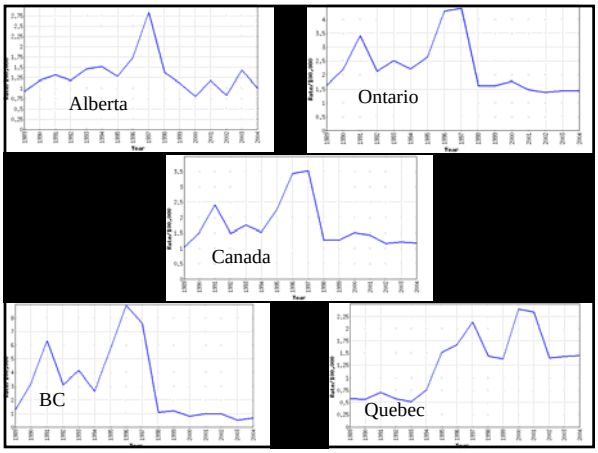
Malaria and other parasites

Public Health WORKS – Speaker Series
Edmonton, January 16/2007

J Dick MacLean
McGill Centre for Tropical Diseases

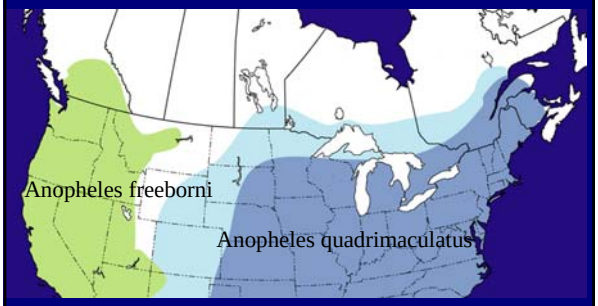
Reported malaria in Canada



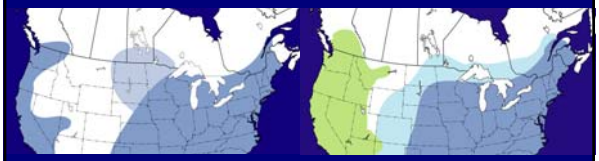
Malaria 18th Century Canada

. Lysenko AY et al; in Lebedew AW (ed) Medical geography,
Academy of Sciences Moscow, 1968
. Drake D. in Malaria in the interior valley of NA Levine ND (ed.) U. of Illinois. Press 1964

Principle malaria vectors in Canada

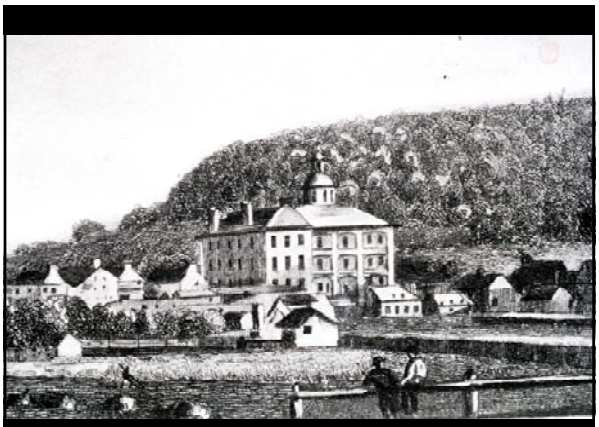


WHO/VBC/89.967
Levine RS et al J Med Entomol 41;607-613: 2004



Malaria 1800s

Malaria mosquitoes 2000



The Montreal General Hospital

MONTREAL GENERAL HOSPITAL ADMISSIONS
1822-5 (3665 ADMISSIONS)

	%
Hibernus	66
Canadensis	12
Anglus	8
Scotus	8
Americans	2
Germanicus	1
Welsh	1
Swiss	0.1

Most frequent Infectious Diseases
% of total admissions

MGH 1822-5 (3655)		Addis Ababa 1989		MGH 1989	
februm cont.	17	tuberculosis	10	respiratory	3
synochus	16	malaria	7	cellulitis	1
ulcera	6	pneumonia	6	urinary	1
typhus	4	meningitis	5	misc ID/parasitol.	1
pneumonia	3	hepatitis	3	female genital	1
diarrhea	3	typhoid	2	otitis media	1
malaria	3			sepsis	1

Post-mortem of missed epidemics: an analysis of malaria surveillance.

JD MacLean*, E Kokoskin*,
M Ndao*, BJ Ward* , S Joseph#, TW Gyorkos#

*McGill University Centre for Tropical Diseases, Montreal General Hospital and #Department of Epidemiology, McGill University, Montreal, Quebec, Canada.

The inquiry

To examine 20 years of malaria surveillance in Canada.

To explain the wild fluctuations in total and species numbers.

Methods

Local

1. McGill University Centre for Tropical Diseases (TDC), National Reference Centre for Parasitology (NRCP)

Provincial

2. Ministère de la santé et des services sociaux, Direction de la santé publique, Québec
3. Disease Control and Epidemiological Service, Ontario Ministry of Health and Long Term Care, Toronto
4. Epidemiological Services, British Columbia Centre for Disease Control

National

5. Division of Disease Surveillance, Centre for Infectious Disease Prevention and Control, Health Canada
6. Medical Services Branch. Field Operating Support System, Citizen and Immigration Canada
7. Notifiable Diseases On-Line. Ottawa, Population and Public Health Branch, Health Canada

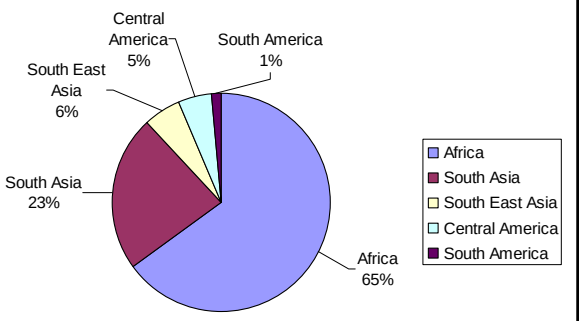
International

8. Malaria surveillance---United States. In: CDC surveillance summaries. MMWR
9. US Census Bureau. IDB Data Access
10. Computerized information system on infectious diseases (CISID) Copenhagen, WHO Regional Office for Europe
11. World Tourist Organization, Madrid
12. Dept. of Communicable Diseases, WHO Regional Office for South East Asia, New Delhi, India

Local

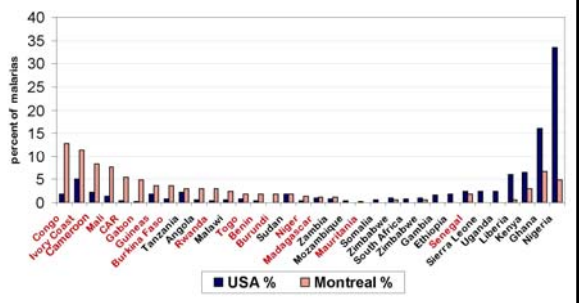
Tropical Disease Centre , Montreal

Geographic origins of TDC malaria (n=553)
(1980-2002)

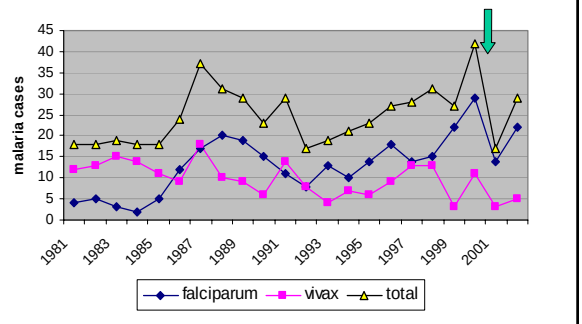


1. McGill Centre for Tropical Disease data base

Malaria in TDC and USA (1990-2000)



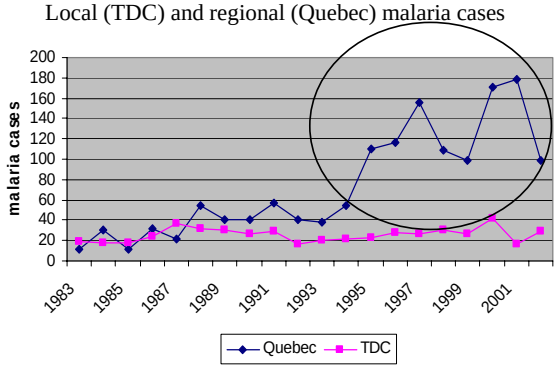
Malaria cases at Tropical Disease Centre (n=553)



Regional

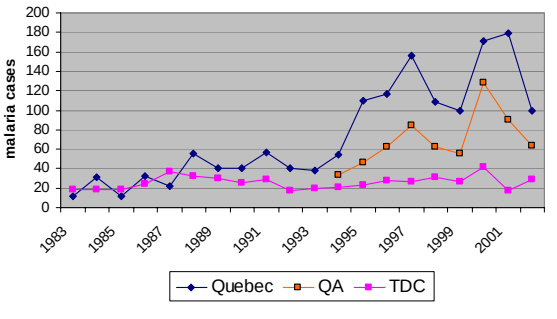
Province of Quebec
population 7.5 million

Local (TDC) and regional (Quebec) malaria cases

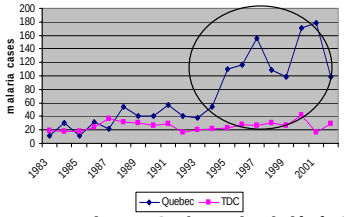


Direction de la santé publique, Québec

Quebec, QA and Tropical Disease Centre malaria reporting



1. McGill Centre for Tropical Disease data base
2. Ministère de la santé et des services sociaux, Direction de la santé publique, Québec



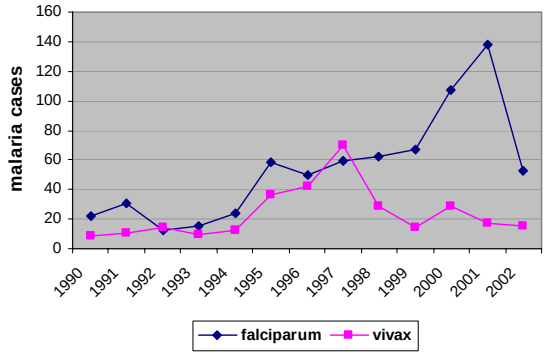
3-fold increase in malaria in Quebec in last half of 1990s

In 1994 a malaria Quality Assurance Program jointly started by TDC and Quebec Provincial Health Laboratory (LSPQ)

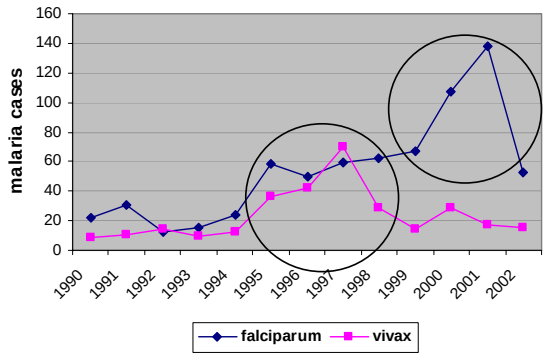
…..malaria reference laboratory, biannual workshops, and annual proficiency testing

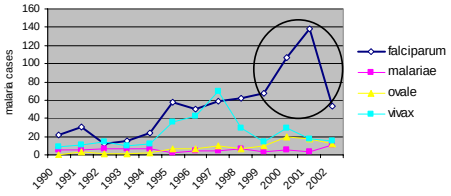
Conclusion: Pseudo epidemic due to increased malaria reporting

Province of Quebec malaria species dynamics



Province of Quebec malaria species dynamics





2-fold increase in falciparum malaria in 2000-1

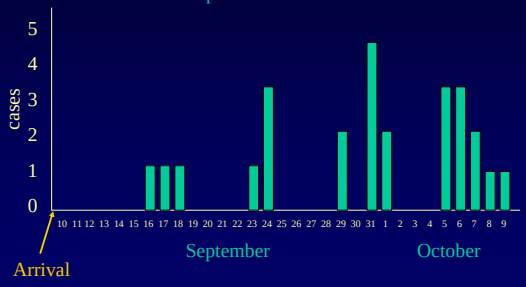
Plane loads of refugees brought to Quebec from Tanzanian refugee camps

Active surveillance of 330 refugees Quebec 2000-1 (14% positive)

Conclusion: Epidemic of refugee related *P. falciparum* malaria

Evolution of malaria 'epidemic' in Quebec

Slides received at TDC Reference Laboratory, MGH
Sept-Oct 2000

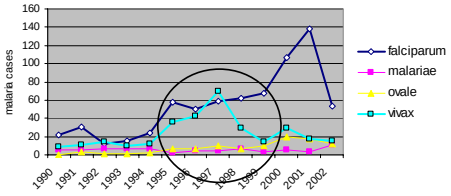


Active surveillance 4 months after arrival

210 subjects

Microscopy	11.4 %
Antigen capture (ICT)	8.8 %
PCR	22.8 %

Preliminary data - May 1, 2001



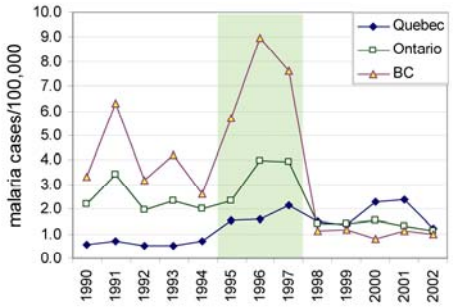
3-fold increase in vivax malaria in 1995-7

Conclusion: Epidemic of *P. vivax* malaria unexplained

Polyprovincial

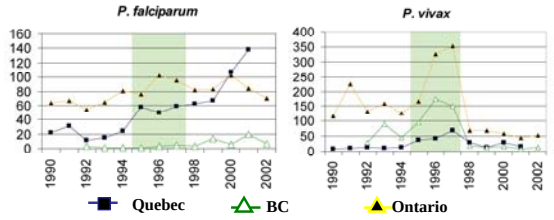
Quebec
Ontario
British Columbia

Malaria rates in 3 provinces



1. Ministère de la santé et des services sociaux, Direction de la santé publique, Québec
2. Disease Control and Epidemiological Service, Ontario Ministry of Health and Long Term Care, Toronto
3. Epidemiological Services, British Columbia Centre for Disease Control

Species cases by province



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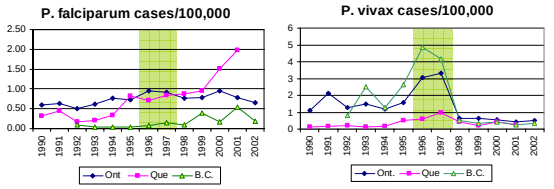
Species rate by province



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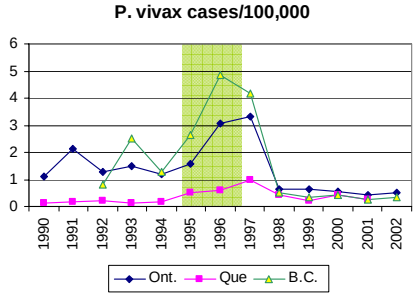
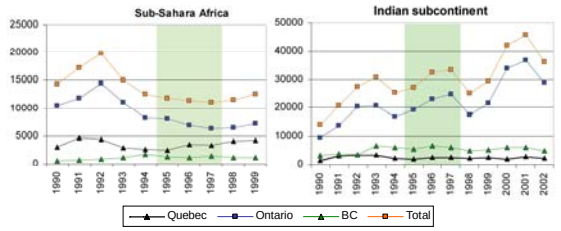


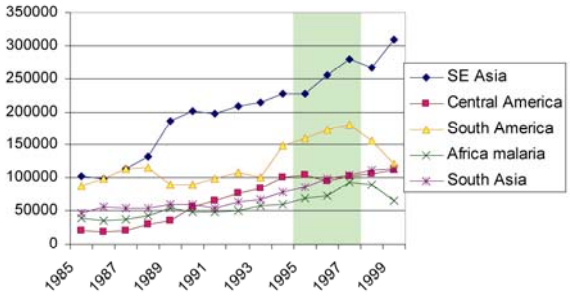
Immigration to Canadian provinces



Citizen and Immigration Canada

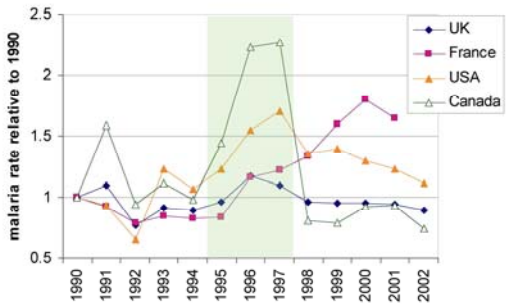
International

Canadian visits to malaria regions



World Tourist Organization, Madrid

Standardized malaria rates relative to 1990

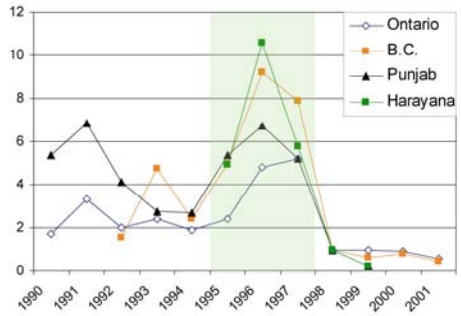


1. WHO Regional Office for Europe, Copenhagen,
2. Population and Public Health Branch, Health Canada
3. CDC surveillance summaries. MMWR
4. US Census Bureau.

Interim conclusions

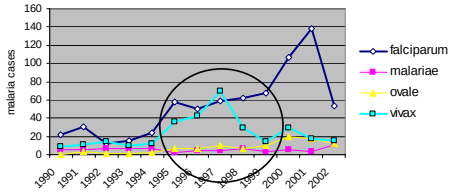
1. Malaria epidemic in Canada in 1995-7
2. Epidemic was ***P. vivax***
3. Smaller simultaneous increase in USA but not in European countries

Vivax incidence relative to 1998



1.Disease Control and Epidemiological Service, Ontario
2. British Columbia Centre for Disease Control
3. WHO Regional Office for South East Asia, New Delhi, India

	Quebec	Ontario	B.C.
Population (millions)	7.0	10.6	3.7
Punjabi mother tongue (% of province)	0.1%	1%	3%
Punjabi mother tongue (% of Punjabi-Canadians)	4	41	45



5-fold decrease in vivax malaria in Quebec, Ontario and B.C. in 1995-7

Conclusion: Epidemic of *P. vivax* malaria related to a vivax epidemic in the Indian Punjab

Conclusions

1. Three malaria epidemics described in Canada
   i. 1995-2002 surveillance artifact associated with new QA program
   ii. 2000-2001 *P. falciparum* associated with influx of Tanzanian refugees
   iii. 1995-1997 *P. vivax* associated with Punjab epidemic and Canadian VFRs

2. Local, provincial, national and multinational surveillance systems are required for timely recognition of malaria dynamics

Conclusions

3. Lack of travel and/ or malaria species information in Canadian government surveillance data severely limits interpretation and public health response.

4. Malaria surveillance databases have become more complete since 1990 and offer increased opportunities for research

Parts of the province of Ontario were hot-beds of the disease, which within my memory has disappeared from the districts about the western end of Lake Ontario and the northern shores of Lake Erie. The marshes are there, and the anopheles are there, but the disease has gone. As in parts of Italy the important factor appears to have been the chinchonising of the inhabitants. I retain lively recollections of the buzzing ears of my boyhood from the larges doses of quinine administered to us in the spring and autumn

William Osler, Oxford Lancet, Oct 20, 1917

Malaria is not the only surveillance-challenged parasitic disease in Canada.

	Endemic	Imported
Intestinal helminths	pinworms	hookworms, Ascaris, Trichuris, Strongyloides
Systemic helminths	Trichinella, toxocara Balyascaris, dirofilaria	disseminated Strongyloides
Intestinal protozoa	Giardia, E. histolytica Cryptosporidium	Cyclospora
Systemic protozoa	Toxoplasma	Malaria, Chagas, Babesia, Leishmania, African trypanosomiasis
Trematodes	avian Schistosoma Metorchis, Fasciola	Schistosoma Opisthorchis
Cestodes	fish tapeworm sylvatic hydatid	cysticercosis pastoral hydatid

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cestodes	fish tapeworm sylvatic hydatid	cysticercosis pastoral hydatid

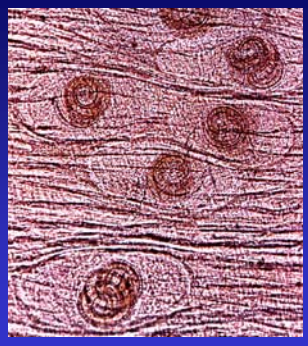
Trichinellosis
Trichinella nativa

Trichinella spiralis

Trichinella nativa

Man
Bear
Walrus
Pig
Rat
Cat
Dog
Lion

in fact any carnivore



Trichinella spp.

reservoir…muscles of all carnivorous animals (bear, walrus, rat, man, pig)

location…encysted in individual striated muscle cells

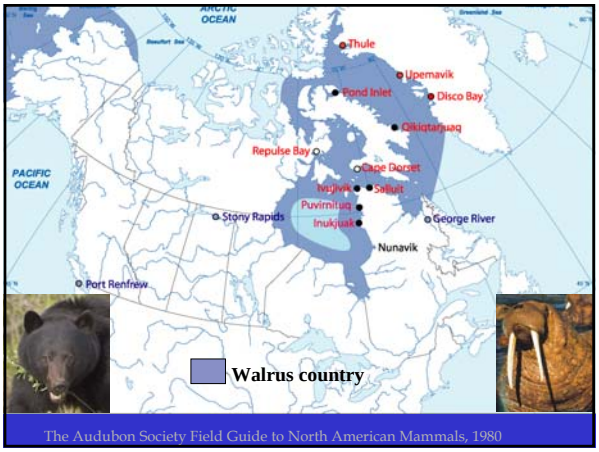
longevity…years

biology…*T. nativa* resists freezing

transmission…raw meat ingestion

Myopathic (classic) (primary)	Diarrheic (secondary)
muscle pain, weakness	diarrhea
fever	no fever
edema	no edema
↑↑ CPK	normal CPK
↑↑eosinophils	↑↑ eos
↑↑trichinella IgG	↑↑ trichinella IgG
↑↑trichinella IgM	
positive muscle biopsy	neg muscle box
EMG abnormal	EMG normal

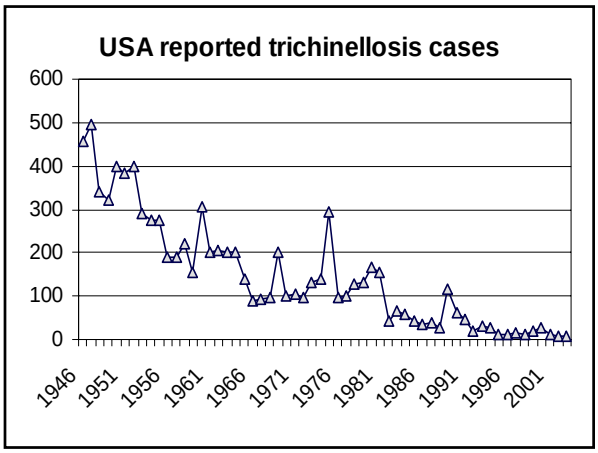
MacLean JD et al. Epidemiologic and Serologic definition of primary and secondary trichinosis in the Arctic JID 165; 908-912;1992

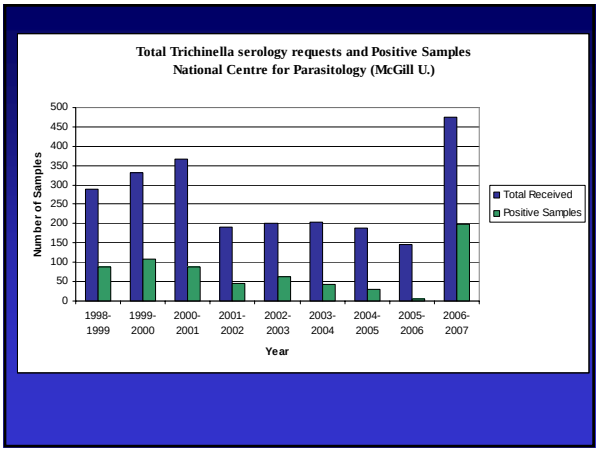


The Audubon Society Field Guide to North American Mammals, 1980

Community	year	cases	source	diagnosis
Salluit	1982	10	walrus	Epid
Ivujivik	1983	3	walrus	Epid
Salluit	1984	8	walrus	Epid
Ivujivik	1984	15	walrus	Epid
Salluit	1987	42	walrus	Epid/lab
Inukjuak	1995	1	Walrus	Epid
Inukjuak	1996	1	Walrus	Epid
Puvirnituq	1996	1	Fox	Epid
Inukjuak/Puvirnituq	1997	3	Walrus	Epid/lab
Inukjuak	1998	1	Polar bear	Lab
Kuujjuaq	2004	4	Black bear	Epid/lab
George River	2005	12	Black Bear	Epid/lab
Kuujuaq/Cape Dorset	2006	2/50	Walrus	Epid/lab

1. Leclair D. Makivik Magazine, 48: 18-22; 1989. 2. MADO 3. Maclean JD. JID 160; 513-519, 1989


USA reported trichinellosis cases
600
500
400
300
200
100
0
1946
1951
1956
1961
1966
1971
1976
1981
1986
1991
1996
2001


Total Trichinella serology requests and Positive Samples
National Centre for Parasitology (McGill U.)
Number of Samples
500
450
400
350
300
250
200
150
100
50
0
1998-1999
1999-2000
2000-2001
2001-2002
2002-2003
2003-2004
2004-2005
2005-2006
2006-2007
Year
Total Received
Positive Samples


ARCTIC OCEAN
PACIFIC OCEAN
Thule
Upernavik
Pond Inlet
Disco Bay
Qikiqtarjuaq
Repulse Bay
Cape Dorset
Ivujivik
Salluit
Puvirnituq
Inukjuak
Stony Rapids
George River
Kuujjuaq
Nunavik
Port Renfrew

Prevention program for trichinellosis in Inuit communities

Proulx J-F, MacLean JD, Gyorkos TW, Leclair D, Richter A-K, Serhir B, Forbes L, Gajadhar AA. Clin Infect Dis 2002;34:1508-1514

Only primary prevention program for trichinellosis based on laboratory testing of wild animals.

Supported by local and regional Inuit organizations because:

- raw walrus consumed often
- there is promotion of local food sources
- community is aware of trichinellosis

Effective Partnership

- **Department of Public Health, Nunavik Regional Board of Health and Social Services**
- **McGill University Tropical Disease Centre**
- **Makivik Corporation, Nunavik Research Centre**
- **Inuulitsivik Health Centre, Inukjuak Local Community Service Centre**
- **Canadian Food Inspection Agency (CFIA)**

Prevention program

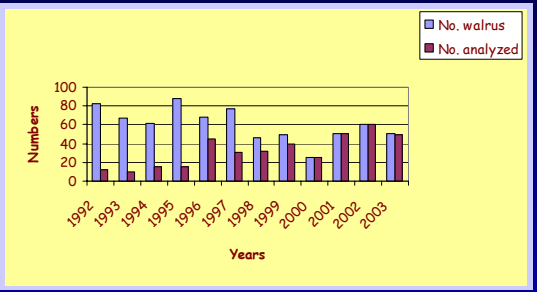
- Training session for hunters
- Pamphlet and video for communities
- Tagging hunted meat on site
- Holding walrus until clearance
- Analysis of pooled sample of meat (locally)
- Communication of result to communities
- If pooled sample positive ➔ CFIA
  - separate laboratory analysis of each walrus
  - communication of results to communities

Reasons for success…

- Hunters compliant
- Confirmatory testing rapid
- Education and communication necessary for continued program effectiveness

- Major outbreaks prevented
  - (known by community)

Walrus harvest and analysis in Nunavik



Manon Simard, MSc, Nunavik Research Centre, Makivik Corporation, Kuujjuaq
Jean François Proulx, MD, Nunavik Health Board and Social Services, Kuujjuaq

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Salluit	1984	8	walrus	Epid
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Puvirnituq	1996	1	Fox	Epid
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Inukjuak	1998	1	Polar bear	Lab
Kuujjuaq	2004	4	Black bear	Epid/lab
George River	2005	12	Black Bear	Epid/lab
Kuujuaq/Cape Dorset	2006	2/50	Walrus	Epid/lab

1. Leclair D. Makivik Magazine, 48: 18-22; 1989. 2. MADO 3. Maclean JD. JID 160; 513-519, 1989

To survey or not survey

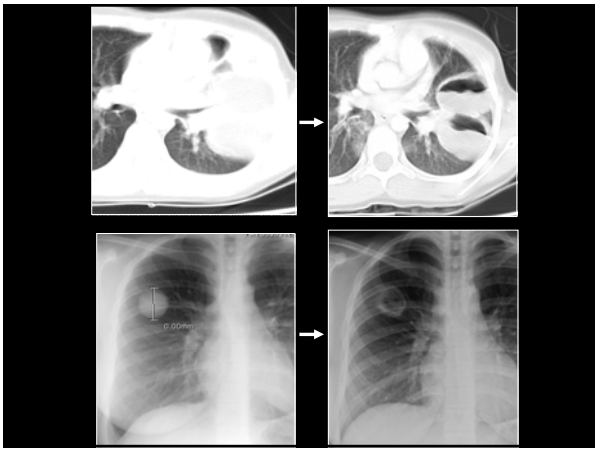
Selection criteria (Public Health Agency of Canada)

1. Diseases of interest
2. 5-year average incidence
3. Severity
4. Communicability
5. Potential for outbreaks
6. Socioeconomic burden
7. Preventability
8. Risk perception
9. Necessity for a Public Health response
10. Increasing or changing pattern

CCDR 32: October 1, 2006

Each weighted 0 to 4

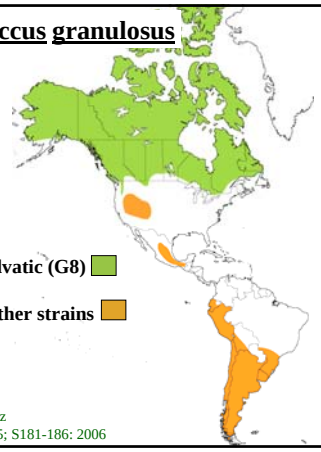
Echinococcus granulosis
Sylvatic hydatid disease



Echinococcus life cycle (sylvatic)

HYDATID CYST	ADULT TAPE WORM
human caribou (reindeer) moose (elk)	wolf dog

Echinococcus granulosus

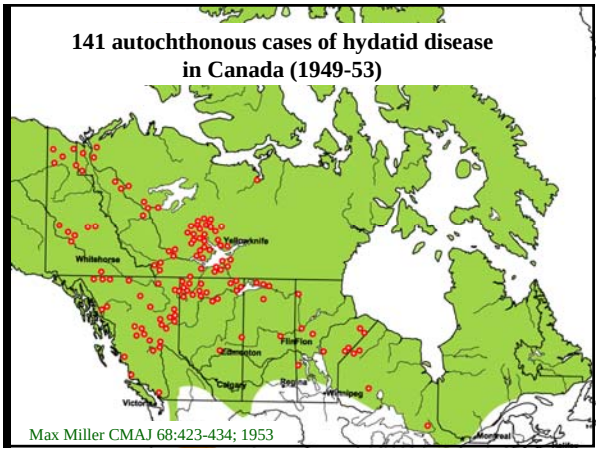


Northern sylvatic (G8)

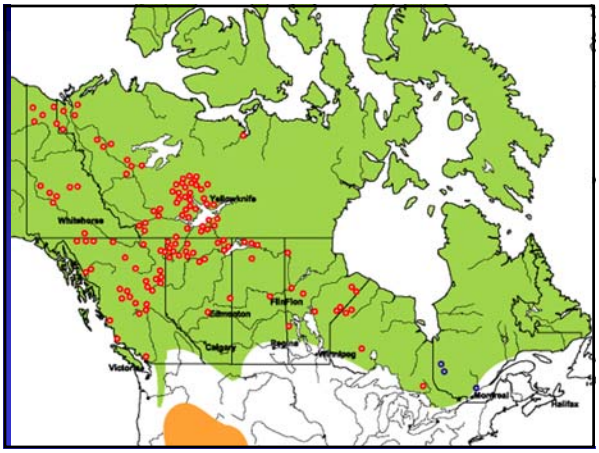
Sheep and other strains

P Moro, P Schantz
Parasit Internat 55; S181-186: 2006

141 autochthonous cases of hydatid disease in Canada (1949-53)



Max Miller CMAJ 68:423-434; 1953



Canadian hydatid prevalence studies

	year	case definition	region	prevalence
Meltzer, H	1956	clinical cases	Yukon, Alta, NWT	2.7%
Miller, M	1953	sheep hydatid ag Casoni	Yukon to Ontario	15%
Wolfgang R	1954	caribou hydatid ag serology	Southern Yukon	45%

Meltzer H, Kovacs L, Orford T et al CMAJ 75; 121:1956
Miller MJ CMAJ 68; 423:1953

Indigenous Echinococcal granulosis

			N	region
Al Saghier M et al	Can J Inf Dis	2001	17	Man & Ont
Finley JC et al	Ped Infect Dis J	1992	5	BC
Somily A et al	BMC Inf Dis	2005	9	NWT
Castrodale L	State Alaska Epi Bull	2003	8 (1990-2002	Alaska
MacLean JD	personal		3 (2005-6)	Central Quebec

Is disease in humans different?

1. Lack of mortality and morbidity (1 in 300, Alaska)
2. Lack of daughter cysts and few to absent protoscolices
3. Immunogenicity is poor? and serology with southern antigen poorly sensitive
4. Northern biotype has different genotype (G8)
5. Looks different; surgeons describe a blue hue

1. Castrodale LJ et al. AJTMH 66:323-327; 2002
2. Wilson JF et al.Am Rev Resp Dis 98: 1-15; 1968
3. Rausch RL Parasitology 127; S73-S85 2003

Challenges

1. Incidence in humans, no Canadian surveillance
2. Clinical distinctiveness of sylvatic (cervid) form (presentation, treatment)
3. Genotype markers of phenotypes
4. Lack of a cervid Echinococcus antigen for serology

Some conclusions

1. Almost all indiginous Canadian parasites are zoonoses that require a multidisciplinary approach to understanding and control.
2. Canada is becoming a nation of "VFRs" and as such has changing public health responsibilities and challenges.
3. Provincial governments have a direct responsibility for citizens' health and infectious disease monitoring. A better federal surveillance system is needed to meet provincial needs.