Parasitology (2013.Nov.) 140巻13号:1547～1550.

Control of cestode zoonoses in Asia: role of basic and applied science.

AKIRA ITO, XIAONONG ZHOU, PHILIP S. CRAIG, PATRICK GIRAUDOUX

PAR-2013-0220.R1

PREFACE

The importance of basic and applied science towards control of cestode zoonoses*

AKIRA ITO[1], XIAONONG ZHOU[2], PHILIP S. CRAIG[3] *and* PATRICK GIRAUDOUX[4]

[1] *Department of Parasitology and Laboratory of NTDs, Asahikawa Medical University, Asahikawa 078-8510, Japan*

[2] *National Institute of Parasitic Diseases, China CDC, Shanghai 200025, PR China*

[3] *Cestode Zoonoses Research Group, School of Environment and Life Sciences, University of Salford, Greater Manchester, UK*

[4] *Department of Chrono-environment, University of Franche-Comté/CNRS and Institut Universitaire de France, Besançon, France*

On a global scale, human cystic and alveolar echinococcoses and cysticercosis due to *Taenia solium* are classed as neglected zoonotic diseases (NZD), due to their high burden of disease which together is greater than 2 million lost DALYs (WHO, 2005, 1010; Budke *et al*. 2006; Craig *et al*. 2007). These cestodes require two mammalian hosts for the completion of their life cycle through natural or anthropogenic mediated predator-prey systems.

Human taeniases are caused by the adult stage of three species, *Taenia solium*, *T. saginata* and *T. asiatica* all of which are food- or meat-borne cestodiases (Ito *et al*. 2003*a*; Flisser *et al*. 2011). *Taenia solium* is unique, since it is the only one of these three species that can cause human cysticercosis, one of the most potentially lethal helminthiases contracted from accidental ingestion of eggs of this species (Ito *et al*. 2003*a*). Animal cysticercoses due to the three human *Taenia* species as well as several other *Taenia* species normally infect domestic and/or wild animals. In developed countries where meat inspection is pronounced and livestock generally raised under strict controls, human taeniases are uncommon.

In this special issue, we mainly focus on taeniases/cysticercoses and echinococcoses in developing countries and regions of Eurasia. At first, Ito (2013) based on a 40-years' experience reviews the caveats and advances in immunological and molecular studies of cestode zoonoses. The first topics in this special issue focus on human taeniases as food-borne infections. They are generally more common in rural areas where under-cooked contaminated meat or viscera are consumed in local communities without meat inspection (Li *et al*. 2013; Wandra *et al*. 2013). Human cysticercosis caused by the ingestion of the eggs of *T. solium* has been considered to be the major causative agent of the late onset epilepsy in developing countries where pork consumption is common (Lightowlers, 2013; Raoul *et al*. 2013). *Taenia solium* is unique, since it causes two different parasitoses in humans through its life-cycle completion: (i) cysticercosis due to the ingestion of eggs with development of cysticerci, mainly in muscles but also, more problematically, in the brain (neurocysticercosis), and (ii) taeniasis due to the ingestion of cysticerci from uncooked pork contaminated with the metacestode (Wandra *et al*.

2013). Pigs may be infected with cysticerci not only of *T. solium* or *T. asiatica* but also other non-human *Taenia* species, such as *T. hydatigena* (Ito, 2013). The occurrence of *T. solium* transmission in a region presents a high risk of humans acquiring accidental cysticercosis, either from self-infection (e.g. adult worm carrier) or from tapeworm carriers living in the same community (Sorvillo *et al*. 1992; Li *et al*. 2013; Wandra *et al*. 2013). Taeniid eggs cannot be differentiated morphologically; therefore immunological and molecular advanced methods are essential for accurate diagnosis and should be combined with the analysis of spatial patterns of distribution for evidence based control (Raoul *et al*. 2013; Sako *et al*. 2013). Cysticercosis due to *T. solium*, has also been classed as a potentially eradicable disease (Schantz *et al*. 1983) for which accurate surveillance is of paramount importance.

Lightowlers (2013) overviews the future aspect on the control of *T. solium* taeniasis/cysticercosis (T/C) based on his over 40 years work. Raoul *et al.* (2013) overview the strategy available for research on T/C. Sako *et al*. (2013) show a new simple method for purification of diagnostic antigens applicable in endemic areas. Yamane *et al*. (2013) show hybrids between *T. saginata* and *T. asiatica* and show additional data showing hybrids between the two species. Li *et al*. (2013) stress the usefulness of self-detection and stool microscopy in community-based mass screening for taeniases. The last article is by Wandra *et al*. (2013) on the overview of T/C in Indonesia and also stress the usefulness of questionnaire of self-detection of taeniid proglottids.

By contrast, the life cycles of *Echinococcus* species are completed through domestic animals and/or wildlife. In echinococcoses, humans are infected by accidental ingestion of parasite eggs, and are generally a dead-end for the parasite (Macpherson, 1983;

Rausch, 1995). However, echinococcoses caused by metacestodes established in parenteral tissues, mainly the liver and the lungs, are severe and potentially lethal to humans.

Echinococcoses are widespread diseases caused by environmental contamination of parasite eggs by canid definitive hosts such as dogs, foxes and wolves via faeces. Human alveolar echinococcosis (AE) due to *Echinococcus multilocularis* occurs focally in regions of developed and developing countries of the northern hemisphere, while human cystic echinococcosis (CE) due to *E. granulosus* is of greater concern because it has a worldwide distribution (Torgerson, 2013; Said Ali *et al*. 2013; Giraudoux *et al*. 2013*a*).

Cystic echinococcosis caused by the ingestion of eggs of the dog tapeworm, *E. granulosus* sensu stricto (genotypes G1-G3), has widely been recognized as an endemic disease in pastoral regions. Recent molecular re-evaluation of *E. granulosus* has revealed that *E. granulosus* sensu lato includes 5 different independent species: *E. granulosus* s.s., *E. equinus*, *E. ortleppi*, *E. canadensis*, and *E. felidis* (Nakao *et al*. 2010). Molecular approaches for identification of pathogenic *Echinococcus* species will become more essential for future epidemiological studies. *Echinococcus multilocularis* was originally considered to be mainly distributed in European Alpine countries and in western Alaska half a century ago (Rausch and Fay, 2002), however it has since been found widely in mountainous or upland areas in almost all countries in the holarctic and central regions of Eurasia, and has expanded its range in temperate areas of Europe (Craig *et al*. 2000, 2008; Romig *et al*. 2006; Torgerson *et al*. 2006; Beiromvand *et al*. 2012; Konyaev *et al*. 2012; Combes *et al*. 2012).

The second topics are on taxonomic issues of the genus *Echinococcus*. McManus

(2013) overviews historical remarks on biology and taxonomy of *Echinococcus*. Nakao *et al*. (2013) show how to evaluate *E. canadensis*. Konyaev *et al*. (2013) unveil the recent data on *Echinococcus* spp. and show all four genotypes of *E. multilocularis* and *E. granulosus* sensu stricto, *E. canadensis*, G6, G7 and G10 in Russia. This is the first original report on molecular evaluation of *Echinococcus* spp. from Russia. Ito *et al*. (2013) also describe *E. multilocularis* and *E. canadensis*, G6/7 and G10 from wild canids, especially wolves in Mongolia.

The third topics are on various aspects of transmission ecology and epidemiology of echinococcoses in Eurasia. Giraudoux *et al*. (2013*a*) present regional types of transmission of *E. multilocularis* and their ecological characteristics in China and Central Asia. Torgerson (2013) overviews the current situation of echinococcoses in Central Asia. Kesteren *et al*. (2013) assess dog demographics, roles of dogs, dog movements and faecal environmental contamination of rural communities of southern Kyrgyzstan, and Moss *et al*. (2013) try to evaluate re-infection patterns of purged dogs on the Tibetan plateau, China. The last article, using data from the French National Registry on human AE, points out the importance of investigating distributions at several scales to better understand their nested clustered structure (Said Ali *et al*. 2013).

There are several common problems for control or eradication of NTDs (including echinococcoses and cysticercosis): 1) major endemic areas of cysticercosis and CE are mainly in developing countries, especially in rural or remote areas where people are living under poor socio-economic conditions, 2) the lack of priority for control of NTDs in developing countries, 3) the lack of reliable data due to the lack of scientifically reliable tools and methods for identifying people in their communities.

In addition however, echinococcosis and cysticercosis/taeniasis are neglected zoonotic diseases and thus present a greater problem for control because of the necessity to manage or treat domestic animals (dogs, livestock) or wildlife (foxes). This is usually complicated by the lack of communication on surveillance between human and animal health authorities. Therefore, the burden of zoonotic cestodiases is largely underestimated (Budke *et al*. 2006; WHO, 2010).

Towards control of these cestode zoonoses, we have to clarify which are the risk factors (Lightowlers, 2013; Torgerson, 2013; Kesteren *et al*. 2013; Moss *et al*. 2013) and their distribution in time and space (Raoul *et al*. 2013; Giraudoux *et al*. 2013*a*). It also requests us how to identify the parasite species (Nakao *et al.* 2013; Konyaev *et al*. 2013; Ito *et al*. 2013; Said Ali *et al*. 2013; Sako *et al*. 2013). This can be done integrating human and animal epidemiology with host behaviour and parasite ecology (Raoul *et al*. 2013). In this symposium, we try to join molecular (McManus, 2013; Nakao *et al*. 2013; Konyaev *et al*. 2013; Ito *et al*. 2013), immunological (Sako *et al*. 2013) and spatial ecology approaches (Raoul *et al*. 2013; Giraudoux *et al*. 2013*a*; Kesteren *et al*. 2013; Moss *et al*. 2013) in order to provide research based evidence towards control of cestode zoonoses (Danson *et al*. 2006; Giraudoux *et al*. 2006, 2007, 2008, 2013*b*). One of the most important strategies for efficient control of taeniasis and cysticercosis may be to establish or to introduce real-time detection of patients in the endemic areas themselves (Sako *et al*. 2013; Raoul *et al*. 2013).

In Asia, a series of meetings on Cestode Zoonoses have been organized, especially sponsored by the Japanese Society for the Promotion of Science since 2000 (Ito, 2007). Among them, we have to point out pioneer contributions in China toward control of echinococcoses that have been coordinated through a team of scientists from America, Europe, Australia, and Japan (Andersen *et al*. 1993; Craig *et al*. 2000; Ito *et al.* 2003*b*, 2006; Schantz *et al*. 2003; Xiao *et al*. 2003, 2005; Mamuti *et al*. 2004, 2007; Heath *et al*. 2005; Li *et al*. 2005, 2006; Bart *et al*. 2006; Giraudoux *et al*. 2013*b*) as well as the contribution toward control of echinococcoses made by scientists from China (Wen *et al*. 2005) and cysticercosis (Chen *et al*. 2005) as joint project with scientists from Japan (Ito *et al*. 2003*b*, 2005).

This symposium in Shanghai was launched and co-organized by two of the Guest-Editors, Akira Ito (Japan) and Xiao-Nong Zhou (China), and supported by the Asian Science and Technology Strategic Cooperation Promotion Programs sponsored by the Special Coordination Funds for Promoting Science and Technology, Ministry of Education, Japan (MEXT) (2010-2012), and the national office of the Chinese Center for Disease Control and Prevention.

ACKNOWLEDGEMENT

We dedicate this special issue to the late Prof. Robert L. Rausch who continuously worked as a great pioneer on biology of cestodes, especially on *Echinococcus* as his life work. He died on 6th October 2012.

REFERENCES

Andersen, F. L., Chai, J. J. and Liu, F. J. (1993). Compendium on cystic echinococcosis with special reference to the Xinjiang Uygur Autonomous region, the People's Republic of China, pp.1-235. Brigham Young University, Provo, USA.

Bart, J. M., Abdukader, M., Zhang, Y. L., Lin, R. Y., Wang, Y. H., Nakao, M.,

Ito, A., Craig, P. S., Piarroux, R., Vuitton, D. A. and Wen, H. (2006). Genotyping of human cystic echinococcosis in Xinjiang, PR China. *Parasitology* **133**, 571-579.

Beiromvand, M., Akhlaghi, L., Massom, S. H. F., Mobedi, I., Meamar, A. R., Oormazdi, H., Motevalian, A. and Razmjou, E. (2012). Detection of *Echinococcus multilocularis* in carnivores in Razavi Khorasan Province, Iran using mitochondrial DNA. *PLoS Neglected Tropical Diseases* **5**, e1379.

Budke, C. M., Deplazes, P. and Torgerson, P. R. (2006). Global socioeconomic impact of cystic echinococcosis. *Emerging Infectious Diseases* **12**, 296-303.

Chen, Y, Xu, L. and Zhou X. (2005). Cysticercosis cellulosae in China. *Asian Parasitology* **2**, 37-83.

Combes, B., Comte, S., Raton, V., Raoul, F., Boué, F., Umhang, G., Favier, S., Dunoyer, C., Woronoff, N. and Giraudoux, P. (2012). Westward Spread of *Echinococcus multilocularis i*n Foxes, France, 2005–2010. *Emerging Infectious Disease* **18**, 2059-2062.

Craig, P. S., Budke, C. M., Schantz, P. M., Li, T., Qiu, J., Yang, Y., Zeyhle, E., Rogan, M. T. and Ito, A. (2007). Human echinococcosis: a neglected disease? *Tropical Medicine and Health* **35**, 283-292.

Craig, P. S., Giraudoux, P., Shi, D., Barethlomot, B., Barnish, G., Delattre, P., Quere, J. P., Harraga, S., Bao, G., Wang, Y., Lu, F., Ito, A. and Vuitton, D. A. (2000). An epidemiological and ecological study of human alveolar echinococcosis transmission in south Gansu, China. *Acta Tropica* **77**, 167-177.

Craig, P. S., Li, T., Qiu, J., Zhen, R., Wang, Q., Giraudoux, P., Ito, A., Heath, D., Warnock, B., Schantz, P. and Yang, W. (2008). Echinococcoses and

Tibetan communities. *Emerging Infectious Diseases* **14**, 1674-1675.

Danson, F. M., Giraudoux, P. and Craig, P. S. (2006). Spatial modeling and ecology of *Echinococcus multilocularis* transmission in China. *Parasitology International* **55**, S227-S231.

Flisser, A., Craig, P. S. and Ito, A. (2011). *Taenia solium*, *Taenia saginata* and *Taenia asiatica*. In *Zoonoses* (eds. Palmer, S. R., Lord Soulsby, Torgerson, P. R. and Brown, D. W. G.), pp. 627-644. Oxford University Press, Oxford.

Giraudoux, P., Pleydell, D., Raoul, F., Quéré, J., Wang, Q., Yang, Y., Vuitton, D. A., Qiu, J., Yang, W. and Craig, P. S. (2006). Transmission ecology of *Echinococcus multilocularis*: What are the ranges of parasite stability among various host communities in China? *Parasitology International* **55**, S237-S246.

Giraudoux, P., Pleydell, D., Raoul, F., Quéré, J. P., Qian, W., Yang, Y., Vuitton, D. A., Qiu, J. M., Yang, W., and Craig, P. S. (2007). *Echinococcus multilocularis*: why are multidisciplinary and multiscale approaches essential in infectious disease ecology? *Tropical Medicine and Health* **55**, S237-S246.

Giraudoux, P., Raoul, F., Pleydell P. and Craig, P. S. (2008). Multidisciplinary studies, systems approaches and parasite eco-epidemiology: Something old, something new. *Parasite* **15**, 469-476.

Giraudoux, P., Raoul, F., Afonso, E., Ziadinov, I., Yang, Y., Li, L., Li, T., QUÉRÉ, J. P., Feng, Z., Wang, Q., Wen, H., Ito, A. and Craig, P. S. (2013*a*). Transmission ecosystems of *Echinococcus multilocularis* in China and Central Asia. *Parasitology* **140**, in press.

Giraudoux, P., Raoul, F., Pleydell, D., Li, T., Han, X., Qiu, J., Xie, Y., Wang, H., Ito, A. and Craig, P. S. (2013*b*). Drivers of *Echinococcus multilocularis* transmission in China: host biodiversity, landscape or climate? *PLoS Neglected Tropical Diseases* **7**, e2045.

Heath, D. D., Zhang, L. H. and McManus, D. P. (2005). Inadequacy of yaks as hosts for the sheep dog strain of *Echinococcus granulosus* or for *E. multilocularis*. *American Journal of Tropical Medicine and Hygiene* **72**, 289-290.

Ito, A. (2007). Welcome remarks and introduction to symposium on cestode zoonoses in Asia and the Pacific. *Southeast Asian Journal of Tropical Medicine and Public Health* **38** (suppl), 115-118.

Ito, A. (2013). Nothing is perfect! Trouble-shooting in immunological and molecular studies on cestode infections. *Parasitology* **140**, in press.

Ito, A., Craig, P. S. and Schantz, P. M. (2006). Taeniasis/cysticercosis and echinococcosis with focus on Asia and the Pacific. *Parasitology International* **55,** S1-S311.

Ito, A., Nakao, M. and Wandra, T. (2003*a*). Human taeniasis and cysticercosis in Asia. *Lancet* **362**, 1918-1920.

Ito, A., Wen, H. and Yamasaki, H. (2005). Taeniasis/cysticercosis and echinococcosis in Asia. *Asian Parasitology* **2**, 1-334.

Ito, A., Chuluunbaatar, G., Yanagida, T., Davaasuren, A., Sumiya, B., Asakawa, M., Ki, T., Nakaya, K., Davaajav, A., Dorjsuren, T., Nakao, M. and Sako, Y. (2013). *Echinococcus* species from red foxes, corsac foxes, and wolves in Mongolia. *Parasitology* **140**, in press.

Ito, A., Urbani, C., Qiu, J., Vuitton, D. A., Qiu, D., Heath, D. D., Craig, P. S., Feng, Z. and Schantz, P. M. (2003*b*). Control of echinococcosis and cysticercosis: a public health challenge to international cooperation in China.

Acta Tropica **86**, 3-17.

Kesteren, F., Mastin, A., Mytynova, B., Ziadinov, I., Boufana, B., Torgerson, P. R., Rogan, M. R. and Craig, P. S. (2013). Dog ownership, dog behaviour and transmission of *Echinococcus* spp*.* in the Alay Valley, southern Kyrgyzstan. *Parasitology* **140**, in press.

Konyaev, S. V., Yanagida, T., Ingovatova, G. M., Shoikhet, Y. N., Nakao, M., Sako, Y., Bondarev, A. Y. and Ito, A. (2012). Molecular identification of human echinococcosis in the Altai region of Russia. *Parasitology International* **61**, 711-714.

Konyaev, S., Yanagida, T., Nakao, M., Ingovatova, G. M., Shoykhet, Y. N., BOndarev, A. Y., Odnokurtsev, V. A., Lostutova, K. S., Lukmanova, G. I., Dokuchaev, N. E., Spiridonov, S., Alshinecky, M. V., Tatyana, S. N., Andreyanov, O. N., Abramov, S. A., Krivopalov, A. V., Karpenko, S. V., Lopatina, N. V., Dupal, T. A., Sako, Y. and Ito, A. (2013). Genetic diversity of *Echinococcus* spp. in Russia. *Parasitology* **140**, in press.

Li, T., Craig, P. S., Ito, A., Chen, X., Qiu, D., Qiu, J., Sato, M.O., Wandra, T., Bradshaw, H., Li, L., Yang, Y. and Wang, Q. (2006). Taeniasis/cysticercosis in a Tibetan population in Sichuan Province, China. *Acta Tropica* **100**, 223-231.

Li, T., Qiu, J., Yang, W., Craig, P. S., Chen, X., Xiao, N., Ito, A., Giraudoux, P., Mamuti, W., Yu, W. and Schantz, P. M. (2005). Echinococcosis in Tibetan populations, western Sichuan province, China. *Emerging Infectious Diseases* **11**, 1866-1873.

Li, T., Chen, X., Yanagida, T., Wang, H., Long, C., Sako, Y., Okamoto, M., Wu, Y., Giraudoux, P., Raoul, F., Nkouawa, A., Nakao, M. Craig, P. S. and Ito, A.

(2013). Detection of human taeniases in Tibetan endemic areas, China. *Parasitology* **140**, in press.

Lightowlers, M. W. (2013). Control of *Taenia solium* taeniasis/cysticercosis: past practices and new possibilities. *Parasitology* **140**, in press.

Macpherson, C. N. L. (1983). An active intermediate host role for man in the life cycle of *Echinococcus granulosus* in Turkana, Kenya. *American Journal of Tropical Medicine and Hygiene* **32**, 397-404.

Mamuti, W., Sako, Y., Bart, J. M., Nakao, M., Ma, X., Wen, H. and Ito, A. (2007). Molecular characterization of a novel gene encoding an 8-kDa-subunit of antigen B from *Echinococcus granulosus* genotypes 1 and 6. *Parasitology International* **56**, 313-316.

Mamuti, W., Yamasaki, H., Sako, Y., Nakao, M., Xiao, N., Nakaya, K., Sato, N., Vuitton, D. A., Piarroux, R., Lightowlers, M. W., Craig, P. S. and Ito, A. (2004). Molecular cloning, expression and serological evaluation of an 8-kilodalton subunit of antigen B from *Echinococcus multilocularis*. *Journal of Clinical Microbiology* **42**, 1082-1088.

McManus, D. P. (2013). Current status of the genetics/molecular taxonomy of *Echinococcus* species. *Parasitology* **140**, in press.

Moss, J. E., Chen, X., Li, T., Qiu, J. Wang, Q., Giraudoux, P., Ito, A., Torgerson P. R. and Craig, P. S. (2013). Reinfection studies of canine echinococcosis and role of dogs in transmission of *Echinococcus multilocularis* in Tibetan communities, Sichuan, China. *Parasitology* **140**, in press.

Nakao, M., Yanagida, T., Konyaev, S., Lavikainen, A., Odnokurtsev, V. A., Zaikov, V. A. and Ito, A. (2013). Mitochondrial phylogeny of the genus

Echinococcus (Cestoda: Taeniidae) with emphasis on relationships among *Echinococcus canadensis* genotypes. *Parasitology* **140**, in press.

Nakao, M., Yanagida, T., Okamoto, M., Knapp, J., Nkouawa, A., Sako, Y. and Ito, A. (2010). State-of-Art *Echinococcus* and *Taenia*: Phylogenetic taxonomy of human-pathogenic tapeworms and its application to molecular diagnosis. *Infection, Genetics and Evolution* **10**, 444-452.

Pawlowski, Z. S. (2006). Role of chemotherapy of taeniasis in prevention of neurocysticercosis. *Parasitology International* **55**, S105-S109.

Raoul, F., Li, T., Sako, Y., Chen, X., Long, C., Yanagida, T., Wu, Y., Nakao, M., Okamoto, M., Craig, P. S., Giraudoux, P. and Ito, A. (2013). Advances in diagnosis and spatial analysis of cysticercosis and taeniasis. *Parasitology* **140**, in press.

Rausch, R. L. (1995). Life cycle patterns and geographic distribution of *Echinococcus* species. In Echinococcus *and Hydatid Disease* (eds. Thompson, R.C. A. and Lymbery, A. J.), pp. 89-134. CAB International, Oxon.

Rausch, R. L. and Fay, F. H. (2002). Epidemiology of alveolar echinococcosis, with reference to St Lawrence Island, Bering Sea. In *Cestode Zoonoses: Echinococcosis and Cysticercosis* (eds. Craig, P.S. and Pawlowski, Z.), pp. 309-325. IOS, Amsterdam.

Romig, T., Dinkel, A. and Mackenstedt, U. (2006). The present situation of echinoccosis in Europe. *Parasitology International* **55**, S187-S191.

Said Ali, Z., Grenouillet, F., Knapp, J., Bresson-Hadni, S., Vuitton, D. A., Raoul, F., Richou, C., Millon, L., Giraudoux, P. and the FracEchino Network. (2013). Detecting nested clusters of human alveolar echinococcosis in France, 1982-2011. *Parasitology* **140**, in press.

Schantz, P. M. Cruz, M., Sarti, E. and Pawlowski, Z. (1983). Potential eradicability of taeniasis and cysticercosis. *Bulletin of Pan American Health Organization* **27**, 397-403.

Sako, Y., Itoh, S., Okamoto, M., Nakaya, K. and Ito, A. (2013). Simple and reliable preparation of immunodiagnostic antigens for *Taenia solium* cysticercosis. *Parasitology* **140**, in press.

Schantz, P. M., Wang, H., Qiu, J., Liu, F. J., Saito, E., Emshoff, A., Ito, A., Roberts, J. M. and Delker, C. (2003). Echinococcosis on the Tibetan Plateau: prevalence and risk factors for cystic and alveolar echinococcosis in Tibetan populations in Qinghai Province, China. *Parasitology* **127**, 109-120.

Sorvillo, F. J., Waterman, S. H., Richard, F. O. and Schantz, P. M. (1992). Cysticercosis surveillance: locally acquired and travel-related infections and detection of intestinal tapeworm carriers in Los Angeles County. *American Journal of Tropical Medicine and Hygiene* **47**, 365-371.

Torgerson, P. R. (2013). The emergence of echinococcosis in Central Asia. *Parasitology* **140**, in press.

Torgerson, P. R., Oguljahan, B., Muminov, A. E., Karaeva, R. R., Kuttubaev, O. T., Aminjanov, M. and Shaikenov, B. (2006). Present situation of cystic echinococcosis in Central Asia. *Parasitology International* **55**, S207-S212.

Wandra, T., Ito, A., Swastika, K., Dharmawan, N. S., Sako, Y. and Okamoto, M. (2013). The past and present situation of taeniases and cysticercosis in Indonesia. *Parasitology* **140**, in press.

Wen, H., Wang, Y. and Zhou, H. (2005). *Echinococcus* infections and echinococcosis in China. *Asian Parasitology* **2**, 185-238.

WHO (2005). The Control of Neglected Zoonotic Diseases. A route to poverty alleviation. Report of a Joint WHO/DFID-AHP Meeting with participation of FAO and OIE. Geneva, 20-21 September 2005.

WHO (2010). Working to overcome the global impact of neglected tropical diseases. First report on neglected tropical diseases. World Health Organization, Geneva.

Xiao, N., Qiu, J., Nakao, M., Nakaya, K., Yamasaki, H., Sako, Y., Mamuti, W., Schantz, P. M., Craig, P. S. and Ito, A. (2003). Identification of *Echinococcus* species from a yak in the Qinghai-Tibet plateau region of China. *American Journal of Tropical Medicine and Hygiene* **69**, 445-446.

Xiao, N., Qiu, J., Nakao, M., Li, T., Yang, W., Chen, X., Schantz, P. M., Craig, P. S. and Ito, A. (2005). *Echinococcus shiquicus* n. sp., a taeniid cestode from Tibetan fox and plateau pika in China. *International Journal for Parasitology* **35**, 693-701.

Yamane, K., Yanagida, T., Li, T., Chen, X., Dekumyoy, P., Waikagul, J., Nkouawa, A., Nakao, M., Sako, Y., Ito, A., Sato, H. and Okamoto, M. (2013). Complicated relationships between *Taenia saginata*, *Taenia asiatica* and their hybrids. *Parasitology* **140**, in press.