identification of <i>Echinococcus</i> species and strains.....	17
Chapter 2: Echinococcosis in humans: clinical aspects, diagnosis and treatment.....	20
Summary	20
2.1. Forms of echinococcosis in humans	20
2.2. Cystic echinococcosis.....	21
2.2.1. Causative agent and course of infection	21
2.2.2. Clinical presentation	23
2.2.3. Diagnosis	25
2.2.3.1. General aspects	25
2.2.3.2. Standard radiology.....	28
2.2.3.3. Ultrasonography	30
2.2.3.4. Computed tomography	31
2.2.3.5. Other exploratory methods	34
2.2.3.6. Diagnostic puncture	35
2.2.3.7. Laboratory findings	35
2.2.3.8. Immunodiagnosis.....	36
2.2.3.8.1. Immunodiagnosis in individual patients.....	36
2.2.3.8.2. Immunodiagnosis of cystic echinococcosis in human populations.....	40
2.2.4. Treatment	41
2.2.4.1. Surgery.....	41
2.2.4.2. Puncture, aspiration, injection, reaspiration (PAIR).....	43
2.2.4.3. Chemotherapy	44
2.3. Alveolar echinococcosis.....	47
2.3.1. Causative agent and course of infection	47

2.3.2. Clinical presentation	48
2.3.3. Diagnosis	48
2.3.3.1. Imaging	48
2.3.3.2. Diagnostic puncture	51
2.3.3.3. Laboratory findings	51
2.3.3.4. Immunodiagnosis	51
2.3.3.4.1. Immunodiagnosis in individual patients	52
2.3.3.4.2. Immunodiagnosis in human populations	54
2.3.3.5. Pathological and histological examination	54
2.3.4. Treatment	55
2.3.4.1. Surgery	55
2.3.4.2. Chemotherapy	56
2.3.4.3. Interventional procedures	57
2.3.4.4. Liver transplantation	58
2.4. Other forms of echinococcosis	59
2.4.1. Polycystic echinococcosis due to <i>Echinococcus vogeli</i>	59
2.4.2. Polycystic echinococcosis due to <i>Echinococcus oligarthrus</i>	59
2.5. Ethical aspects	59
References	61
Annex 2.1.: Determination of performance characteristics for immunodiagnostic assays	66
Annex 2.2.: Characteristics of benzimidazoles	69
Chapter 3: Echinococcosis in animals: clinical aspects, diagnosis and treatment	72
Summary	72
3.1. Forms of echinococcosis in animals	73
3.2. Echinococcosis in definitive hosts	73
3.2.1. Biological aspects	73
3.2.2. Clinical aspects	73
3.2.3. Diagnosis	74
3.2.3.1. Diagnosis of <i>Echinococcus granulosus</i> in dogs	74
3.2.3.1.1. Diagnosis in living animals	74
3.2.3.1.2. Diagnosis at necropsy	77
3.2.3.2. Diagnosis of <i>Echinococcus multilocularis</i> in foxes and other final hosts	78
3.2.3.2.1. Parasitological diagnosis at necropsy	78
3.2.3.2.2. Detection of circulating antibodies	81
3.2.3.2.3. Coproantigen detection	82
3.2.3.2.4. Detection of copro-DNA	83
3.2.3.3. Intravital diagnosis of <i>Echinococcus multilocularis</i> in dogs and cats	84
3.2.4. Chemotherapy	85
3.2.5. Immunity and immunisation	86
3.3. Echinococcosis in intermediate and aberrant hosts	87
3.3.1. Cystic echinococcosis (<i>Echinococcus granulosus</i> infection)	87
3.3.1.1. Biological aspects	87
3.3.1.2. Clinical aspects	87
3.3.1.3. Diagnosis of cystic echinococcosis in intermediate hosts	88
3.3.2. Alveolar echinococcosis (<i>Echinococcus multilocularis</i> infection)	89
3.3.2.1. Biological aspects	89
3.3.2.2. Clinical aspects	90
3.3.2.3. Diagnosis	91
3.3.3. Chemotherapy	91
3.3.4. Immunisation	92
3.4. Ethical aspects	92
References	94

Chapter 4: Geographic distribution and prevalence	100
Summary.....	100
4.1. <i>Echinococcus granulosus</i>	101
4.1.1. Global distribution of <i>Echinococcus granulosus</i>	101
4.1.2. <i>Echinococcus granulosus</i> in Europe.....	103
4.1.2.1. Northern Europe (Iceland, Greenland, Norway, Sweden, Denmark, Finland and the Baltic States).....	103
4.1.2.2. Western and south-western Europe (United Kingdom, Republic of Ireland, France, Spain and Portugal).....	103
4.1.2.3. Central Europe.....	104
4.1.2.4. Eastern Europe.....	104
4.1.2.5. Southern and south-eastern Europe (Italy and Balkan countries).....	104
4.1.3. <i>Echinococcus granulosus</i> in the Eastern Mediterranean.....	106
4.1.3.1. Turkey.....	106
4.1.3.2. Cyprus.....	106
4.1.3.3. Gulf Littoral States.....	106
4.1.3.4. Levant countries.....	107
4.1.4. <i>Echinococcus granulosus</i> in the Russian Federation and adjacent countries.....	108
4.1.5. <i>Echinococcus granulosus</i> in Mongolia.....	109
4.1.6. <i>Echinococcus granulosus</i> in the People's Republic of China.....	109
4.1.7. <i>Echinococcus granulosus</i> in southern Asia.....	112
4.1.7.1. Afghanistan and Pakistan.....	112
4.1.7.2. India, Bangladesh and Sri Lanka.....	112
4.1.7.3. Nepal and Bhutan.....	112
4.1.8. <i>Echinococcus granulosus</i> in South-East and East Asia.....	112
4.1.9. <i>Echinococcus granulosus</i> in Oceania, Australia and New Zealand.....	112
4.1.9.1. New Zealand.....	113
4.1.9.2. Australia: Tasmania.....	113
4.1.9.3. Australia: mainland.....	113
4.1.10. <i>Echinococcus granulosus</i> in Africa.....	114
4.1.10.1. North African countries.....	114
4.1.10.2. Sub-Saharan Africa.....	115
4.1.11. <i>Echinococcus granulosus</i> in North America.....	116
4.1.12. <i>Echinococcus granulosus</i> in Central and South America, the Caribbean and the Falkland Islands.....	118
4.2. <i>Echinococcus multilocularis</i>	120
4.2.1. Global distribution of <i>Echinococcus multilocularis</i>	122
4.2.2. <i>Echinococcus multilocularis</i> in Europe (excluding the Russian Federation and adjacent countries).....	122
4.2.3. <i>Echinococcus multilocularis</i> in the Eastern Mediterranean and northern Africa.....	127
4.2.3.1. Turkey.....	127
4.2.3.2. Iran.....	127
4.2.3.3. North Africa.....	127
4.2.4. <i>Echinococcus multilocularis</i> in the Russian Federation and adjacent countries.....	127
4.2.5. <i>Echinococcus multilocularis</i> in Mongolia and the People's Republic of China.....	129
4.2.6. <i>Echinococcus multilocularis</i> in Japan.....	131
4.2.7. <i>Echinococcus multilocularis</i> in North America.....	132
4.3. <i>Echinococcus vogeli</i> and <i>Echinococcus oligarthrus</i>	134
References.....	134
Chapter 5: Epidemiology	143
5.1. Quantitative epidemiology and transmission dynamics with special reference to <i>Echinococcus granulosus</i>	143
Summary.....	143

5.1.1. Contributions by the parasite to transmission dynamics	143
5.1.2. Contributions by the hosts to transmission dynamics	145
5.1.3. Contributions by the environment to transmission dynamics	147
5.1.4. Stability and equilibrium steady states	149
5.1.5. Transmission dynamics of human cystic echinococcosis	151
References	154
5.2. Epidemiology of <i>Echinococcus granulosus</i> in transhumant situations	156
Summary	156
5.2.1. Definition and general aspects	156
5.2.2. Cystic echinococcosis among transhumant pastoralists in the arid and semi-arid areas of Africa	158
5.2.3. Cystic echinococcosis in transhumant communities in cool and seasonally cold climates	159
5.2.4. Factors affecting the epidemiology of cystic echinococcosis in transhumant situations	160
5.2.5. Climate and human behaviour	161
5.2.6. Surveys, surveillance and control	161
References.....	161
5.3. Epidemiology of <i>Echinococcus multilocularis</i>, <i>Echinococcus vogeli</i> and <i>Echinococcus oligarthrus</i>	164
Summary	164
5.3.1. Epidemiology of <i>Echinococcus multilocularis</i>	164
5.3.1.1.: Life-cycle patterns	164
5.3.1.2.: Transmission dynamics	167
5.3.1.2.1. Contributions of final hosts	168
5.3.1.2.2. Contributions of the parasite	169
5.3.1.2.3. Contributions of eggs	172
5.3.1.2.4. Contributions of intermediate hosts	173
5.3.1.2.5. Contribution of population dynamics	174
5.3.1.3.: Mathematical model	175
5.3.1.4.: Potential transmission routes to humans and infection risk	175
5.3.2. Epidemiology of <i>Echinococcus vogeli</i>	176
5.3.3. Epidemiology of <i>Echinococcus oligarthrus</i>	177
References	177
Annex 5.3.1.: Epidemiological approaches in the study of the <i>Echinococcus multilocularis</i> infection in foxes	182
Annex 5.3.2.: Sampling of rodents for epidemiological studies on <i>Echinococcus multilocularis</i>	188
Annex 5.3.3.: Age determination in foxes	191
Annex 5.3.4.: References to other epidemiological methods	194
Chapter 6: Control of echinococcosis	195
6.1. Control of <i>Echinococcus granulosus</i>	195
Summary	195
6.1.1. Strategies for control and evaluation of control programmes	195
6.1.1.1. Strategies for control	196
6.1.1.2. Testing the feasibility of control and stability of taeniid systems by field trials	197
6.1.1.3. Analysis of some national and regional control programmes in the attack phase	198
6.1.1.4. Dog control policies	200
6.1.1.5. Transformation from attack to consolidation phase	201
6.1.1.6. Conclusions	202
References	202
Annex 6.1.1.: Evolution of programmes for control of <i>Echinococcus granulosus</i> (examples)	204
6.1.2. Formulating effective and cost-effective policies in the planning phase for permanent control of <i>Echinococcus granulosus</i>	209
Summary	209
6.1.2.1. Overall considerations during the planning phase	210

6.1.2.2. General methodology for surveys and surveillance	211
6.1.2.2.1. Human cystic echinococcosis	211
6.1.2.2.2. Echinococcosis in food animals	213
6.1.2.2.3. Canine echinococcosis	214
6.1.2.2.4. Echinococcosis in wild animals	215
6.1.2.3. Quantifying the economics of applying control	215
6.1.2.4. Costs of applying control	217
6.1.2.5. Note on benefit-cost analyses for <i>Echinococcus multilocularis</i> control.....	217
6.1.2.6. Conclusions	217
References	217
6.1.3. Public health education and training in control programmes	219
Summary	219
6.1.3.1. General aspects	220
6.1.3.2. The general impact of health education in control of cystic echinococcosis.....	221
6.1.3.3. The role of health education in various phases of a control programme.....	221
6.1.3.4. Examples of the role of health education in control programmes.....	221
References	224
6.1.4. Socio-economic impact of the <i>Echinococcus granulosus</i> infection.....	225
Summary	225
6.1.4.1. General aspects	225
6.1.4.2. Socio-economic consequences in humans	225
6.1.4.3. Economic consequences in livestock.....	227
6.1.4.4. Costs of control programmes	227
6.1.4.5. General recommendations	228
References	229
6.2. Control of <i>Echinococcus multilocularis</i>	230
Summary	230
6.2.1. General aspects.....	230
6.2.2. Control of <i>Echinococcus multilocularis</i> in sylvatic cycles	230
6.2.2.1. Elimination of final hosts.....	230
6.2.2.2. Anthelmintic treatment of definitive hosts	231
6.2.3. Control of <i>Echinococcus multilocularis</i> in synanthropic cycles	231
6.2.4. Control of spreading of <i>Echinococcus multilocularis</i> during transfer of definitive hosts	233
6.2.5. Measures in human populations to reduce morbidity and mortality caused by alveolar echinococcosis.....	234
6.2.6. Education.....	236
References.....	236
Chapter 7: Prevention of echinococcosis in humans and safety precautions	238
Summary	238
7.1. Safety precautions and disinfection	238
7.1.1. Awareness of the problem	238
7.1.2. Sources and routes of infection	238
7.1.3. Resistance of <i>Echinococcus</i> eggs.....	239
7.1.4. Ovicides and disinfection	240
7.1.5. Decontamination of environment.....	242
7.1.6. Decontamination of living-rooms and cars.....	242
7.1.7. Inactivation of metacestode material	242
7.1.8. Precautions in laboratories	242
7.1.9. Precautions in animal maintenance	244
7.1.10. Precautions during handling of human patients with echinococcosis	244
7.1.11. Precautions for field workers	244
7.1.12. Precautions during treatment of dogs (cats) against <i>Echinococcus multilocularis</i>	245
7.1.13. Precautions during purgation or treatment of dogs infected with <i>Echinococcus granulosus</i>	245

7.2. Prevention of cystic and alveolar echinococcosis in humans	245
7.3. Education.....	246
References	246
WHO Informal Working Group on Echinococcosis.....	249
Subject Index.....	251
Country/Region Index.....	262
