

Neurocysticercosis (*Taenia solium* Infection)

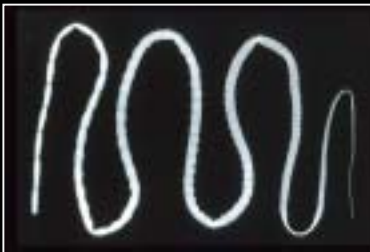
Feasibility and Strategy of Eradication

Peter Schantz

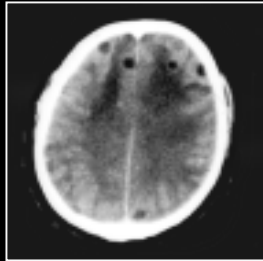
Division of Parasitic Diseases, NCID

Centers For Disease Control and Prevention

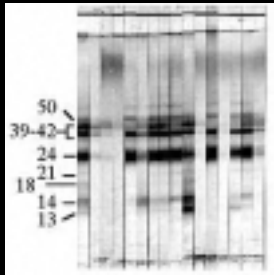
Atlanta, Georgia



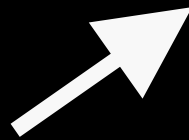
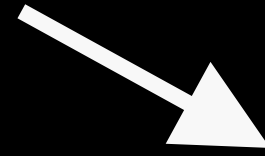
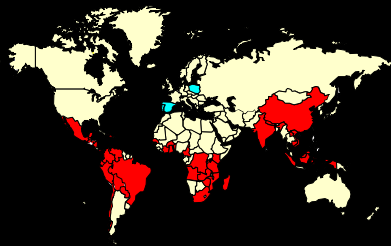
- Imaging



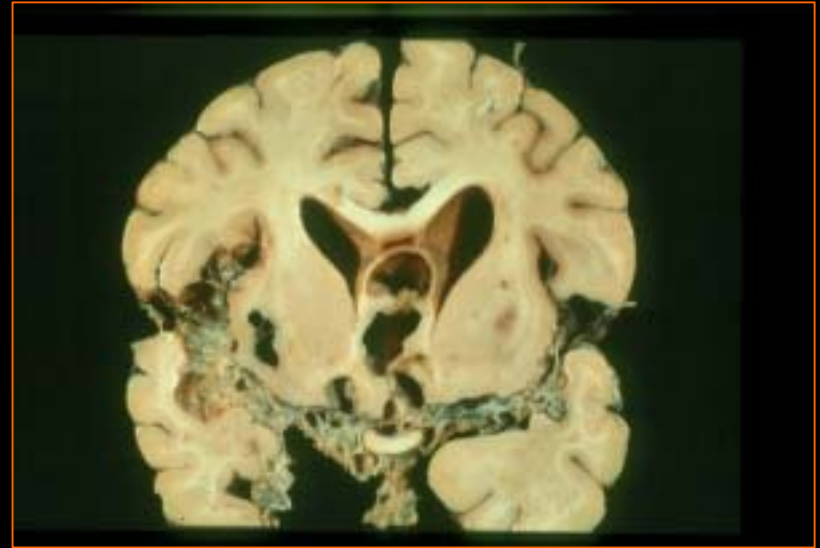
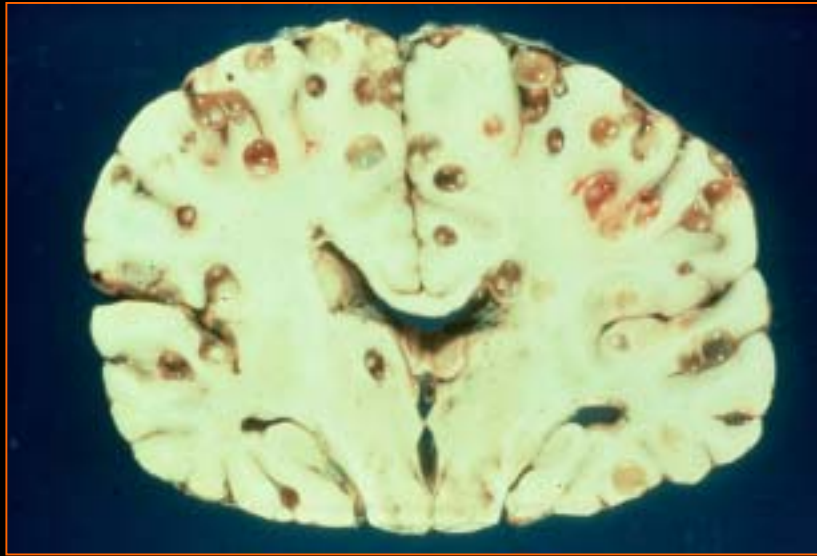
- Immunoblots



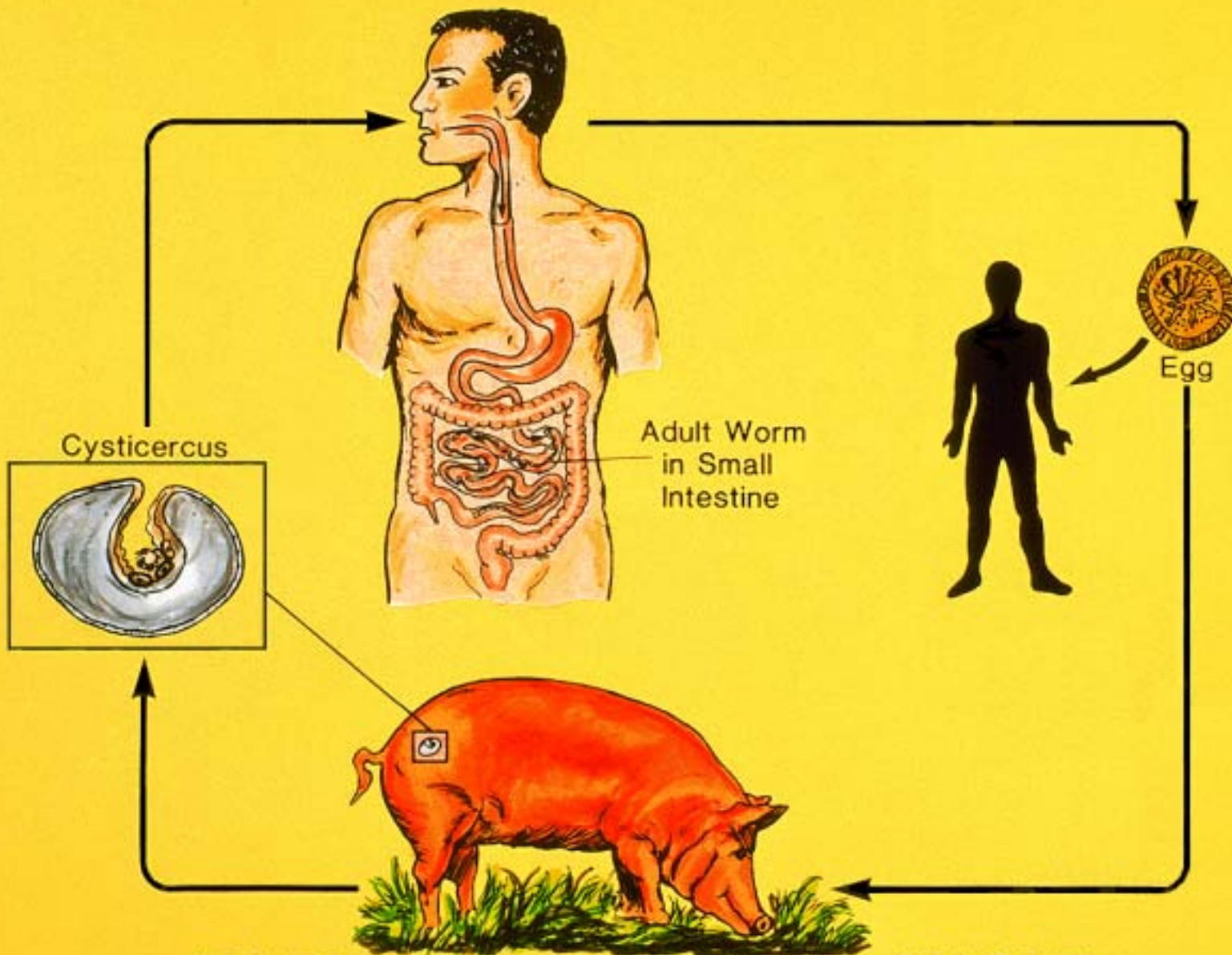
- Immigration



Global
Emergence
of
Taenia solium

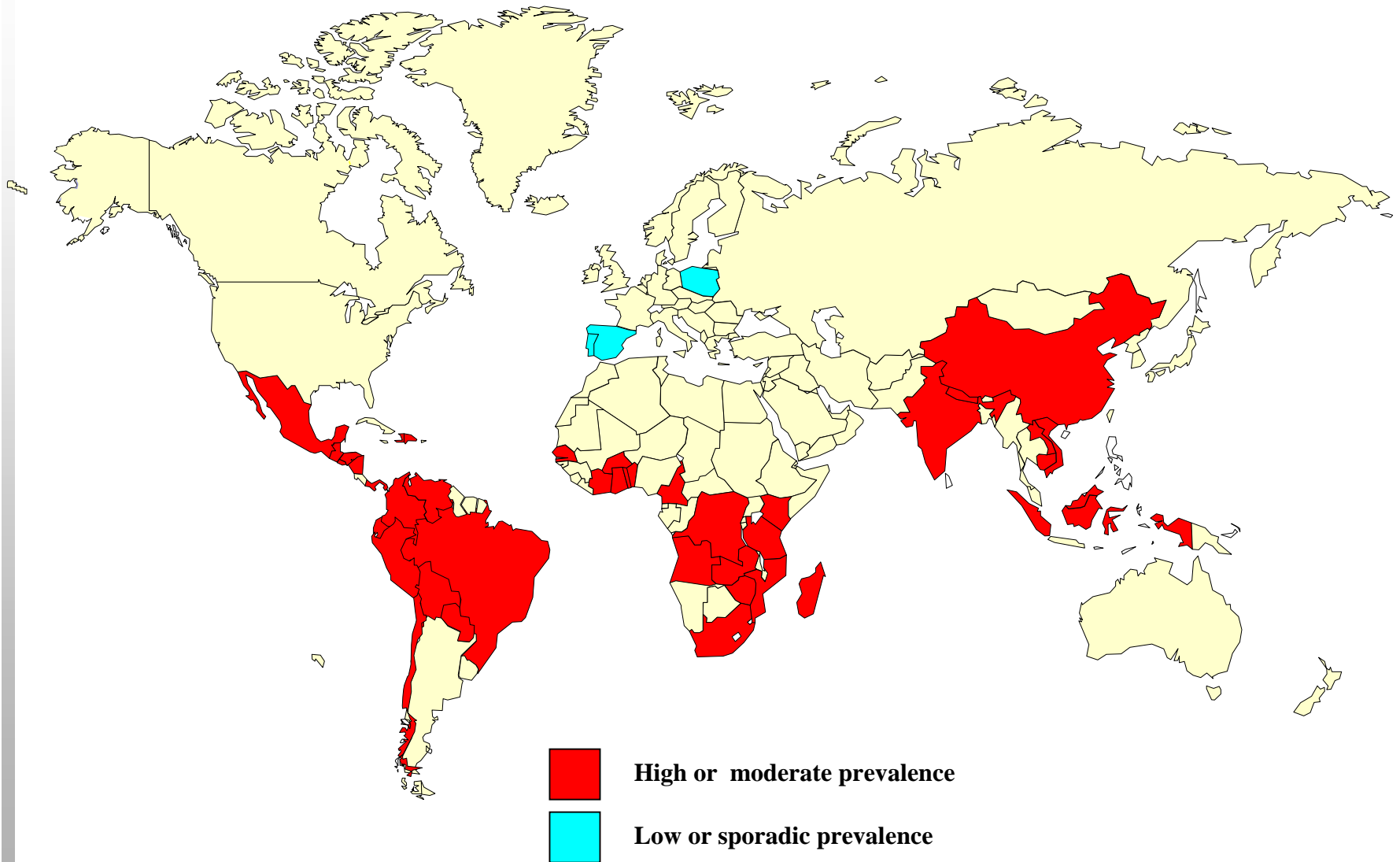


Clinical manifestations of cysticercosis in humans



TAENIA SOLIUM LIFE CYCLE

World Distribution of *Taenia solium*



Ecologic settings conducive to *Taenia solium* transmission



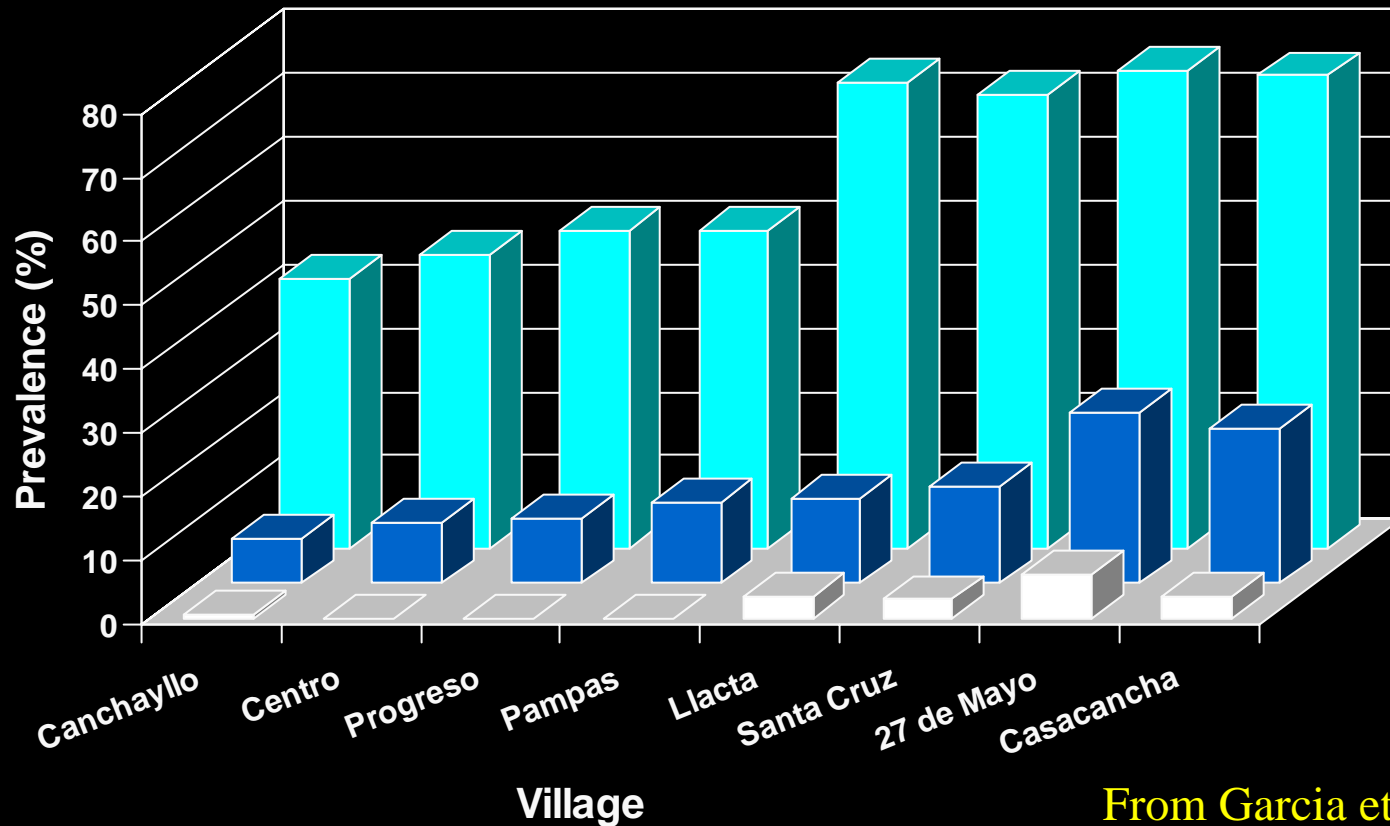
La Neurocisticercosis es "un testimonio al sub-desarrollo" H.M. Canelas, 1962



Seropositive persons often clustered in households in association with taenia carriers



Prevalence of Human and Porcine Cysticercosis Infection and Human Taeniasis in 8 Villages in the Central Sierra of Peru.



From Garcia et al., 2002

■ Taeniasis - Humans (CoproAg) ■ Cysticercosis - Humans ■ Cysticercosis - Pigs

Calculation of Disease Burden Associated with Neurocysticercosis in Peru

| Variable | Calculated value (s) | | |
|--|----------------------|---------|---------|
| Population of Peru (1993) | 22,704,204 | | |
| Population in area of endemicity | 10,449,649 | | |
| Population aged > 15 years in areas of endemicity | 6,269,789 | | |
| Estimated range of cysticercosis seroprevalence, % | 6 | 8 | 10 |
| No. of seropositive persons aged > 15 years | 376,187 | 501,583 | 626,979 |
| with NCC-associated seizure disorders | 18,809 | 25,079 | 31,349 |
| with other clinical manifestations of NCC | 4702 | 6370 | 7837 |
| Total with symptomatic NCC | 23,512 | 31,349 | 39,186 |

Source: Bern et al., 1999

Neurocysticercosis in the U. S. A. is Primarily an Imported Disease

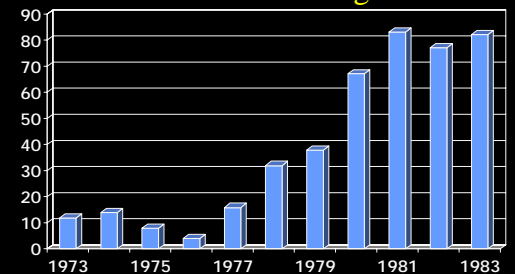


Current husbandry practices for pigs in the U.S. are not conducive to transmission of *Taenia solium*

Clinical and Epidemiologic Experiences with Neurocysticercosis in Non-Endemic Countries

- **Imported Disease** – In Los Angeles Co., epidemic of diagnoses began in the the 1970s

Annual Incidence of Diagnosed NCC



Richards et al., 1985

- **Introduced infection/disease**
 - Cluster of “endemic” cases in Brooklyn community
 - Continuous isolated cases



Schantz et al., 1994

Driving force of continuing emergence of neurocysticercosis in North America is Hispanic immigration



During decade 1991-2000, Hispanic population in USA increased by 58% to 35.3 million.

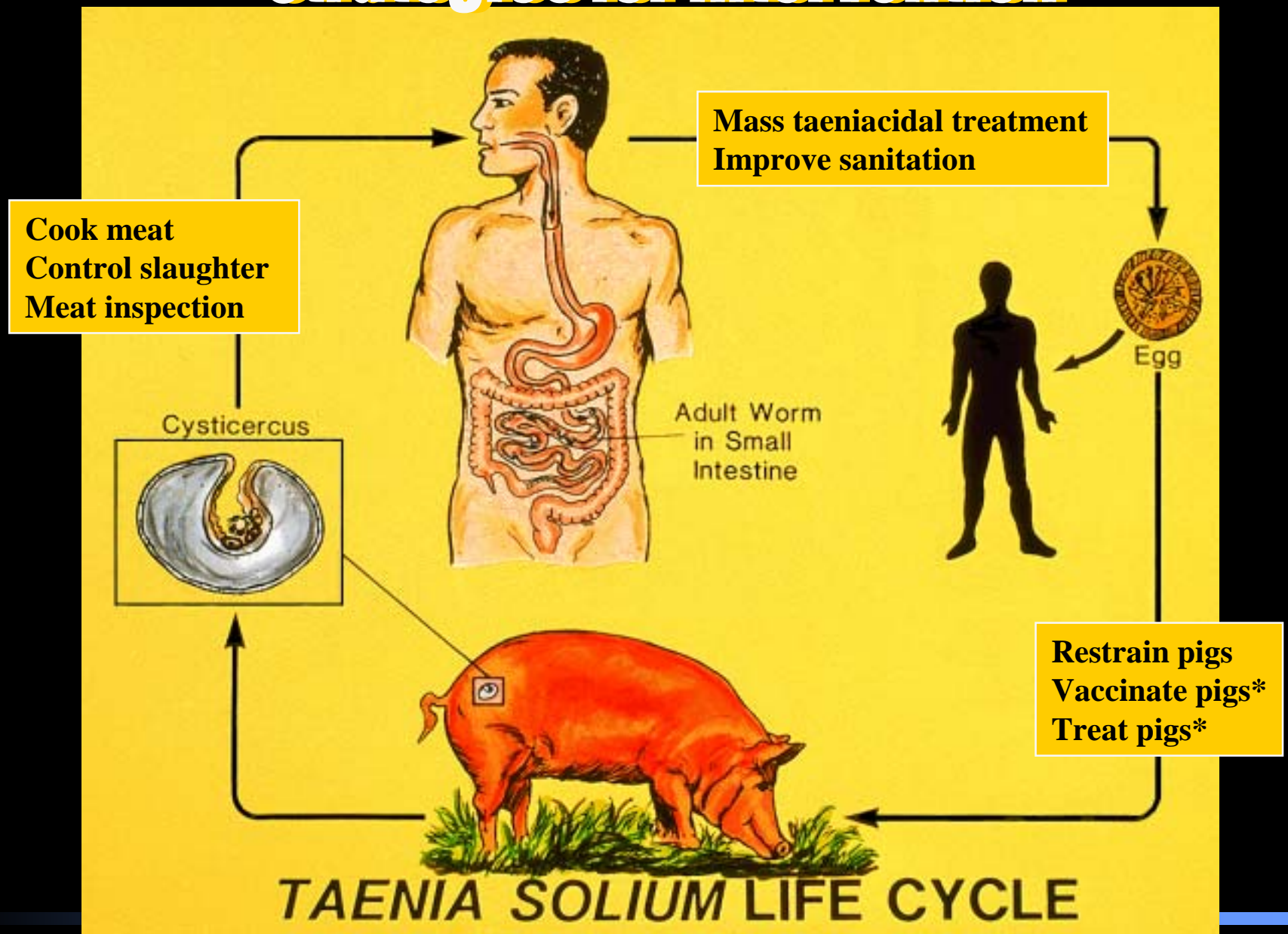
Eradicability of *Taenia solium* Infection

- The International Task Force for Disease Eradication (1992) determined that *Taenia solium* was potentially eradicable based on the following considerations:
 - Life cycle requires humans as definitive hosts
 - Tapeworm infections in humans are the only source of infection for pigs, the natural intermediate host
 - Swineherds can be managed
 - No reservoirs of infection exist in wildlife.

Eradicability of *Taenia solium* Infection

- However, *T solium* has not been eliminated from any region by a designed program and no national programs are yet in place.

Strategies for Intervention



Proposed Control Measures

- Improved living conditions
- Control of pig slaughter
- Health education
- Mass taeniocidal Rx of humans
- Mass cysticercicidal treatment of pigs
- Vaccination of pigs

Effectiveness of Intervention Combining Taeniocidal Treatment in humans and Cysticercicidal Treatment of Pigs in Hyperendemic Villages in Peruvian Highlands

- **Interventions**
 - Mass treatment of pigs
 - Two rounds of oxfendazole (30 mg/kg)
 - Mass treatment of humans
 - One round of praziquantel (5mg/kg)
- **Effect**
 - Reduced prevalence and incidence of cysticercosis in pigs, however, the magnitude of the effect was lower than expected.

Garcia H and the Cysticercosis Working Group in Peru, 2002

Cysticercosis/Taeniasis: Elimination *progress*



- *Categorized as ‘potentially eradicable’*
 - International Task Force for Disease Eradication (1993)
- *Operational research to define optimal strategy*
- *Developing political/social constituencies*
 - **World Health Assembly 2002**

Questions?

Prevalence and Morbidity Caused by Neurocysticercosis in Latin America

- *Seizures*

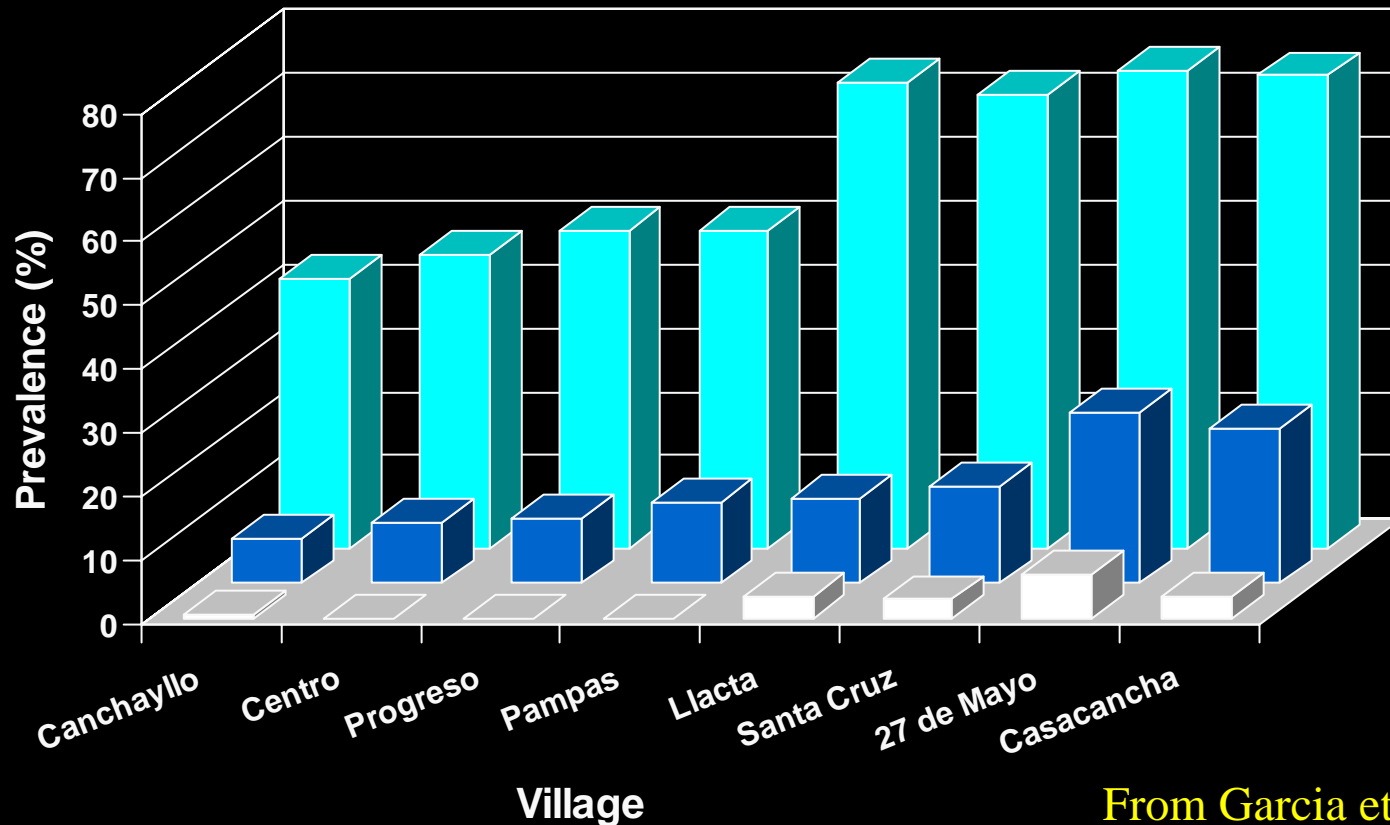
- *Peru-24-39 thousand cases*
- *Latin America- 400 thousand cases*

Some assumptions:

- Nearly 10% of people will be infected by the time they reach adulthood**
- 1 in 200 will develop seizures**

Source: Bern et al. 1999

Prevalence of Human and Porcine Cysticercosis Infection and Human Taeniasis in 8 Villages in the Central Sierra of Peru.



From Garcia et al., 2002

■ Taeniasis - Humans (CoproAg) ■ Cysticercosis - Humans ■ Cysticercosis - Pigs

Prevalence Estimates of *Taenia solium* Cysticercosis and Taeniasis in People and Pigs in Latin American Communities

| Country | Community | Sample Size | Prevalence Cysticercosis (Immunoblot) (%) | Prevalence Taeniasis (%) | Prevalence Cysticercosis in pigs (%) |
|-----------|--------------------|-------------|---|--------------------------|--------------------------------------|
| Mexico | Angahuan | 1552 | 10.8 | 0.3 | 4 |
| | Xoxocotla | 1005 | 4.9 | 0.2 | 7 |
| Guatemala | Quesada | 862 | 11 | 1 | 4 |
| | El Jocote | 955 | 20 | 2.8 | 14 |
| Bolivia | “rural community” | 159 | 22.6 | n.d. | 39 |
| Ecuador | San Pablo del Lago | 118 | 10.4 | n.d. | 8 |
| Peru | Lima (urban) | 250 | 0 | n.d. | 0 |
| | Maceda | 371 | 8 | 0.3 | 43 |
| | Churusapa | 134 | 7 | n.d. | 49 |
| | Haparquilla | 108 | 13 | n.d. | 46 |
| | Monterredonda | 489 | 16 | n.d. | 13 |
| | Quilcas | | 18 | n.d. | 60-70 |
| | Saylla | 99 | 24 | 8.6 | 36 |

From: Schantz , Wilkins and Tsang , 1998

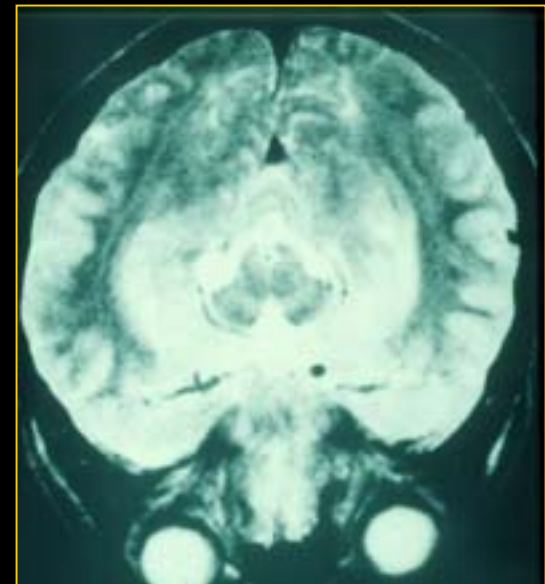
Cysticercosis/Taeniasis: Elimination Strategy

- *Interrupt transmission*
 - health/sanitary education
 - modernize swine husbandry
 - mass-treat populational foci of infection
- *Surveillance*
 - identify infected populations
- *Operational research*
 - explore alternative elimination approaches



**Praziquantel for taeniasis can
provoke neurologic
symptoms in patients with
occult neurocysticercosis**

**12 y.o. girl developed severe headaches
persisting for 10 days after receiving
praziquantel (5mg/kg). MRI revealed 7
intracerebral cysticerci.**



Neurocysticercosis in the U. S. A. is Primarily an Imported Disease

- Published clinical reports through 1986 totaling >900 cases documented that >90% of patients were born outside of U.S. (most frequently in Mexico)
 - only 15 cases were diagnosed in patients born in the U.S. with no foreign travel history to countries with endemic *T. solium* infection.



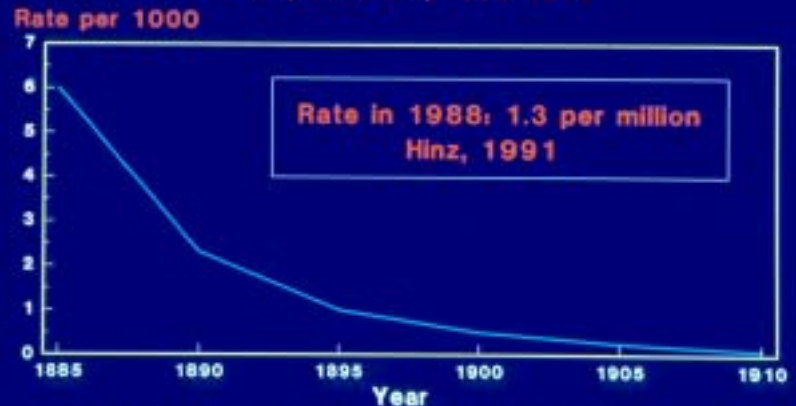
Current husbandry practices for pigs in the U.S. are not conducive to transmission of *Taenia solium*

Cysticercosis/Taeniasis: Elimination strategy

- ◆ *Interrupt transmission*
 - health/sanitary education
 - modernize swine husbandry
 - mass-treat populational foci of infection
- ◆ *Surveillance*
 - identify infected populations
- ◆ *Operational research*
 - explore alternative elimination approaches

CYSTICERCOSIS IN SWINE

BERLIN, GERMANY, 1885-1910



SOURCE: Official slaughterhouse records (Ostertag, 1932)

Criteria for Assessing Eradicability of Diseases

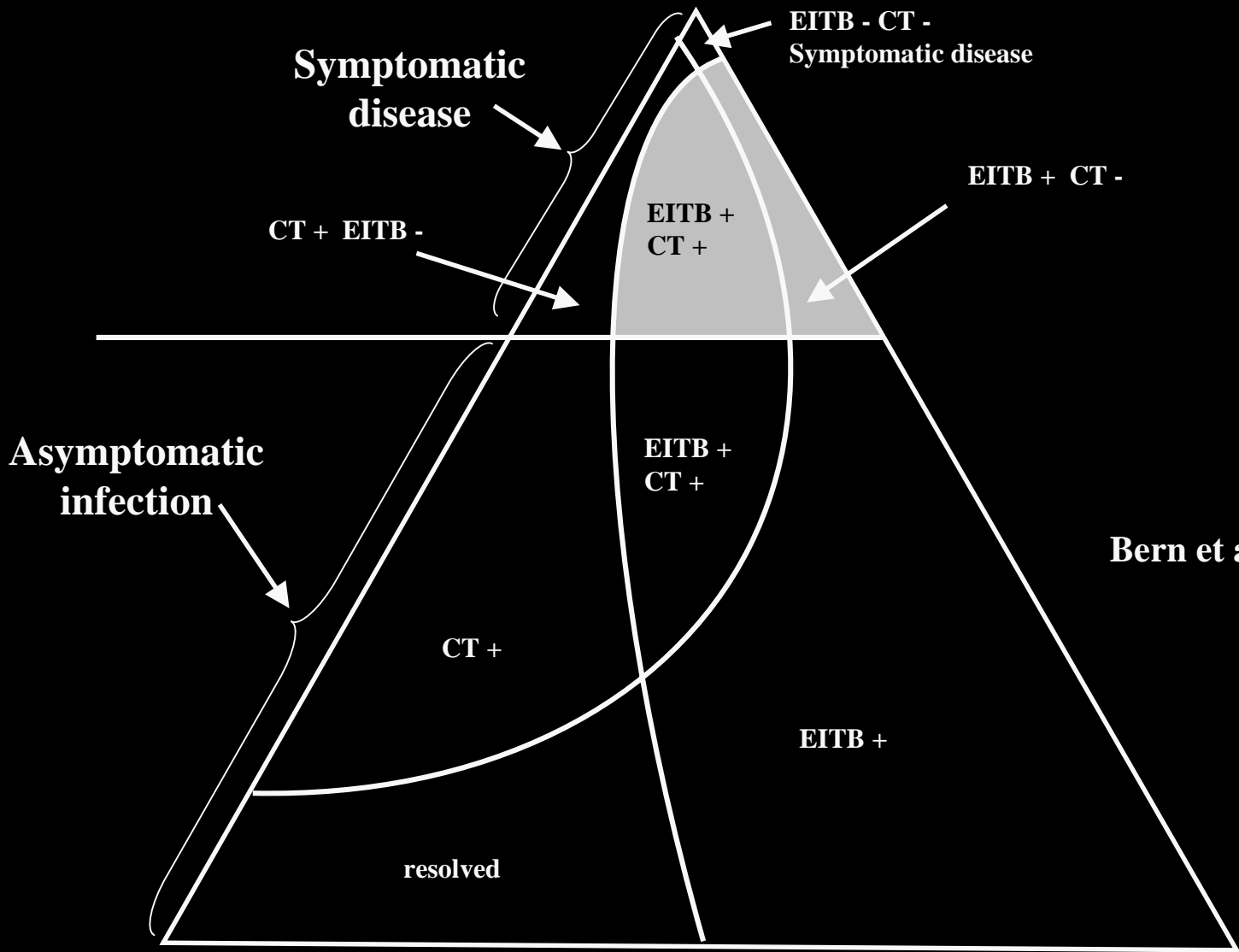
Political Will/Popular Support

- ✓ Perceived burden of disease
- ✓ Expected cost of eradication
- ✓ Synergy of eradication efforts with other interventions
- ✓ Necessity for eradication rather than control

ERADICATION OF *Taenia solium* INFECTIONS IN EUROPE DUE TO: (Pawlowski, 1987)

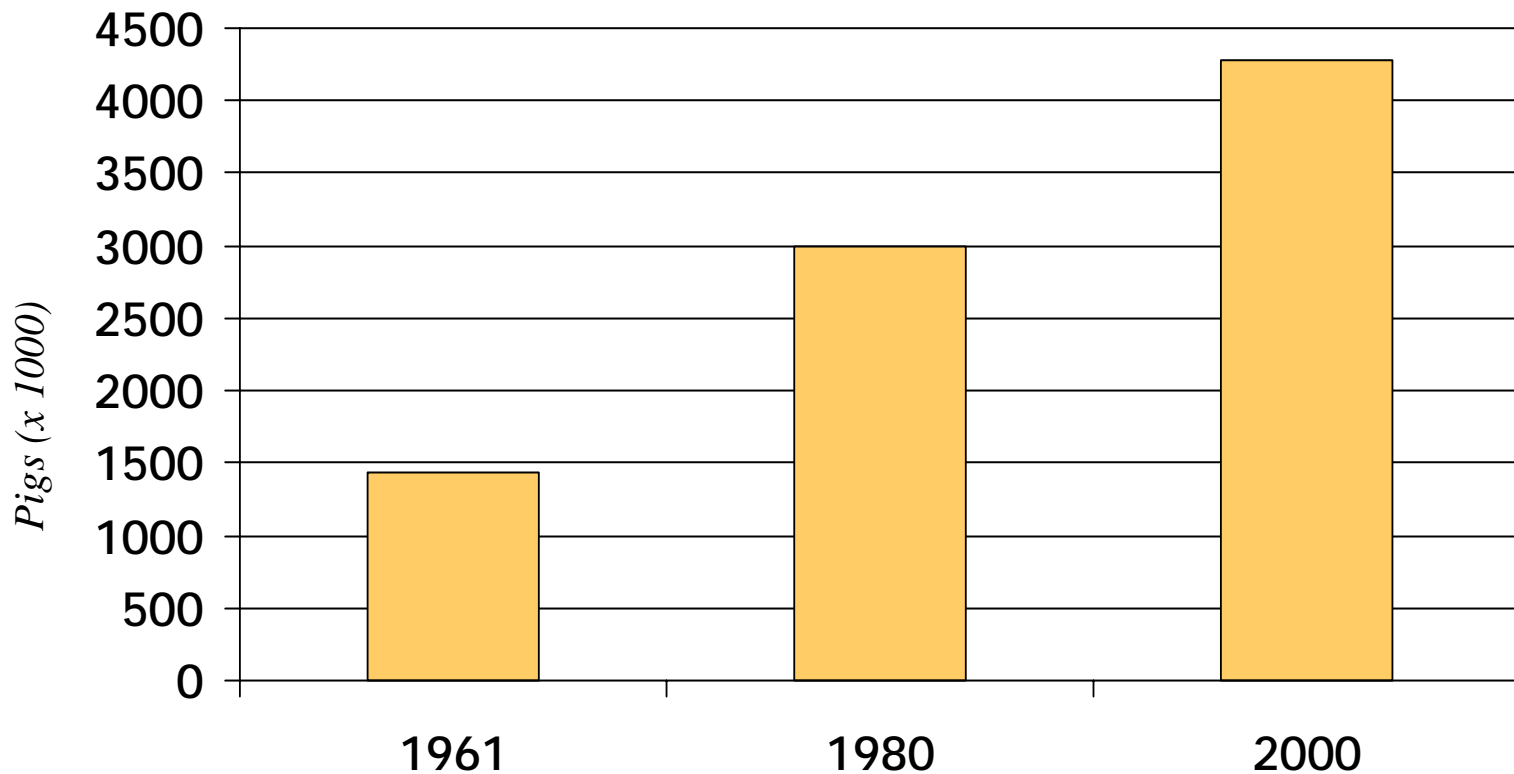
- improvement in general sanitation
- improvement in economy status
- change into in-door husbandry
- rigorous meat inspection

**NONE OF THESE FACTORS OPERATIVE IN
THE ENDEMIC COUNTRIES NOW**



Bern et al., 1999

Pig Population in Eastern & Southern Africa 1961 - 2000*



*excludes South Africa

Hispanic Population in the United States

- **1990 total population: 249 million**
 - 22.4 million Hispanics
 - 9% of total population
- **2000 total population: 281 million**
 - 35.3 million Hispanics
 - 12.5% of total population
- **1990 to 2000 Hispanic change:**
 - 13.0 million
 - 58% increase since 1990