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PERSPECTIVE

Does Active Oral Sex Contribute to Female Infertility?

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Based on recent, historical, and circumstantial evidence, we present a multifactorial hypothesis that has potential direct implications on the epidemiology and management of chlamydial infection and disease in humans. We propose that (1) like its veterinary relatives, the oculogenital pathogen *Chlamydia trachomatis* evolved as a commensal organism of the human gastrointestinal (GI) tract primarily transmissible via the fecal-oral route; (2) in the modern era, *C. trachomatis* causes "opportunistic" infection at non-GI sites under conditions driven by improved sanitation/hygiene and reduced fecal-oral transmission; and (3) the rise in the practice of oral sex is contributing to the increased prevalence of *C. trachomatis* in the human GI tract. Infectious organisms produced in the GI tract and reaching the rectum may then chronically contaminate and infect the female urogenital tract, thereby potentially contributing to the most serious sequelae of chlamydial infection in women: pelvic inflammatory disease, ectopic pregnancy, and tubal factor infertility.

Keywords. oral sex; *Chlamydia trachomatis*; commensalism; fecal-oral transmission; female infertility.

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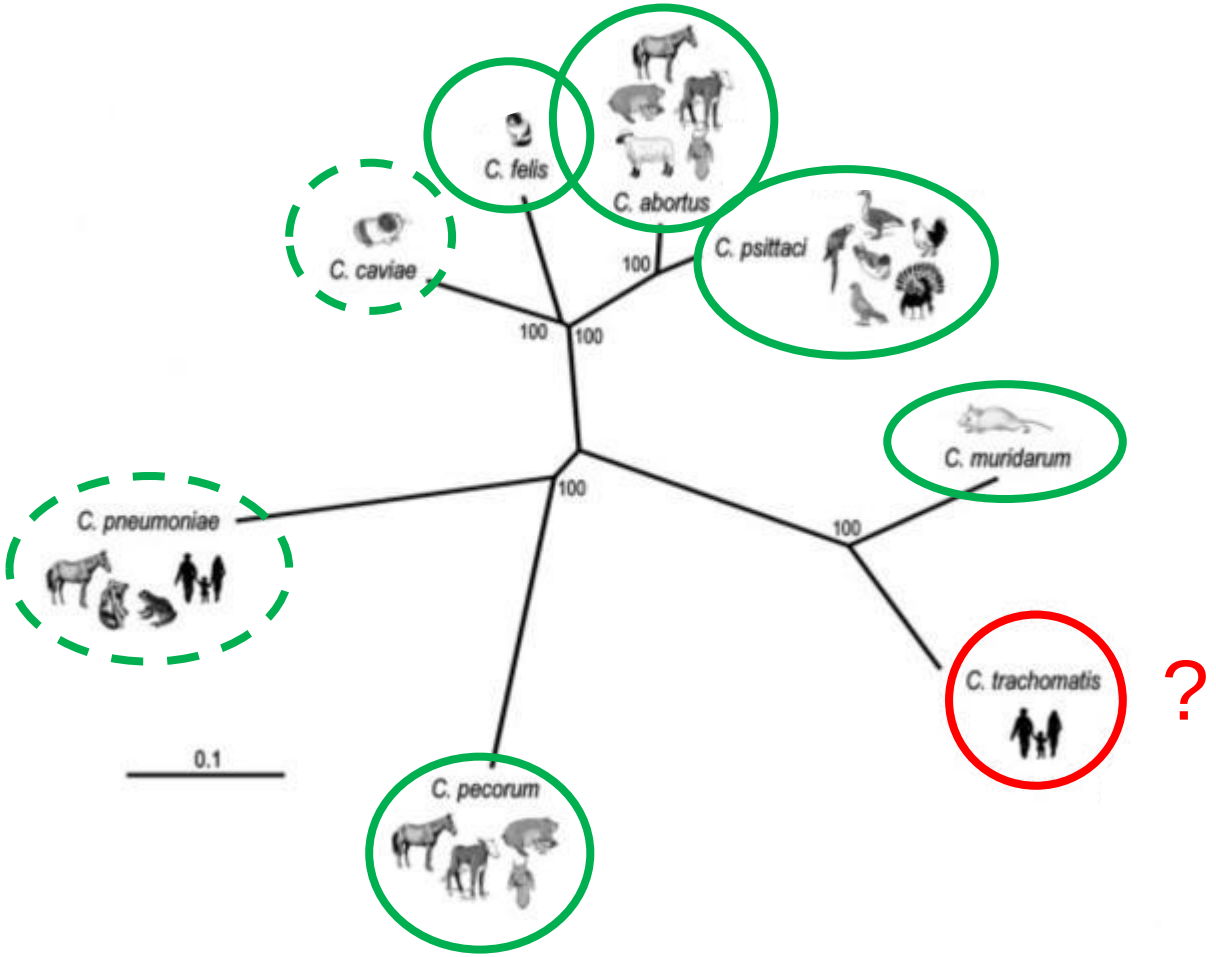
3-point hypothesis

- All *Chlamydia* species, including *C. trachomatis*, have evolved primarily as commensal colonizers of the digestive tract of their host(s), and cause opportunistic infections at non-GI sites
- Sanitation (underground sewers, septic syst.), which effectively separates humans from human waste, has eliminated fecal-oral transmission of many microbes, including *C. trachomatis*
- The rising practice of active oral sex (e.g., fellatio) is 'reintroducing' *C. trachomatis* to the human GI tract

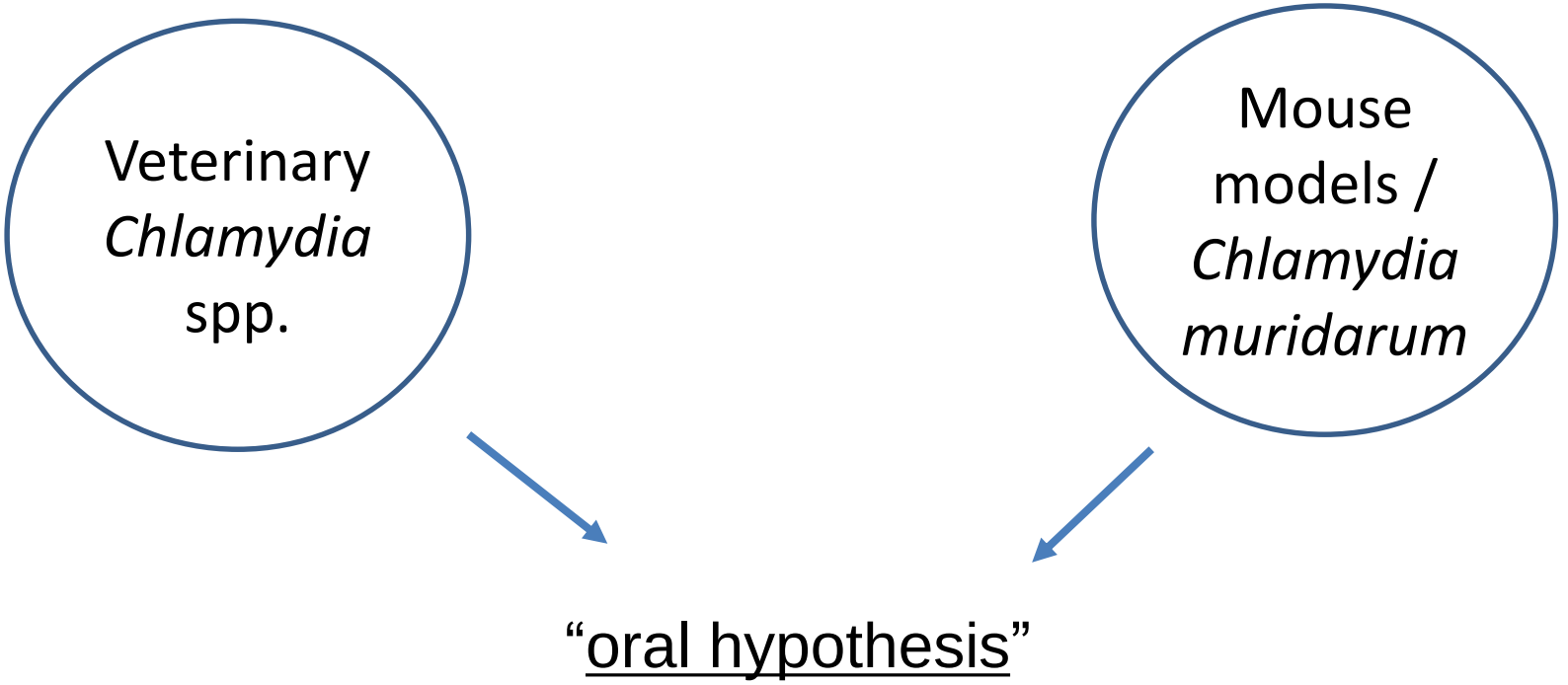
In women, chlamydiae that survive the journey to the rectum may chronically or episodically contaminate/infect the lower reproductive tract via recto-vaginal contamination

"oral hypothesis"

- Veterinary *Chlamydia* spp. are known (———) or highly suspected (– – – –) silent colonizers of the digestive tract of their host



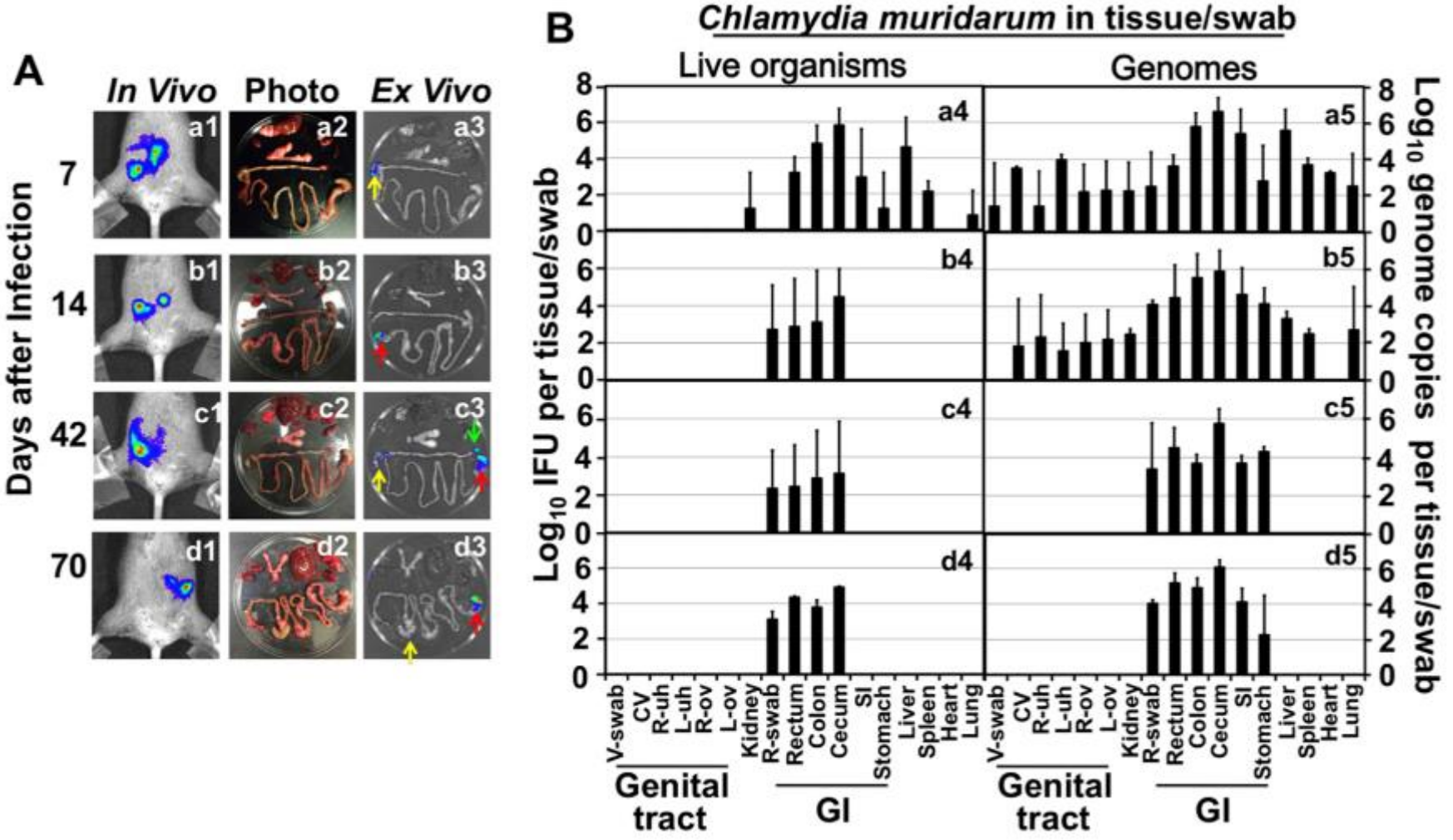
Nunes & Gomes, Infect Genet Evol, 23:49-64, 2014


Veterinary *Chlamydia* spp.
Mouse models / *Chlamydia muridarum*
"oral hypothesis"

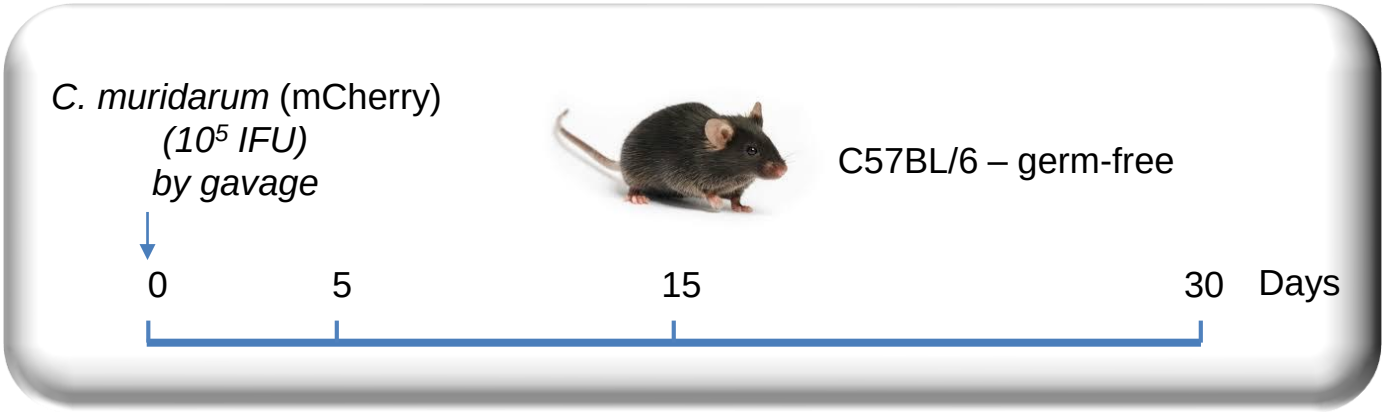
- *C. muridarum* inoculated orally persists in the GI tract of a mouse for its life-time without symptoms

- Antibiotics --or antibodies-- control a genital infection in a mouse infected with *C. muridarum,* but do not impact GI colonization

- *Chlamydia muridarum* inoculated at diverse sites, including IV, “homes” to the GI tract of the mouse



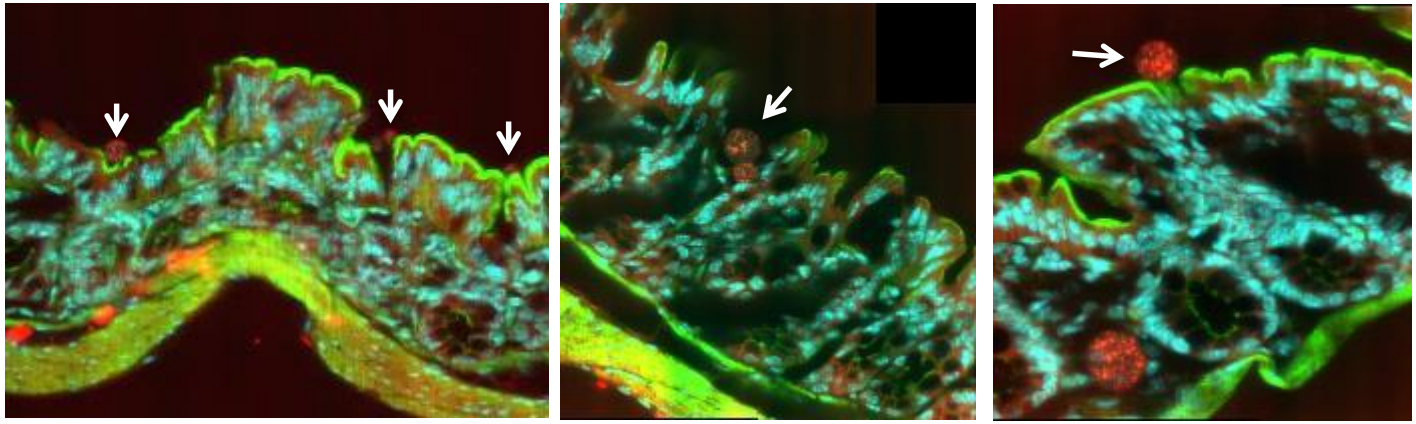
Dai et al, 2016, Infect Immun 84:8



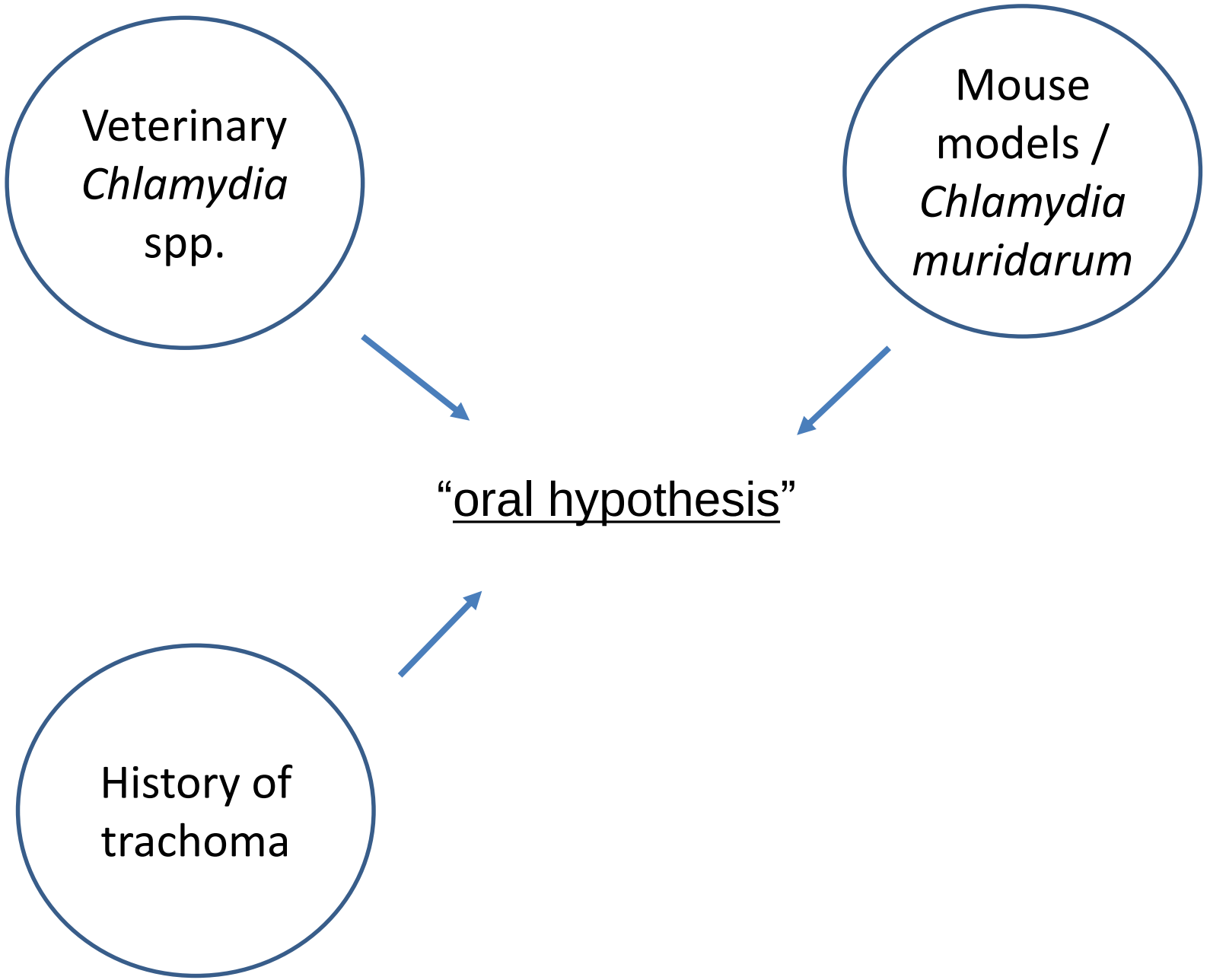
Jacques Ravel
UMB-IGS

Céline Mulet
Inst. Pasteur

Colon D30



Giant extruded chlamydial inclusions?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Mouse models / *Chlamydia muridarum*
"oral hypothesis"
History of trachoma

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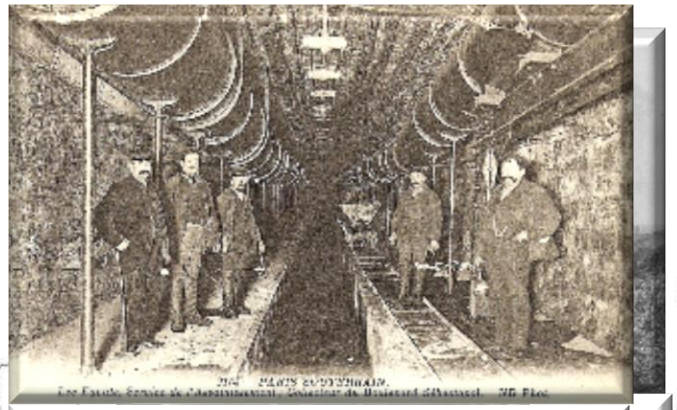


1860-80 Sewers in large cities

Workhouse, circa 1850

1798 Battle of the Pyramids

Two exceptions:

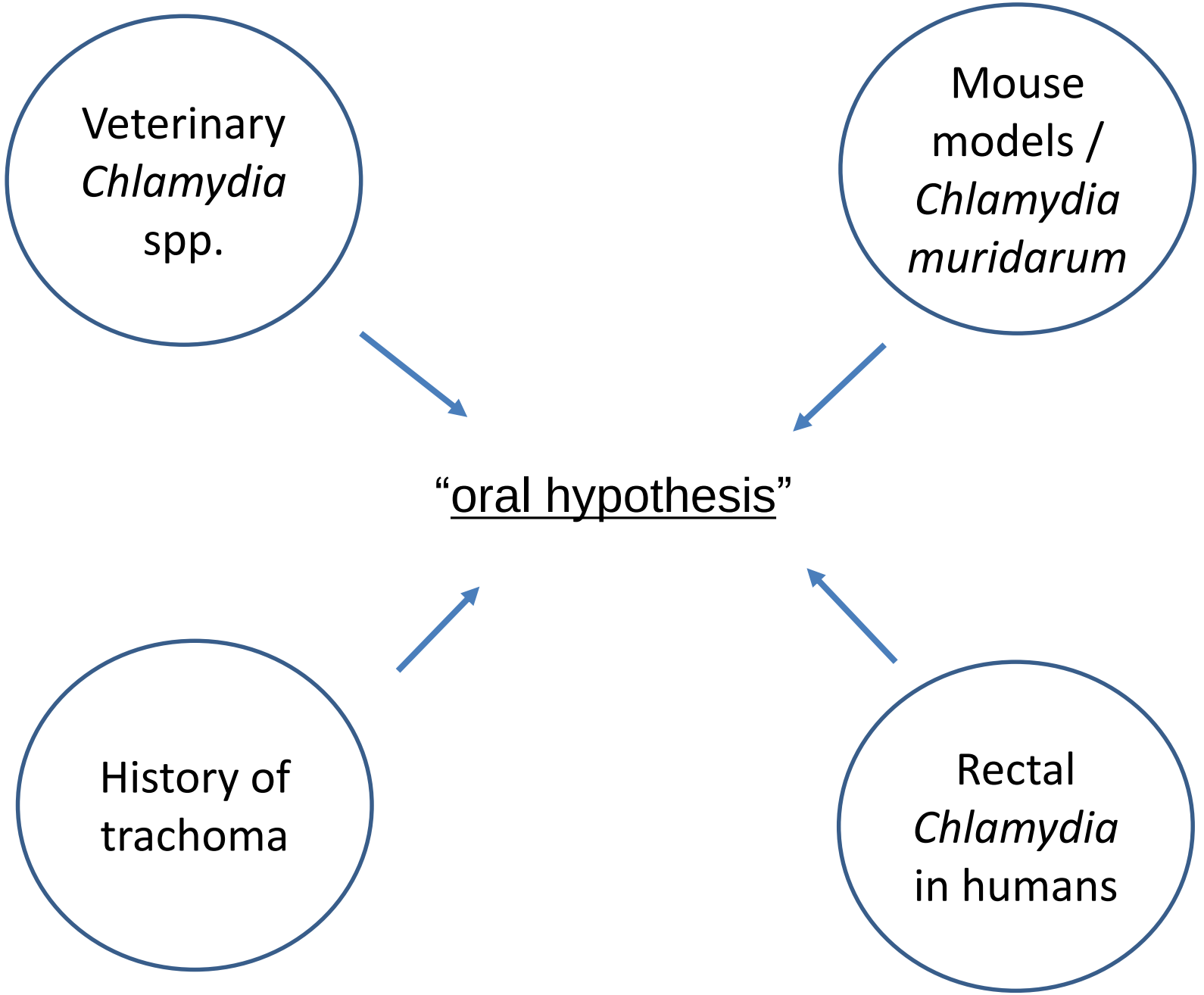
reservations in North America

Aboriginal communities in Northern Australia

SAFE strategy: eliminate trachoma by year 2020

- ‘A’ (year-long azithro) effectively eliminates active trachoma
- ‘F’ removes facial naso-ocular reservoir, “disarming” vector (flies)
- ‘E’ results vary as implementation/application varies

- The history of trachoma in Europe, North America and Australia, and the current failure of the “SAFE” strategy to eradicate trachoma, are consistent with the existence of a missing reservoir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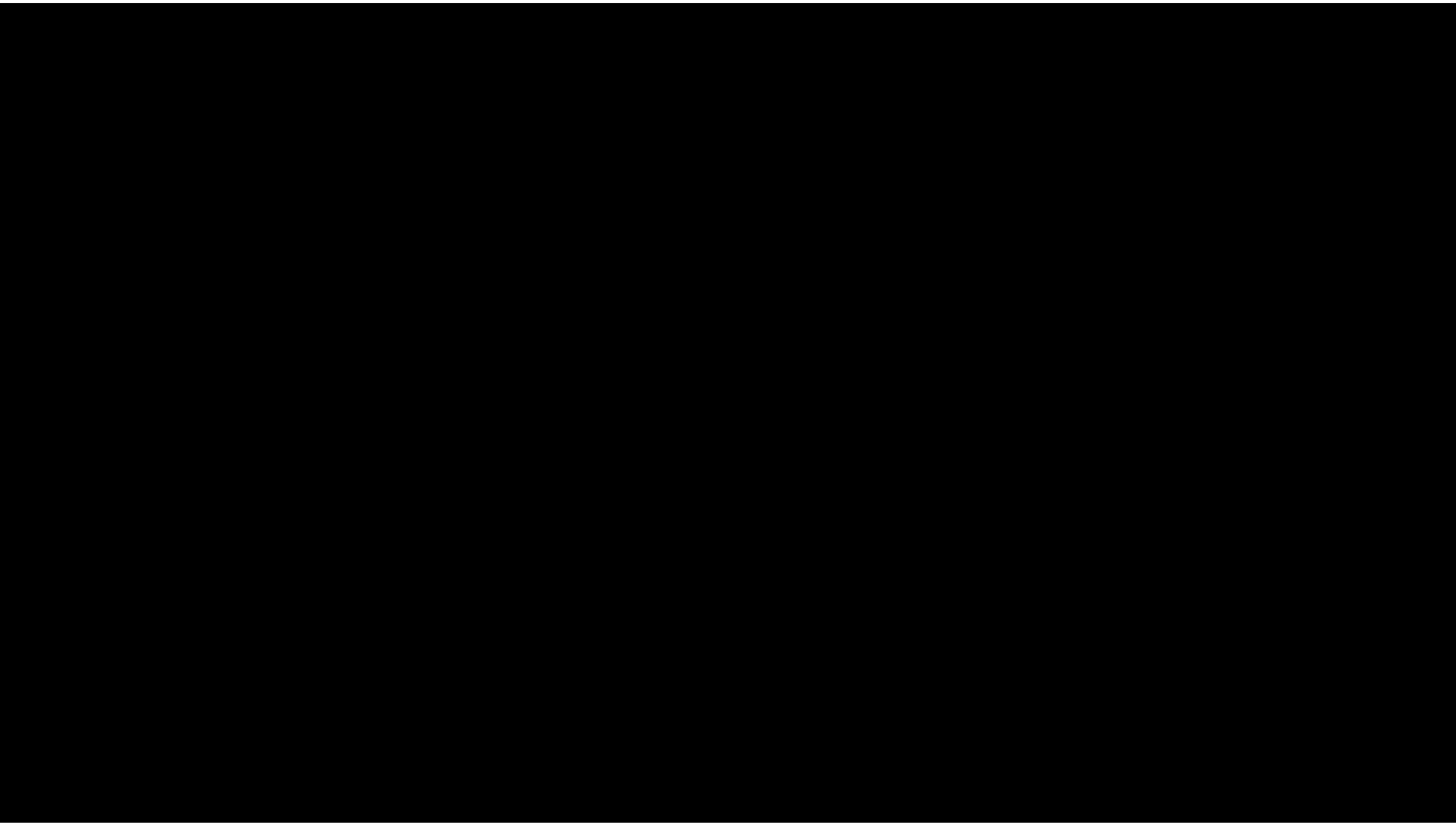
History of trachoma
Rectal *Chlamydia* in humans

Rectal *C. trachomatis* in women

Van Liere *et al*, Clin Infect Dis, study of 1012 women in NL

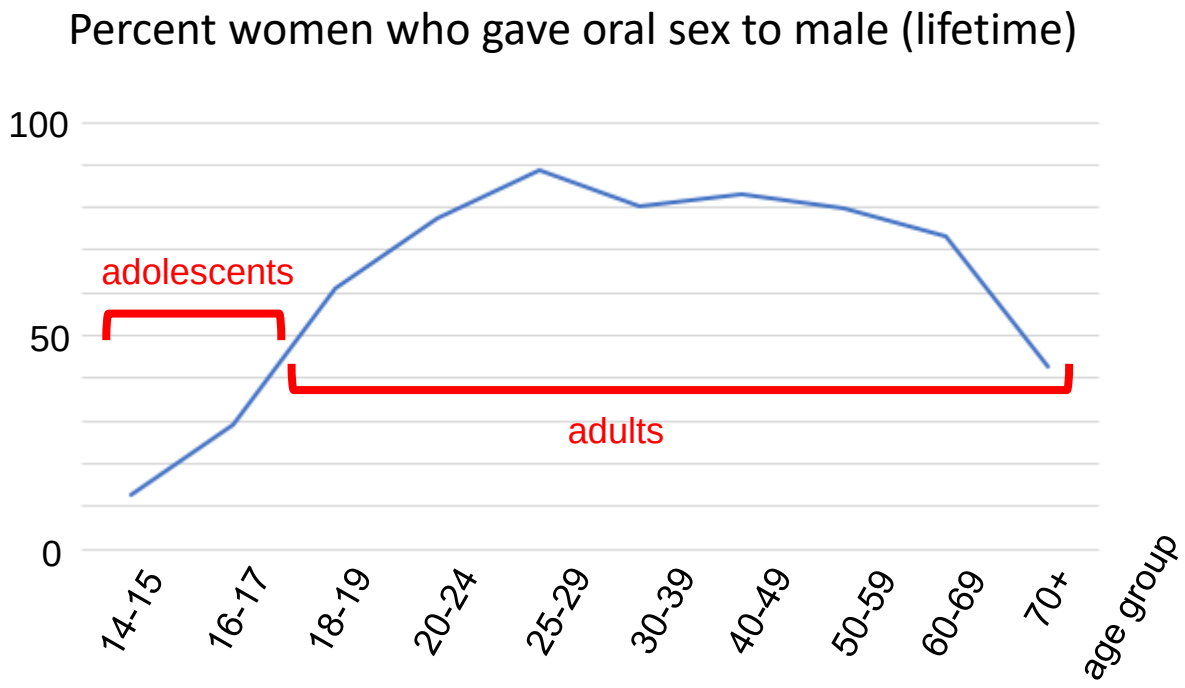
“Of all anorectal chlamydia cases, 72% (n=92) were diagnosed in women without reported anal sex or symptoms, of which 19% (n=19) were anorectal only”



“Indian and French war” circa 1750

The Last of the Mohicans, 1992

Survey of sexual behavior by age group



Herbenick et al, J Sex Med 7(suppl 5), 2010

Oral Sex

Peru
6th Cy AD

60's to 80's sexual revolution

80's HIV-AIDS pandemic

1998
"I did not have sexual relations…"

- The notion that oral sex is not sex, or is safe or safer sex still prevails today

We propose that:

C. trachomatis transmitted via the fecal-oral or genital-oral routes can colonizes GI site(s) without symptoms, and disseminate chronically or episodically to the rectum and feces

Rectal *C. trachomatis* may chronically or episodically contaminate/infect the female lower genital tract, exacerbating host responses and contributing to reproductive sequelae

Human waste is a source of infectious chlamydiae that are transmitted via flies and fecal-contaminated water causing repeat ocular infections and active trachoma

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Thank you!