Onsite Water and Septic Systems Health Effects?

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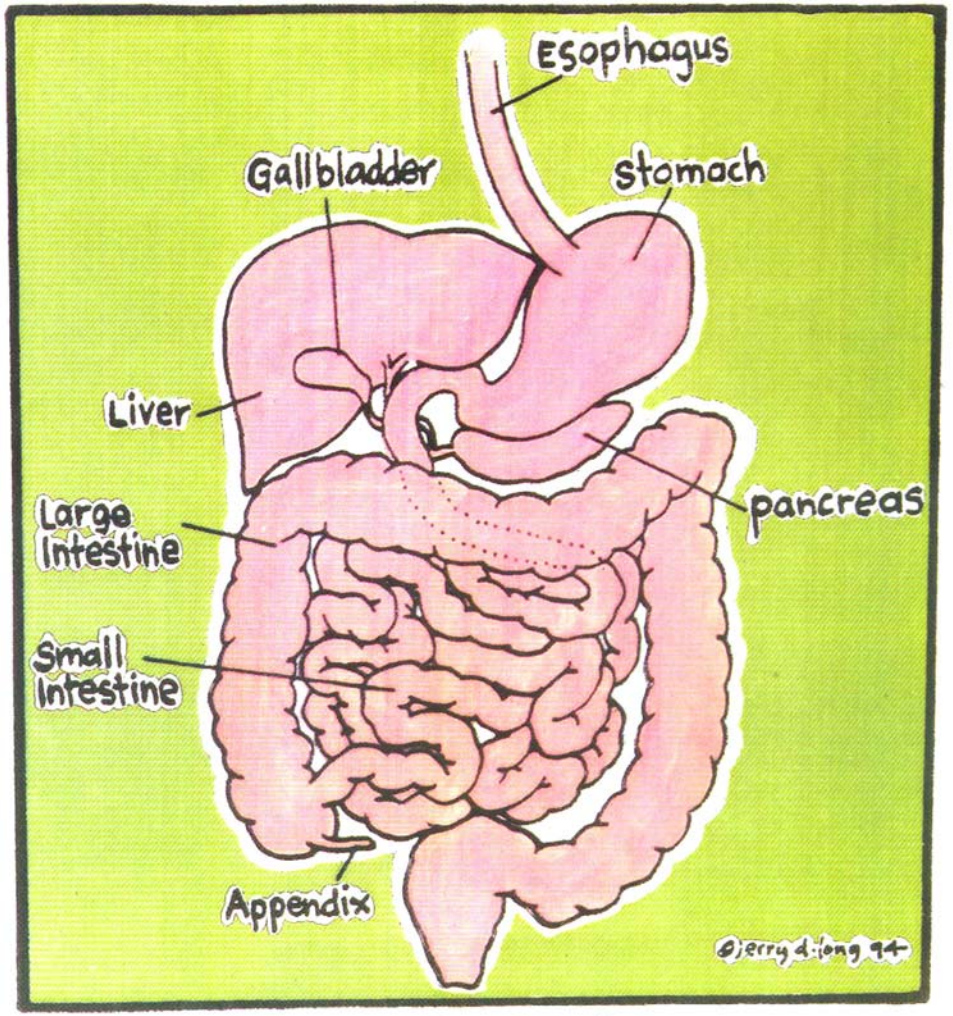
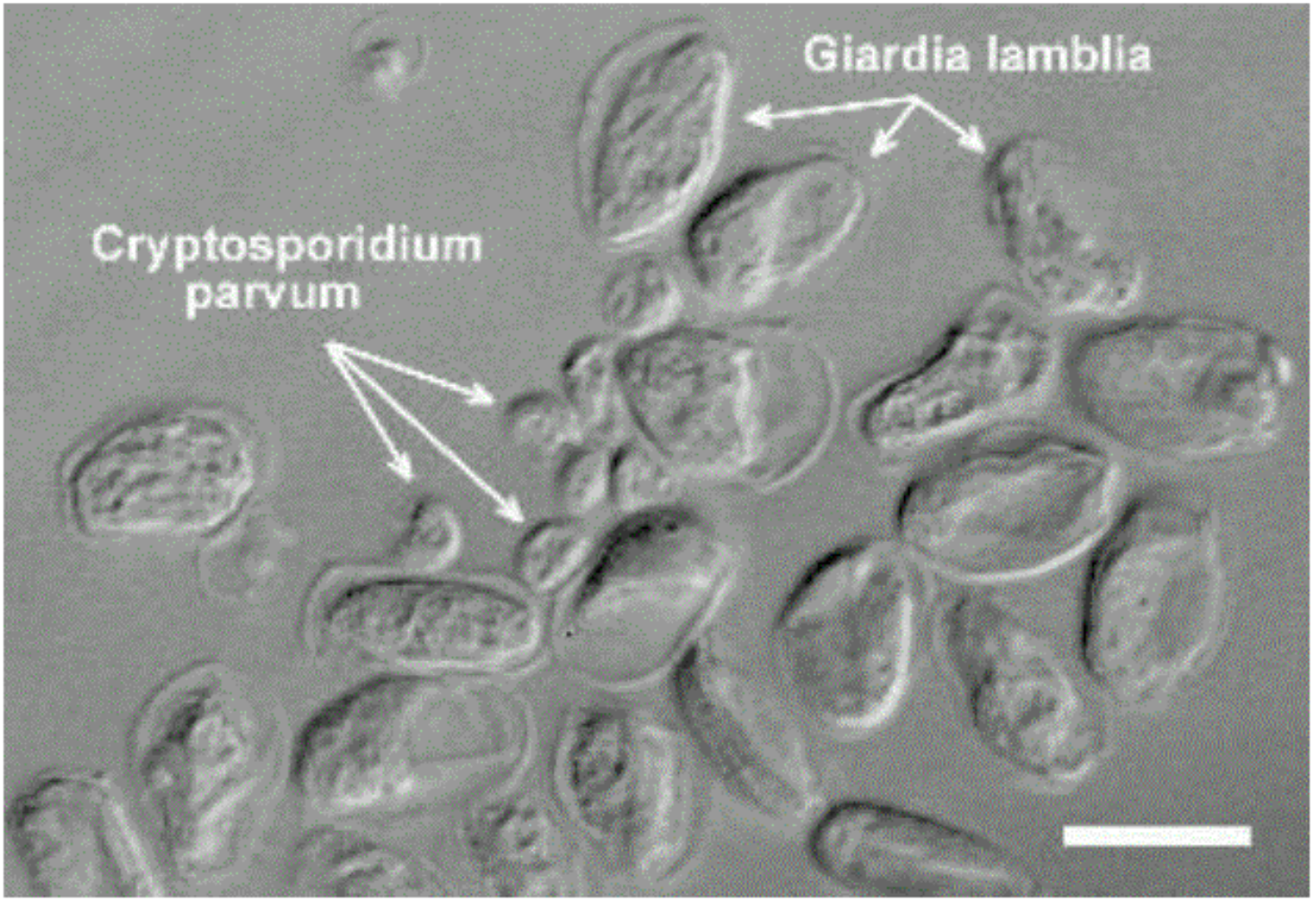
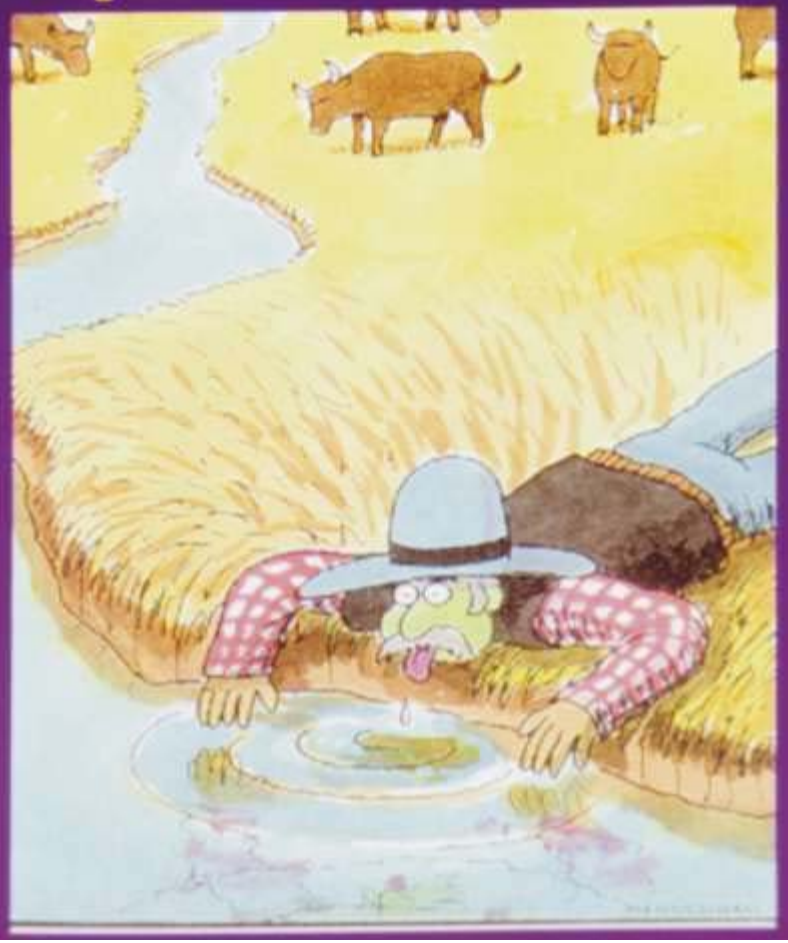


Shit doesn't just happen.


Giardia lamblia
Cryptosporidium
parvum

Jed forgets rule # 1 of The New Mexico Water Quality Handbook: "Always drink upstream from the herd."



Background

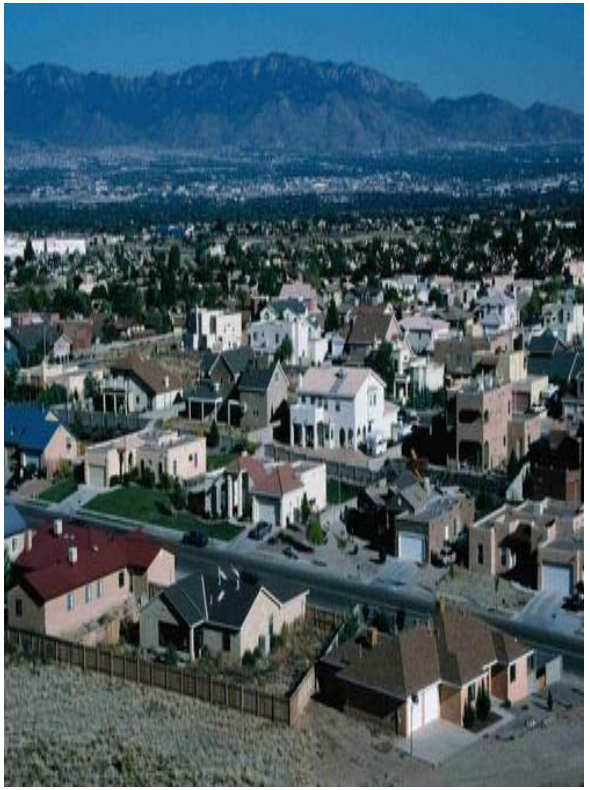
- Ground water may be subject to fecal contamination from a variety of sources, including onsite wastewater treatment (septic) system.
- Most studies have focused on the migration of enteric viruses from septic systems to water supplies.
- It is unknown whether large microbes such as *Cryptosporidium* are able to move significant distances through soils.

Methods

- Recruited from Albuquerque, NM alluvial soil area:
  - 100 households with city water and city sewer hookups.
  - 100 households with private well and septic systems.
- One adult from each household gave a blood sample.
- Water tested from private wells.

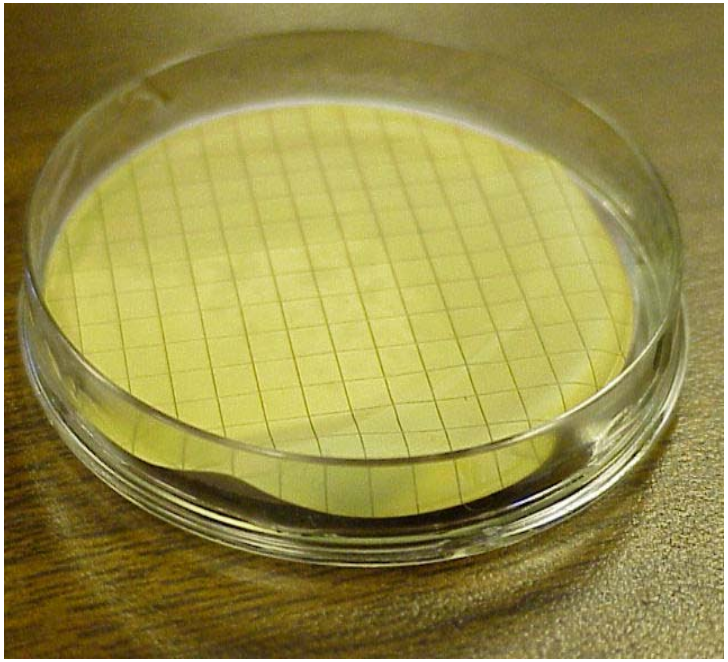
Methods-continued

- Criteria:
  - Lived in the area for 1 year.
  - Drank the tap water.
    - No filters or reverse osmosis on tap.
    - Allowed pitcher filters.
  - Overall, self-reported good health.



Water Analysis

- Water samples were tested by Marylynn Yates, Ph.D. for
  - Total Coliforms
  - Fecal Coliforms
  - Enterococci
  - Coliphage



Marker of Infection

- We wanted evidence that a pathogen was being transmitted via the septic system.
- It could not be so common that it is everywhere but not so rare that it seldom, if ever occurs.
- We needed to be able to measure the response.

Stool surveys versus serosurveys?

- In 1992 CDC asked EPA to fund massive stool surveys to estimate the prevalence of infection in several cities.
- I argued for serosurveys, based on work by NIH researcher Beth Ungar, M.D.
- EPA funded the serosurveys.

Why Did We Develop the Assay?

- Surface water testing found many streams had oocyst contaminated water.
- We could not find evidence of illness associated with these findings
- We needed an intermediate marker of infection, even if there was associated illness.

Beth Ungar M.D.

- The original assay was developed by Dr. Beth Ungar of NIH.
- It effectively detected serological response to oocysts but was expensive to conduct.
- We converted the test from a large-format gel to a mini-blot gel.

Intensity of Response

- We wanted to not just determine that there was a response, but also how intense was the response.
- We developed techniques for examining the intensity of the response.

Cryptosporidium??

- We had the means to measure serological response to *Cryptosporidium* and to interpret the findings.
- During the Milwaukee outbreak it did not appear to be commonly transmitted person-to-person.

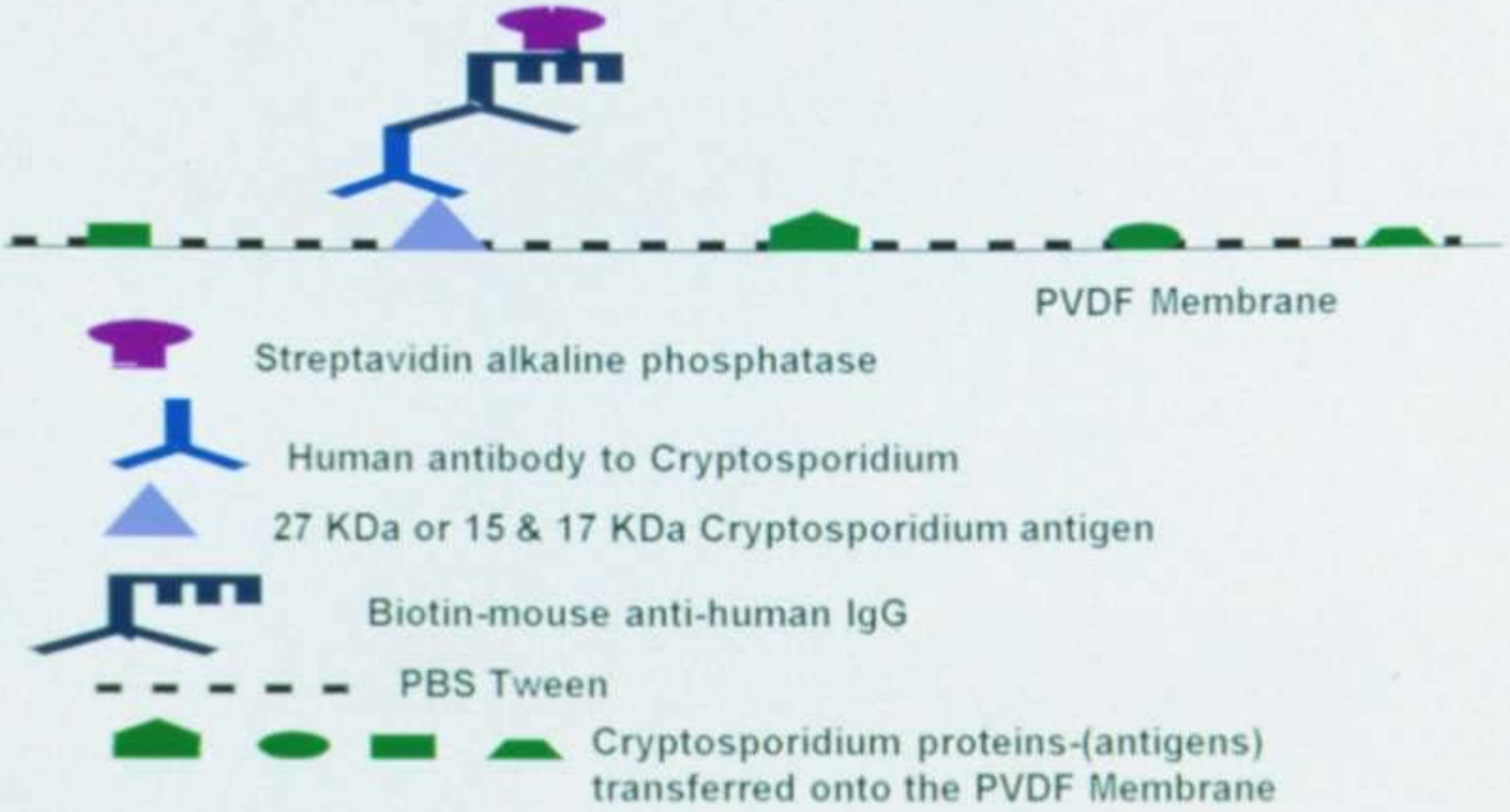
A Useless Piece of Information

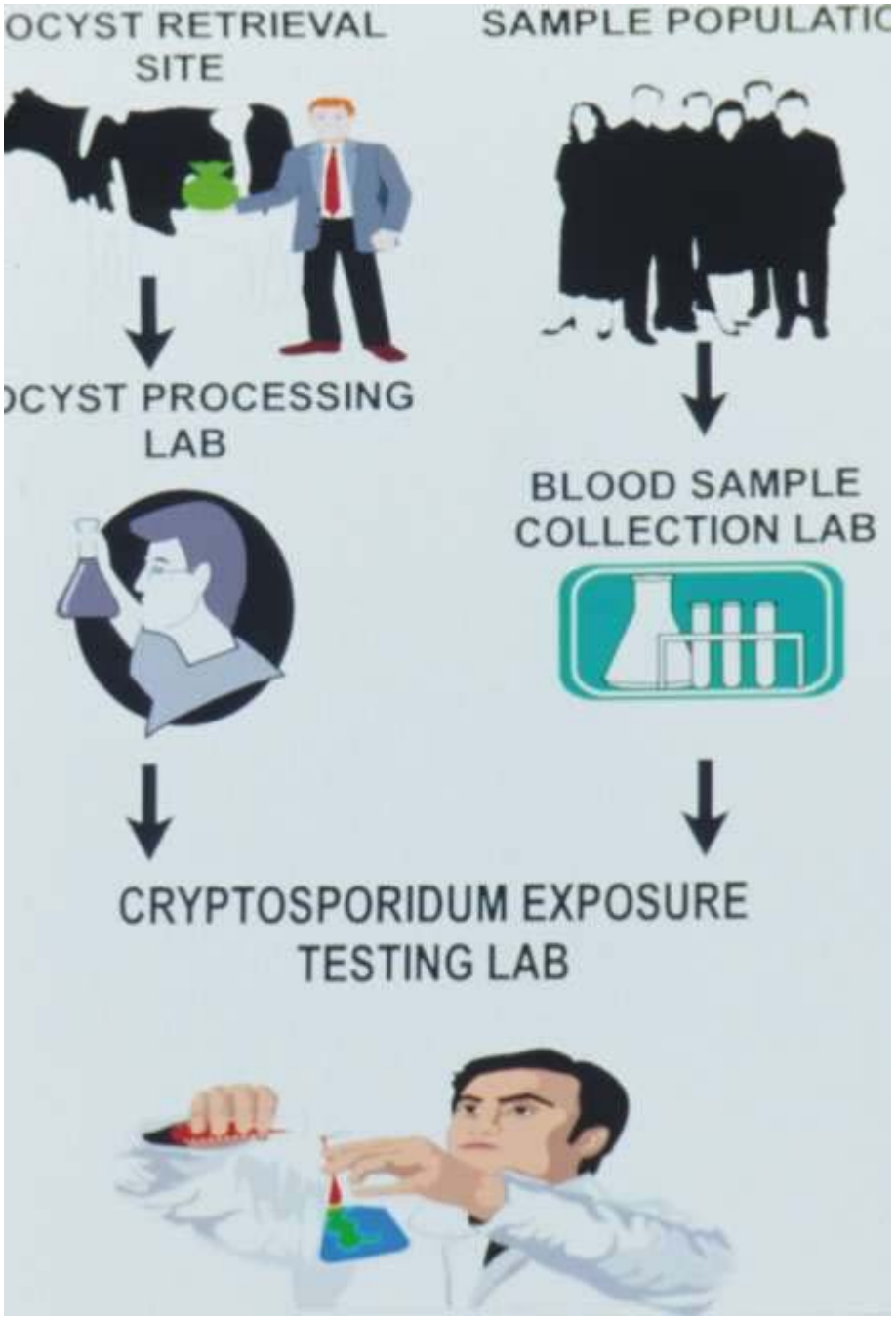
- What does a strong serological response to Cryptosporidium antigens do for you?
- The serological response appears to be a marker of immunity or reduced risk of illness.
- This likely explains why we saw so much *Cryptosporidium* in streams and so little cryptospoidiosis.

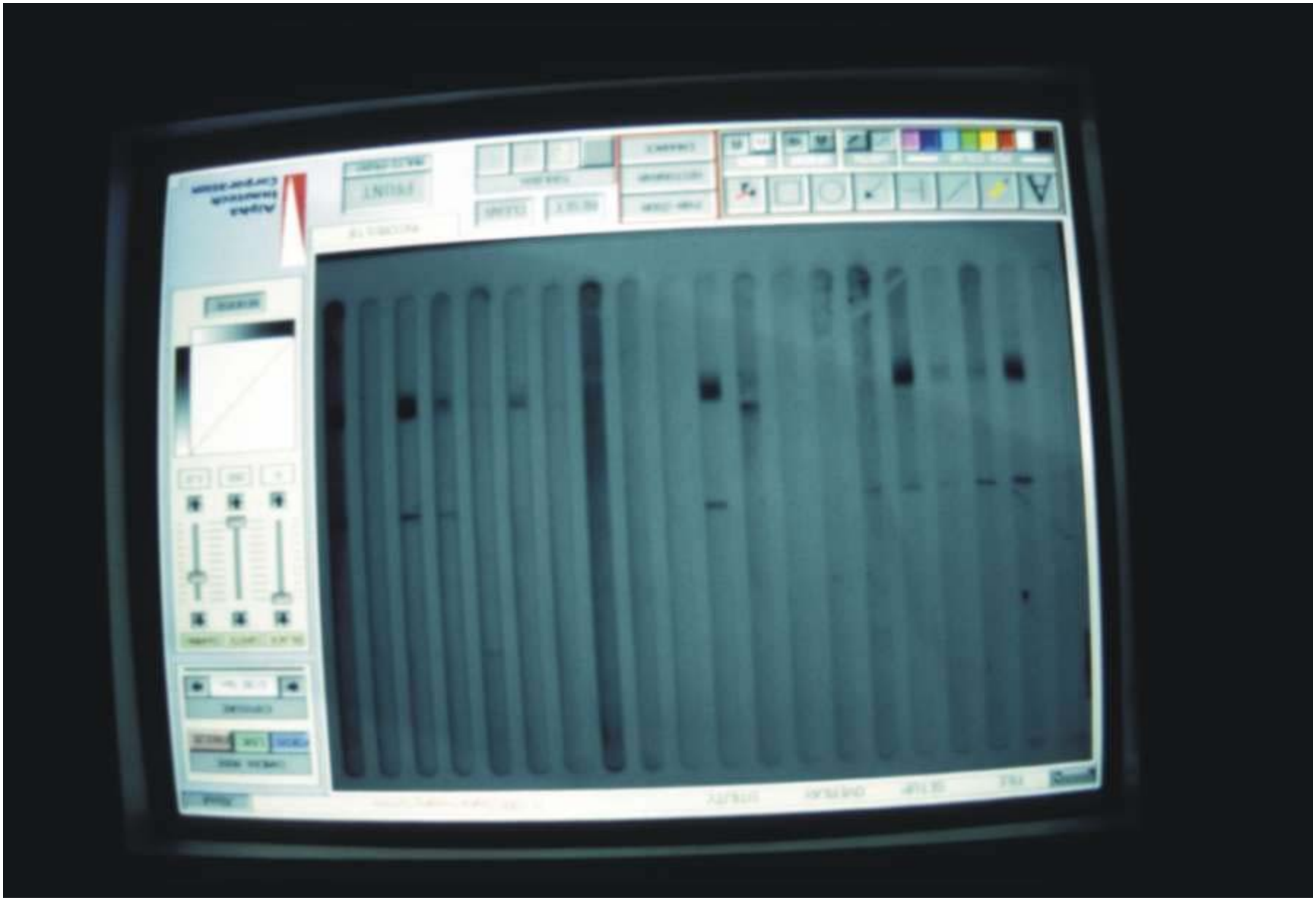
Serological Analyses

- Sera samples were analyzed at Lovelace Clinic Foundation in Albuquerque, NM for *Cryptosporidium* 15/17 –kDa and 27 –kDa antigen groups by Western miniblot.

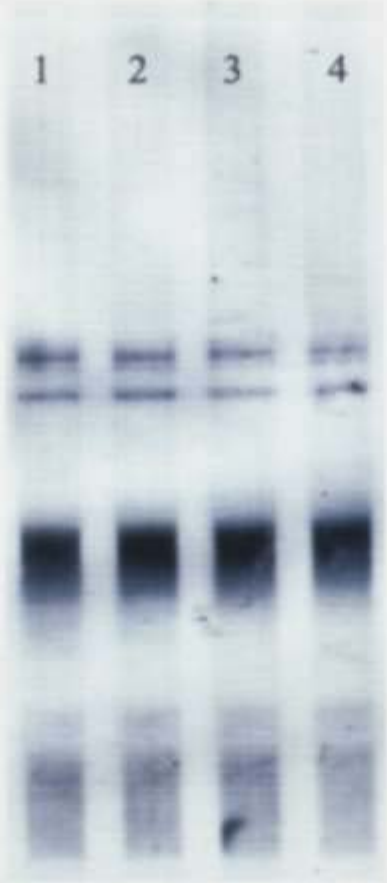
Figure 4
Summary of the Results




OCYST RETRIEVAL SITE
SAMPLE POPULATIO
OCYST PROCESSING LAB
BLOOD SAMPLE COLLECTION LAB
CRYPTOSPORIDUM EXPOSURE TESTING LAB



REPLICATE SAMPLE EXPERIMENT

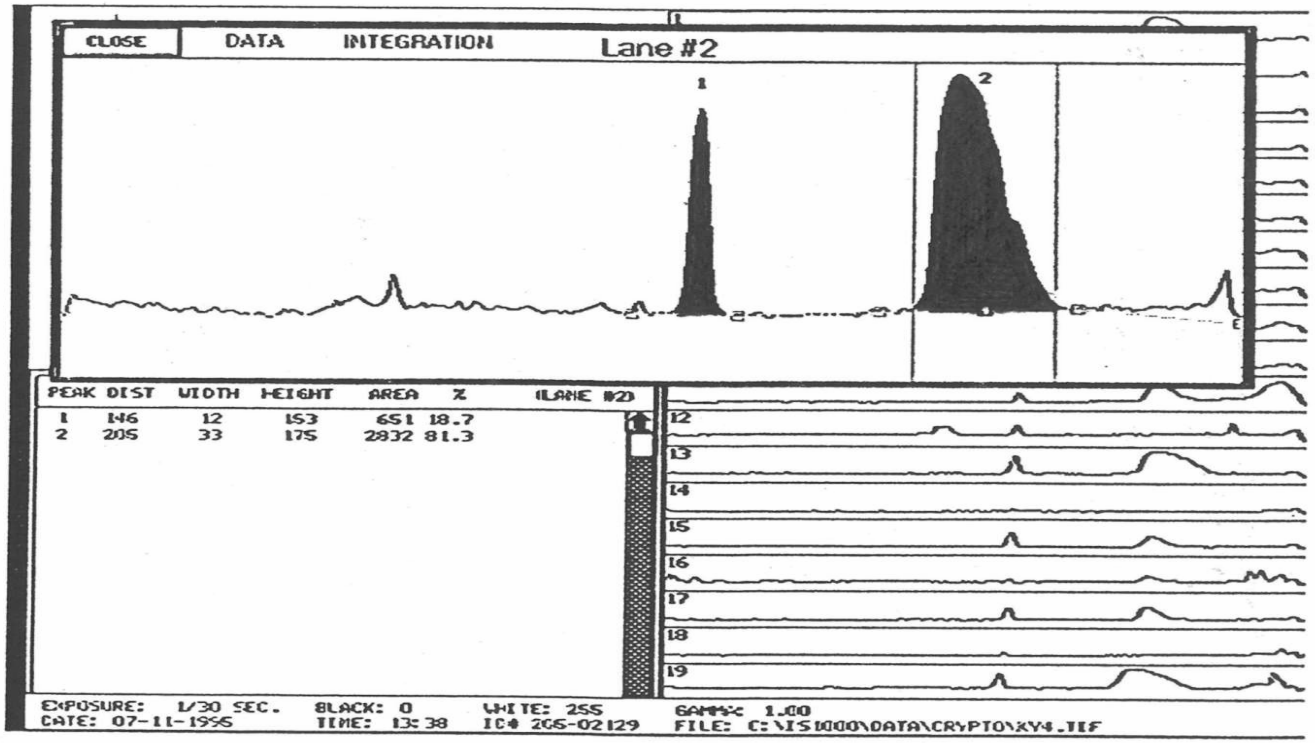


	15/17 H	15/17 A	27 H	27 A
1	65	1859	32	480
2	65	1848	24	337
3	66	1811	26	401
4	67	1811	24	384

Computer Scan of Western Blot

Intensity Graph for Lane 2

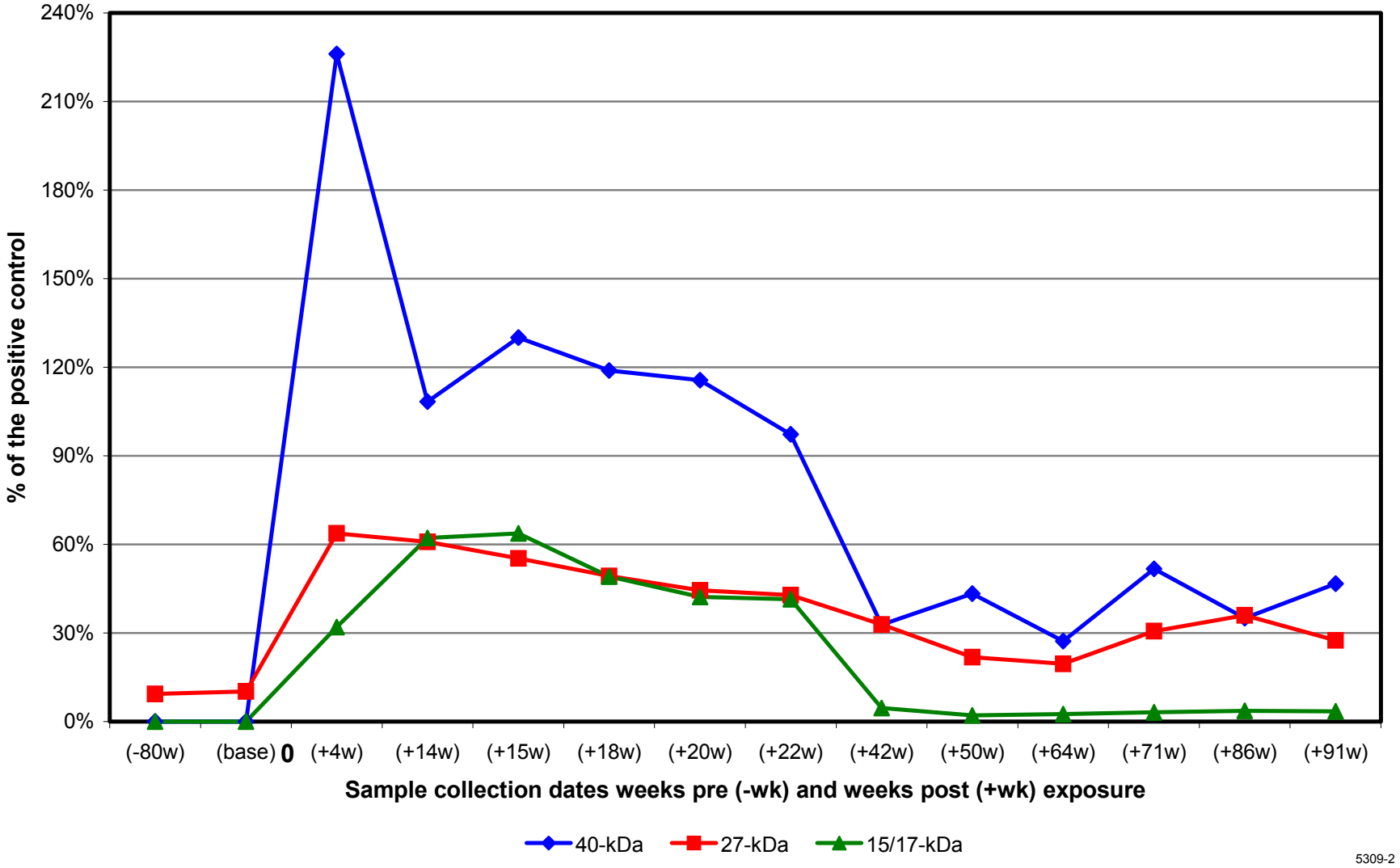
Peak #1	**Intensity score**	**height = 153**	
		area = 651	
	+ control was	**height = 136**	
		area = 526	
	Adjusted intensity score	**height=153/136 =**	**113%**
		area= 651/526=	**124%**
Peak #2	**Intensity score**	**height=175**	
		area=2832	
	+ control was	**height=167**	
		area=3632	
	Adjusted intensity score	**height=175/167=**	**105%**
		area=2832/3632=	**78%**



A Published Bowel Movement

- Because of problems with oocyst sonication, oocysts contaminated our laboratory, infecting Tim Muller, our laboratory technician.
- His reward was a publication of some memorable bowel movements.

IgG Response by Week Post *Cryptosporidium* Exposures



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SOURCE OF HOUSEHOLD WATER?

Questionnaire Data

- Data collected at the time of blood draw included:
  - Age, gender, marital status, education level
  - Length of time at residence
  - Type of water supply
  - Children, pets, travel, activity around water
  - Amount of water consumed in past 24 hours
  - Past diagnosis of cryptosporidiosis

Results-Water Samples

	# of Samples Collected	# of Samples positive for any agent	# of Samples Positive for Total Coliform	# of Samples Positive for Fecal Coliform	# of Samples Positive for Entercocci	# of Samples Positive for Coliphage
No Fecal Coliform Analysis	32	2	2	N/A	1	0
With Fecal Coliform Analysis	68	15	14	2	1	0
Total	100	17	16	2	2	0

Race/ethnicity/gender

	Onsite	City
Female	66%	77%
White (non-Hispanic)	73%	63%
Hispanic	24%	32%
Other/not stated	3%	2%

Marital Status/Age

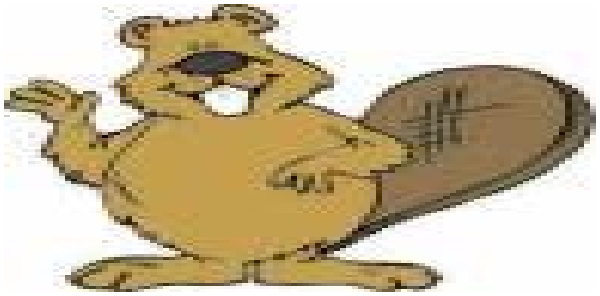
	Onsite	City
Married	33%	67%
Age < 40	13%	25%
Age 40-54	41%	31%
Age 55-64	28%	28%
Age 65+	18%	16%

Subject Characteristics

	Onsite	City
College graduate	64%	61%
Has dog or cat	84%	79%
Child is in day care	11%	9%
Handled diapers	19%	21%
Had diarrhea (< 1 yr)	43%	40%
Drank untreated water	4%	1%

Characteristics Unrelated to a Strong Serological Response

- Drank untreated water from lakes/streams
- Swam or waded in a lake or stream, pool
- Had plumbing work done in home
- Traveled outside of U.S.
- Education level



Strong Serological Responses by Water Consumption

- 27-kDa
- <6 glasses vs 6+
- Relative risk

- % 40% vs 56%
- 1.36 [.95,1.96]

Risk Factors for Strong Serological Responses

	Relative risk
• Handled diapers	1.54 (1.09,2.18)
• Cared for someone with diarrhea (yes=31, no=166)	1.38 (0.93,2.05)

Characteristics Unrelated to Strong Serology Responses

- Marital status or race/ethnicity or gender
- Had a child from your home attend day care
- Visited anyone in the hospital
- Handled pets
- Handled young pets
- Handled livestock

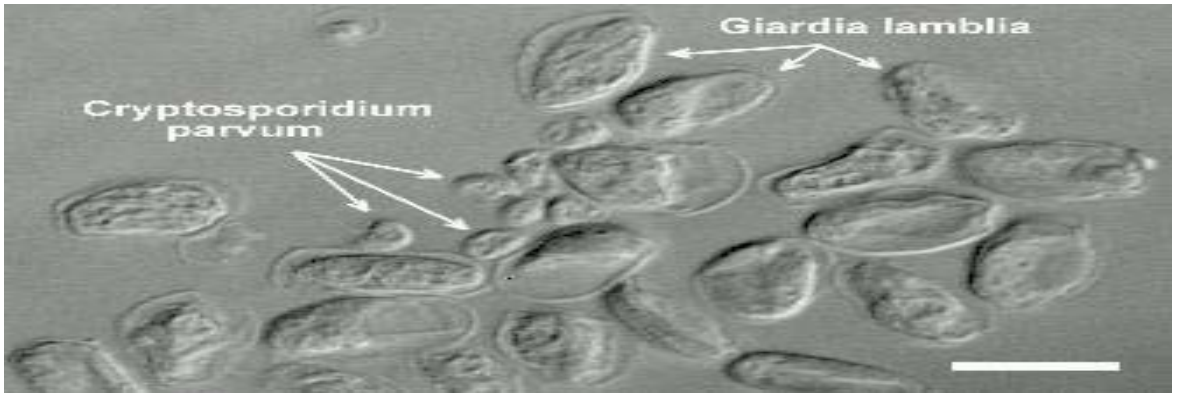
Odds Ratios of Risk Factors

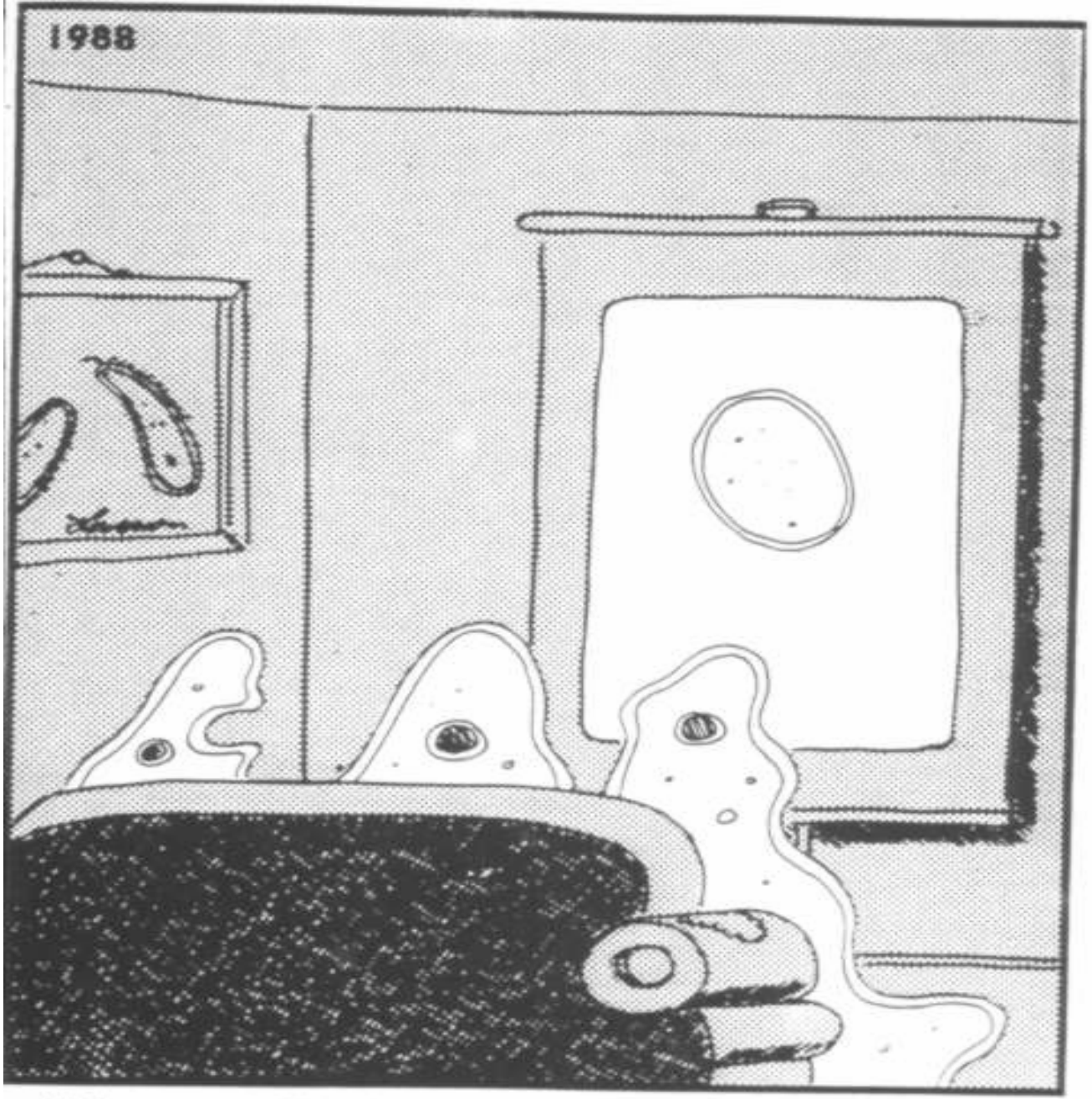
- **15/17-kDa antigen**
- ***********************
- **Onsite septic sys.**
  1.4 [0.8, 2.5]
- **Diaper exposure**
  2.5 [1.2, 5.1]
- **Age 65+**
  2.5 [1.1, 5.3]

- **27-kDa antigen**
- ***********************
- **Onsite septic sys**
  2.0 [1.1, 3.6]
- **Diaper exposure**
  1.3 [0.6, 2.7]
  Livestock Exposure
  0.5 [0.3, 0.9]

Conclusion

- This study suggests that having an onsite private well and septic system may increase the risk of *Cryptosporidium* infection.
- It also suggests that relatively large parasites may be capable of moving considerable distances through the soil.





"No, wait! *That's* not Uncle Floyd! Who is that? ... Criminy, I think it's just an air bubble!"