Ovis and hydatids, why are they still an issue in cattle sheep and goat production?
What are hydatids and ovis?

It is the infection of sheep with the cystic (intermediate) stages of two species of tapeworm that infect domestic and wild dogs and foxes

• Hydatids = *Echinococcus granulosus*

• Ovis (sheep measles) = *Taenia ovis (Cysticercus ovis)*
Hydatids in ovine liver
Cyst contains fluid and thousands of tiny tapeworm heads.
Sheep measles cysts

Viable

Each cyst contains a single tapeworm head.
Hydatids lifecycle
Hydatids & ovis lifecycles

Dog eats infected offal

Eggs passed in dog's faeces

Eggs eaten by intermediate host

Adult tapeworm in dog’s small intestine

Eggs eaten by intermediate host

Dog eats infected offal

Eggs passed in dog’s faeces

Adult tapeworm in dog’s small intestine
Controlling hydatid/ovis transmission

- Do not allow dogs access to livers/lungs (domestic & wild animals) raw sheep meat/hearts
- Confine dogs; offal pits
- Regular treatment of dogs with de-worming products containing praziquantel
- Feed dry/tinned or cooked/frozen (10 days) raw meat/offal
- Public education
If they are so easy to control in dogs, why are they still an issue in livestock?
Wild canids!.............

Wild dogs (dingoes and dingo domestic dog hybrids) and foxes
Why are hydatids and sheep measles important?
Financial losses to the Australian meat industry

- Hydatids – condemnation/downgrading of offal (sheep/cattle/goats*)
- Sheep measles – condemnation/downgrading of carcasses and hearts (sheep/goats*)
- Additional time for inspection/trimming

*There are recent records of sheep measles and hydatids in slaughtered feral goats (Brookes & Jenkins unpublished data). There are very few infected (probably reflecting goats are mainly browsers and live in more arid areas) the financial losses associated with infection in goats are likely to be minimal.
T. ovis distribution/occurrence

T. ovis present in 36% (1306 lines) of 3,608 lines of sheep examined......

.......an ongoing production problem for the sheep meat industry?
Red foxes (*Vulpes vulpes*) and wild dogs (dingoes (*Canis lupus dingo*) and dingo/domestic dog hybrids), as sylvatic hosts for Australian *Taenia hydatigena* and *Taenia ovis*

David J. Jenkins, Nigel A.R. Urwin , Thomas M. Williams , Kate L. Mitchell , Jan J. Lievaart , Maria Teresa Armua-Fernandez

Sheep measles

Losses to sheep abattoirs, anything from a few hundred dollars/day to several thousand per day (approx. $1,500 - $2,500) with bad days up to $4,500/day (Jenkins –MLA report 2014)
also public health impacts of hydatid disease

- Humans can act as a host for the cystic stage. Infection can lead to major health impacts and in some cases death

veterinary impacts of hydatid disease on native wildlife

- In native wildlife (macropods) infection commonly leads to severe health impacts and death
Hydatids in humans

[Images of surgical procedure and patient with hydatid cysts]
Hydatid disease in a wallaby
Where does hydatid disease occur in Australia?
How are hydatids transmitted?

• Dogs eat cysts in offal
• Protoscoleces activate, attach to the inside of the dog’s gut and develop
• They are mature at about 42 days post infection and begin releasing eggs
Eggs in faeces/environment.

Tapeworm transmission in dogs

Cysts in internal organs of intermediate host, eaten by definitive host.

Eggs ingested by intermediate host – sheep.

PPP=42 d

Protoscoleces

6-hooked onchosphere
Eggs in faeces/environment.

Tapeworm control in dogs

Cysts in internal organs of intermediate host, eaten by definitive host.

PPP=42 d

Deworm dogs

Feed safe food

Protoscoleces

Eggs in faeces/environment.

6-hooked onchosphere

Eggs ingested by intermediate host – sheep.

Feed safe food
The Australian hydatid transmission pattern has changed

• Hydatid disease in sheep now generally uncommon with localised areas of transmission
• Hydatid tapeworm infection in rural domestic dogs also uncommon
• Probably due to
  - the development of palatable, inexpensive, dry dog food
  - the inclusion of praziquantel in all widely available generic all-wormers for dogs
• Today hydatid disease is mainly perpetuated in a wildlife cycle between wild dogs (dingoes and their hybrids) and macropod marsupials, particularly wallabies
Tapeworms in definitive hosts - dingoes/ & hybrids, (foxes)

Cysts in internal organs of intermediate host, eaten by definitive host.

Eggs in faeces/environment

Eggs ingested by intermediate hosts – macropod marsupials/wombats, (feral pigs)
Predator/prey interaction
E. granulosus segments
Hydatids in wildlife

Eastern Grey Kangaroo

Wombat

Swamp wallaby
Exotic parasites and naïve host populations.

Cysts 9 months post experimental infection (infected with same batch of eggs)....
Transmission importance of flies?

E. granulosus segment
Transmission of Hydatid Disease to Sheep from Wild Dogs in Victoria, Australia

H. J. GRAINGER*† and D. J. JENKINS‡
Bovine hydatidosis financial impact study

Although hydatid disease in sheep is now uncommon in many areas of eastern Australia hydatid disease in cattle is common.
Distribution of cattle rearing areas in Australia
Cattle rearing and *E. granulosus* transmission areas
Team-hydatid

Sarah Fotheringham  Allan Gunn  Phil Kemsley  Vikki Brookes
Data collected......
• from one abattoir in north-eastern NSW
• between 1\textsuperscript{st} of July 2013 - 30\textsuperscript{th} of June 2015
• n = 781,873
• 43,002 (5.5\%) infected with hydatid disease
• 5.5% beasts infected with hydatid cysts

• organs condemned for hydatid infection:
  • 51% livers
  • 48% lungs
  • 1% spleen
  • < 1% heart

• 93% of infected cattle had both liver and lung infection
• Mean weight loss in cattle infected with hydatid cysts
  • hide = 1.24 kg
  • carcass = 16.8 kg

• Financial loss per annum
  • Hide = $32,155
  • Carcass = $1,255,574
  • Liver = $283,126
  • Lung = $166,767
  • Heart = $1,687
  • Spleen = $588
• Financial value model
  • Financial loss = Total loss due to carcass weight loss + total loss due to hide weight loss + cost due to organ condemnation/ downgrading

• Total lost over the two year period $3,479,738.05

• Total lost per year = $1,739,869.03
• Potential confounders:

• Not all data were available that might influence prevalence and financial impact of hydatid disease were included. For example:
  • Breed of cattle
  • Travel time of cattle to abattoir
  • Pasture raised vs. grain-fed (feed lot)

• This is a case study based on an individual abattoir, therefore results cannot be extrapolated to fit other abattoirs
Cara Wilson - PhD student
Investigating, in much more detail, the data generated by Sarah Fotheringham.
• Cara has a total data base of 5.2 million slaughtered cattle (2000-2016).
• However, she is currently working on a sub-set of 1.8 million (2010-2016) for which she has complete data on hydatid infection and other conditions
• Cara will re-assess prevalence, losses, risk factors and also determine spatial distribution of bovine hydatidosis in Australia and assess financial viability of mitigation strategies
First report of an effective vaccine against sheep measles

EG95 vaccine against hydatid disease in sheep

Lightowlers MW, Lawrence SB, Gauci CG et al.

Vaccination against hydatidosis using a defined recombinant antigen

*Parasite Immunology* (1996) 18; 457-62
Vaccination trials in Australia and Argentina confirm the effectiveness of the EG95 hydatid vaccine in sheep


2 isolates of eggs used in challenge infections:
• NZ sheep/dog
• Australian macropod/dingo

96-100% protection achieved
Experimental use of the EG95 sheep hydatid vaccine in cattle

Vaccine 30 (2012) 3076–3081

Vaccination of bovines against *Echinococcus granulosus* (cystic echinococcosis)

David D. Heath, Christine Robinson, Trevor Shakes, Yan Huang, Tursun Gulnur, Baoxing Shi, Zhuangzhi Zhang, Garry A. Anderson, Marshall W. Lightowlers

Vaccine 30 (2012) 7321–7326

Maternal antibody parameters of cattle and calves receiving EG95 vaccine to protect against *Echinococcus granulosus*

David D. Heath, Christine Robinson, Marshall W. Lightowlers
Expt 1: Vaccination of bovines against *Echinococcus granulosus* (cystic echinococcosis)

- Scaled-up the vaccine for sheep (x5 sheep dose) administered
- Gave 2 vaccinations one month apart
- This treatment gave 90% protection to expt challenge infection that lasted for 12 months

- Giving a 3rd vaccination 12 months after vax 1 & 2 gave 99% protection to expt challenge infection that lasted for at least 11 months
Expt 2:
Maternal antibody parameters of cattle and calves receiving EG95 vaccine to protect against *Echinococcus granulosus*

- 2 gups of pregnant cows, one gp vaccinated (2 vaccinations, 4 wks apart), the other unvaccinated
- Calves of both groups expt challenged @ 4; 9; 13 or 17 wks post vax
- Colostral antibodies from vaccinated cows protected calves for 17 weeks

- 8 &12 week old calves responded well to vax (made antibodies) but incomplete protection
- Full protection only achieved if vaccinated @ 16 weeks old (same for calves from unvaccinated cows)

- Suggests immune system of calves not fully functional until 4-5 months old