Des vaccins contre d'autres IST : *Chlamydia*, gonocoque, syphilis

O. Epaulard

Infectiologie, CHU de Grenoble

Journées Thématiques
Santé Sexuelle - IST, PrEP, Vaccination
15-16 mai 2025 Paris (France)

Pas de lien d’intérêt à déclarer

Key figures

Organisation mondiale de la Santé

New infections of chlamydia, gonorrhoea, syphilis or trichomoniasis

374 million

in adults 15 to 49 in 2020

New infections of chlamydia, gonorrhoea, syphilis or trichomoniasis

over 1 million

new cases per day in adults 15 to 49 in 2020

New infections of syphilis

8 million

in adults 15 to 49 in 2022

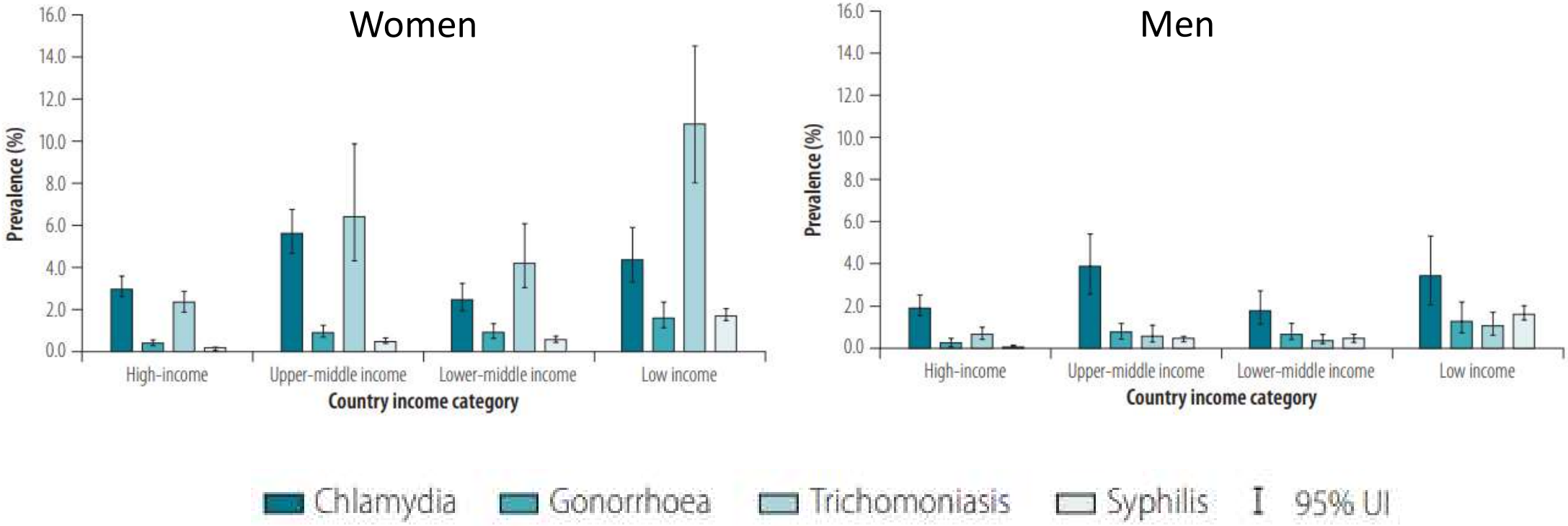
Cases of congenital syphilis

700 000

in 2022

Chlamydia, gonorrhoea, trichomoniasis and syphilis: global prevalence and incidence estimates, 2016

Jane Rowley,[a] Stephen Vander Hoorn,[b] Eline Korenromp,[c] Nicola Low,[d] Magnus Unemo,[e] Laith J Abu-Raddad,[f] R Matthew Chico,[g] Alex Smolak,[f] Lori Newman,[h] Sami Gottlieb,[a] Soe Soe Thwin,[a] Nathalie Broutet[a] & Melanie M Taylor[a]

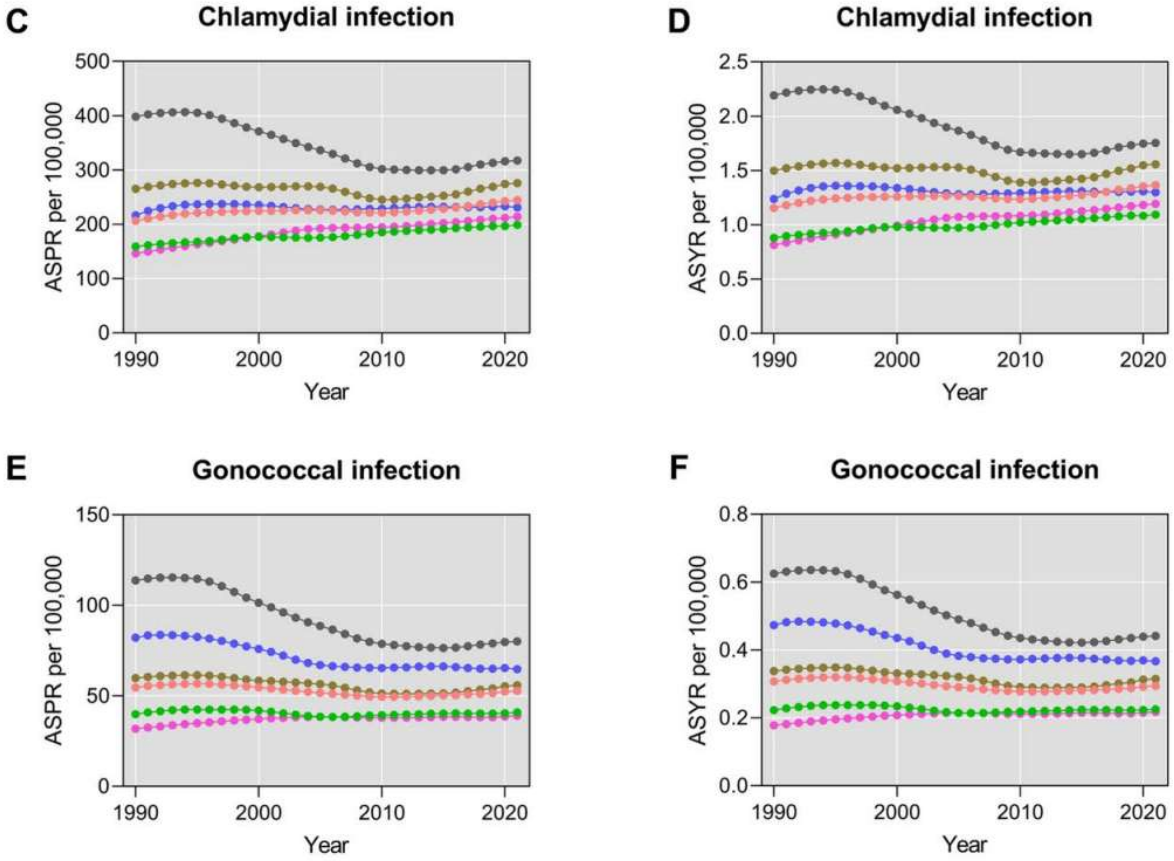


Global burden of female infertility attributable to sexually transmitted infections and maternal sepsis: 1990–2021 and projections to 2050

Jianbo Wei[1,3], Huayu Huang[2,3] & Liangsheng Fan[1]

Nombre de cas / 100 000

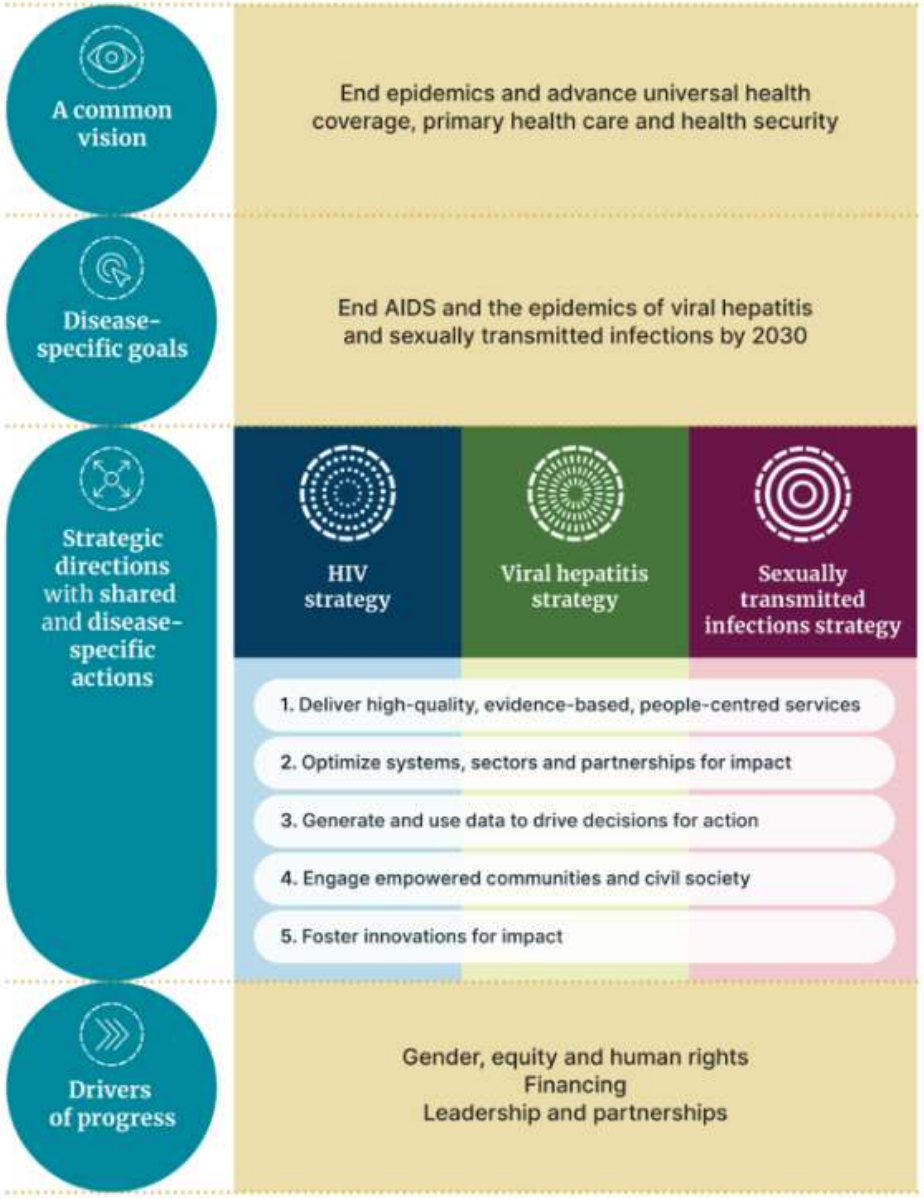
Nombre d'année d'infertilité / 100 000



SDI : index socio-démographique

Organisation mondiale de la Santé

« Mettre fin aux épidémies d'IST en 2030 »



Déclencher une réponse pour une infection limitée aux muqueuses : une gageure

- Le vaccin polio injectable n'empêche pas l'infection/la réplication muqueuse
  - Ni la contagiosité d'ailleurs
  - Il évite la maladie neurologique

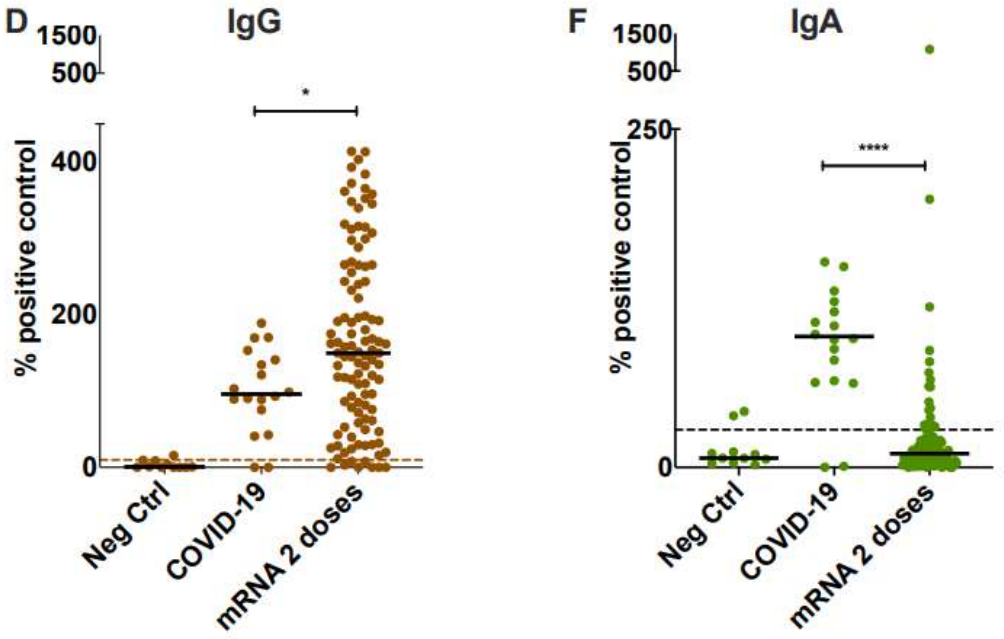
- Le vaccin diphtérie ne cible que la toxine

- Les vaccins grippe, Covid et VRS ciblent surtout l'atteinte pulmonaire

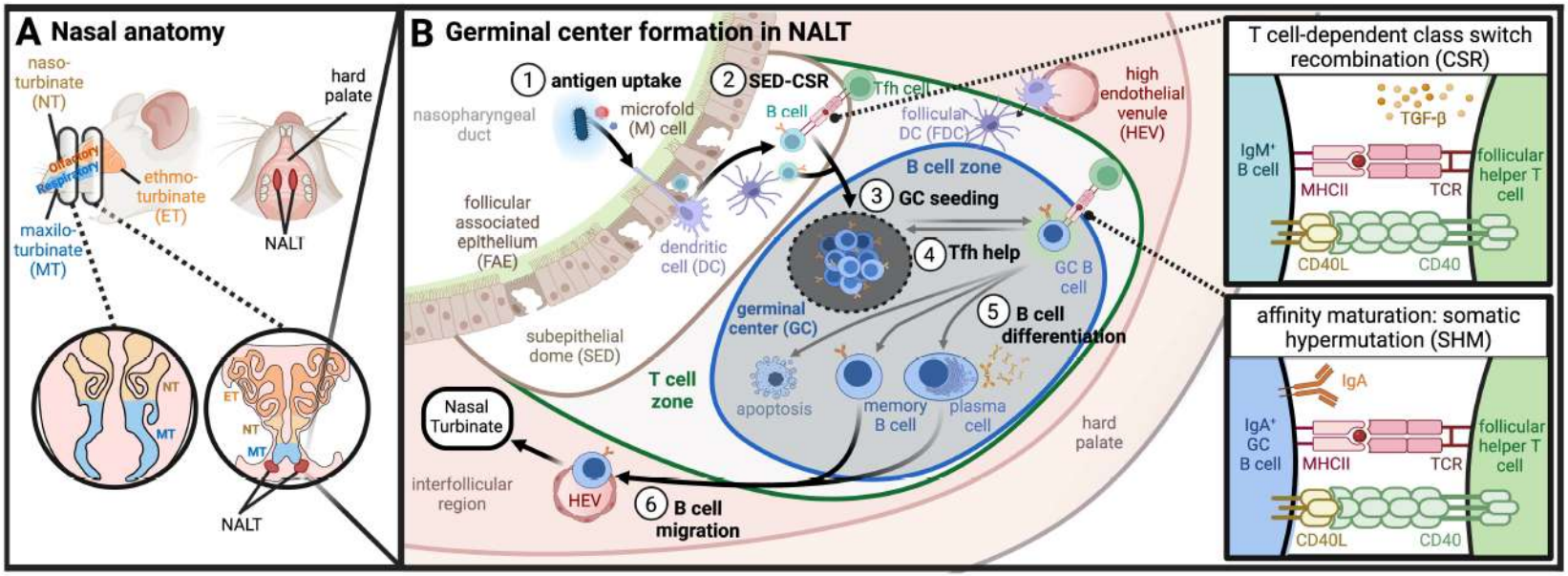
Déclencher une réponse immune muqueuse nécessite plus qu'une injection IM ou SC

Systemic and mucosal IgA responses are variably induced in response to SARS-CoV-2 mRNA vaccination and are associated with protection against subsequent infection

Salma Sheikh-Mohamed[1], Baweleta Isho[1,17], Gary Y. C. Chao[1,17], Michelle Zuo[1,17], Carmit Cohen[2], Yaniv Lustig[2,3,4], George R. Nahass[5,6], Rachel E. Salomon-Shulman[5], Grace Blacker[5], Mahya Fazel-Zarandi[7], Bhavisha Rathod[7], Karen Colwill[7], Alainna Jamal[7], Zhijie Li[8], Keelia Quinn de Launay[7,9], Alyson Takaoka[7,9], Julia Garnham-Takaoka[7,9], Anjali Patel[7,9], Christine Fahim[9], Aimee Paterson[7], Angel Xinliu Li[7], Nazrana Haq[7], Shiva Barati[7], Lois Gilbert[7], Karen Green[7], Mohammad Mozafarihashjin[7], Philip Samaan[10], Patrick Budylowski[10], Walter L. Siqueira[11], Samira Mubareka[10,12], Mario Ostrowski[1,13,14], James M. Rini[8,15], Olga L. Rojas[16], Irving L. Weissman[5], Michal Caspi Tal[5], Allison McGeer[7], Gili Regev-Yochay[2], Sharon Straus[9]✉, Anne-Claude Gingras[7,8]✉ and Jennifer L. Gommerman[1]✉



La solution : délivrer le vaccin au niveau des muqueuses



- Vaccin poliomyélite vivant oral
- Vaccin grippe vivant nasal
- Vaccin choléra oral
- Vaccin typhoïde vivant oral

1999

Induction of Genital Immunity by DNA Priming and Intranasal Booster Immunization with a Replication-Defective Adenoviral Recombinant[1]

Zhi Quan Xiang, Susanna Pasquini,[2] and Hildegund C. J. Ertl[3]

2004

Induction of HIV Immunity in the Genital Tract After Intranasal Delivery of a MVA Vector: Enhanced Immunogenicity After DNA Prime-Modified Vaccinia Virus Ankara Boost Immunization Schedule[1]

M. Magdalena Gherardi, Eva Pérez-Jiménez, José Luis Nájera, and Mariano Esteban[2]

ARTICLE

Received 15 Sep 2014 | Accepted 15 Dec 2014 | Published 20 Jan 2015

DOI: 10.1038/ncomms7100

Vaginal type-II mucosa is an inductive site for primary CD8$^+$ T-cell mucosal immunity

Yichuan Wang[1], Yongjun Sui[1], Shingo Kato[1], Alison E. Hogg[1,2], Jason C. Steel[3,4], John C. Morris[5] & Jay A. Berzofsky[1]

The Human Penis Is a Genuine Immunological Effector Site

2017

*Alexis Sennepin[1,2,3], Fernando Real[1,2,3], Marine Duvivier[1,2,3], Yonatan Ganor[1,2,3], Sonia Henry[1,2,3], Diane Damotte[4], Marc Revol[5], Sonia Cristofari[5] and Morgane Bomsel[1,2,3]**

Une autre gageure pour notre trio : l'immunité naturelle n'est pas protectrice

- Réinfection aisée par *Chlamydia*, le gonocoque et *Treponema*

- Il existe cependant des pathogènes pour lesquels la vaccination déclenche une meilleure réponse que l'infection
  - HPV en particulier

2001

Experimental Gonococcal Urethritis and Reinfection with Homologous Gonococci in Male Volunteers

KATHERINE A. SCHMIDT, PHD,* HERMAN SCHNEIDER, PHD,* JILL A. LINDSTROM, MD,† JOHN W. BOSLEGO, MD,*
RICHARD A. WARREN, PHD,* LILLIAN VAN DE VERG, PHD,* CAROLYN D. DEAL, PHD,*
J. BRUCE McCLAIN, MD,† AND J. McLEOD GRIFFISS, MD‡§

Tentative d'infection expérimentale : obtenue chez

- 6 sur 14 (43%) volontaires déjà infectés par le passé
- 5 sur 10 (50%) volonaires non infectés par le passé

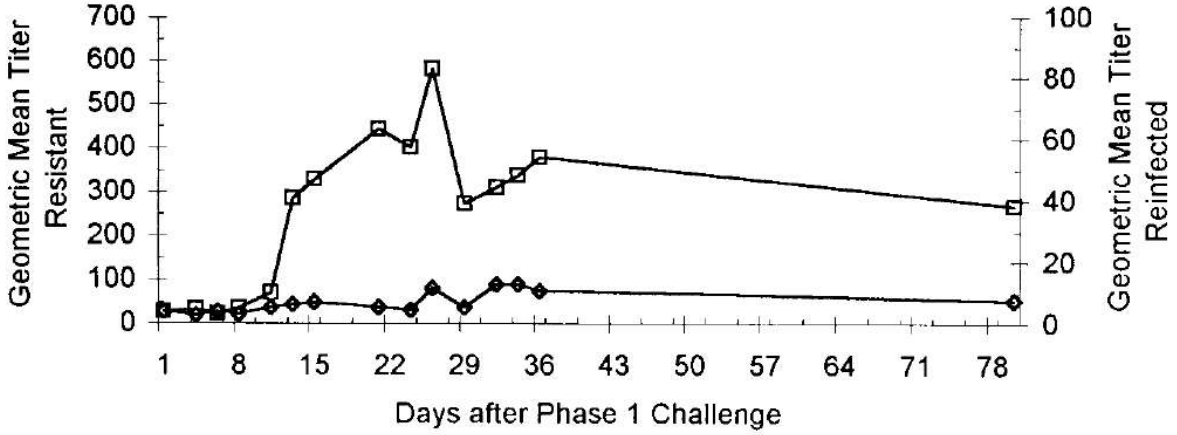


Fig. 4. Geometric mean lipooligosaccharide IgG titers, as determined by enzyme-linked immunoabsorbent assay (see Methods section) in the sera of phase 1 volunteers who did (◇) or did not (□) become reinfected during phase 2.

Repeated *Chlamydia trachomatis* Genital Infections in Adolescent Women

Byron E. Batteiger,[1,3] Wanzhu Tu,[2,5] Susan Ofner,[2] Barbara Van Der Pol,[1,6] Diane R. Stothard,[1,a] Donald P. Orr,[4] Barry P. Katz,[2] and J. Dennis Fortenberry[4]

Divisions of [1]Infectious Diseases and [2]Biostatistics, Department of Medicine, [3]Department of Microbiology and Immunology and [4]Department of Pediatrics, Section of Adolescent Medicine, Indiana University School of Medicine, [5]Regenstrief Institute, and [6]Marion County Health Department, Indianapolis, Indiana

Table 4. Distribution of *Chlamydia trachomatis* Infections

No. of episodes[a]	Participants,[b] no. (%)
0	176 (45.6)
1	89 (23.1)
2	61 (15.8)
3	24 (6.2)
4	13 (3.4)
5	9 (2.3)
6	7 (1.8)
7	3 (0.78)
8	1 (0.26)
9	3 (0.78)

[a] $n = 478$.
[b] $n = 386$.

Table 5. Comparison of Infection Episode Pairs of the Same and Different Genotypes

Variable	Same genotype ($n = 83$)	Different genotype ($n = 100$)
Interval, median, days	88	278
Treatment documented	79 (95.2)	96 (96.0)
Coitus	71 (85.5)	90 (90.0)
N. gonorrhoeae at second episode	9 (10.8)	16 (16.0)
T. vaginalis at second episode	8 (9.6)	14 (14.0)
Coitus same partner[a]	41 (49.4)	26 (26.0)
Coitus different partner[a]	43 (51.8)	74 (74.0)
B serogroup[b]	55 (66.3)	58 (58.0)
C serogroup[b]	20 (24.1)	27 (27.0)
Intermediate[b]	8 (9.6)	15 (15.0)

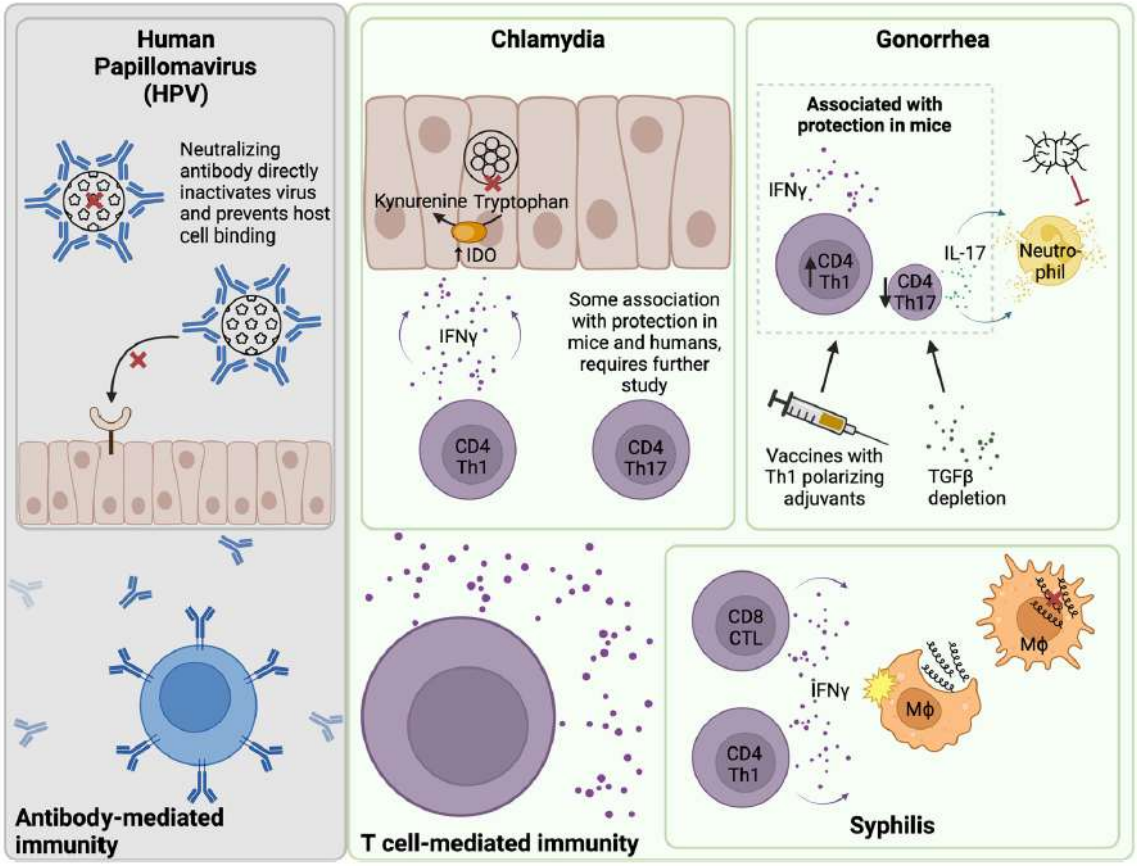
vaccines

MDPI

Review

Immunity to Sexually Transmitted Bacterial Infections of the Female Genital Tract: Toward Effective Vaccines

Kacy S. Yount and Toni Darville *



Des précédents qui indiquent un chemin

- Vaccin contre le virus de l'hépatite B
- Vaccin contre les HPV
- Vaccin polysaccharidiques antibactériens
  - Méningocoque
  - Pneumocoque

… actifs sur le portage muqueux

SEXUALLY TRANSMITTED DISEASES
Journal of the American Sexually Transmitted Diseases Association (ASTDA)
www.stdjournal.com

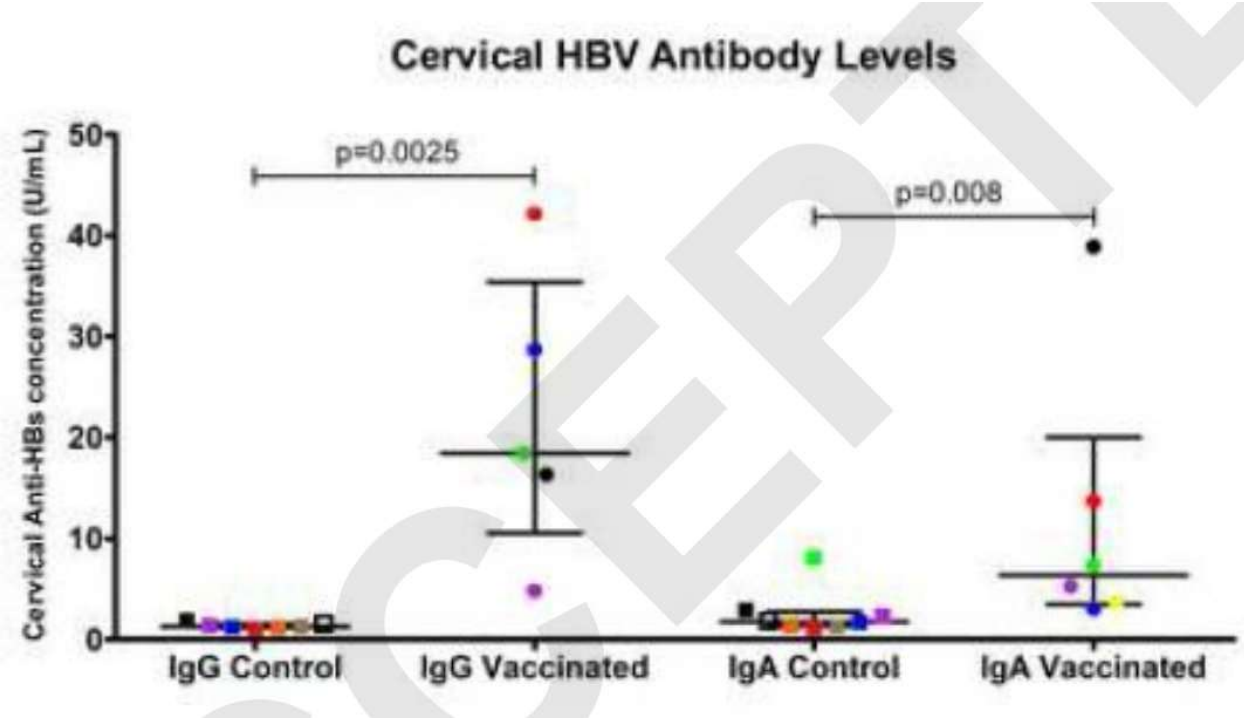
NOTES

Hepatitis B Vaccination Induces Mucosal Antibody Responses in the Female Genital Tract, Indicating Potential Mechanisms of Protection Against Infection

Simpson, Samuel J. MBChB, BMedSci; Wiggins, Rebecca PhD; Fox, James M. PhD; Mthethwa, Jabu FRCSEd, MBChB; Cai, Chun MBChB; Lacey, Charles J.N. MD, FRCP

Author Information

Sexually Transmitted Diseases 46(5):p e53-e56, May 2019. | *DOI:* 10.1097/OLQ.0000000000000949



Chlamydia

Maladies associées à *C. trachomatis*

- Kératoconjonctivite chronique : trachome
  - 1ère cause de cécité d'origine infectieuse
  - 1-2 million(s) de cas annuels de cécité (chiffres OMS)

- Atteinte (uro)génitale féminine basse et haute
  - Cervicite, (urétrite,) endométrite, salpingite, atteinte pelvienne inflammatoire
  - deux tiers des cas d'infertilité tubaire, un tiers des grossesses extra-utérines

- Urétrite masculine, voire extension testicule(/prostate)

- Rectite

- Lymphogranulomatose vénérienne

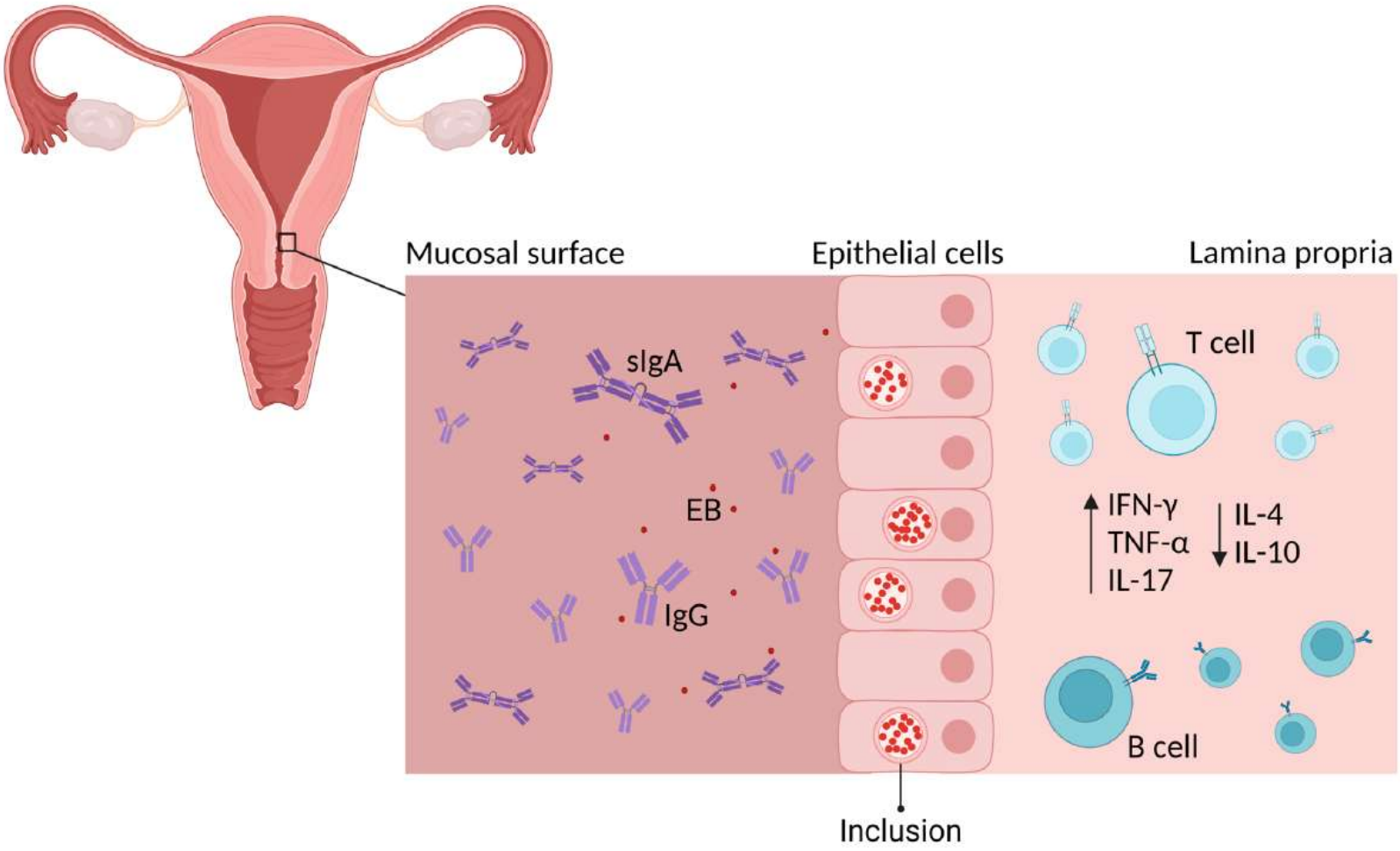


Figure 1. Mouse models have demonstrated that vaccine-induced adaptive immune responses against *C. trachomatis* should comprise humoral immune responses including mucosal IgG and IgA responses with neutralizing capabilities, and CMI responses, including upregulation of IFN-γ, TNF-α and IL-17 and downregulation of IL-4 and IL-10. Created with BioRender.com.

Kiekens 2024

Seventy Years of *Chlamydia* Vaccine Research – Limitations of the Past and Directions for the Future

Samuel Phillips, Bonnie L. Quigley and Peter Timms*

Genecology Research Centre, The University of the Sunshine Coast, Maroochydore, QLD, Australia

TABLE 2 | Targeted host and the number of trials for each, separated by chlamydial strain.

Host	*Chlamydia* strains (number of studies)	Purpose of trials	Total number of trials
Mice/Rats	*C. muridarum* (82),	*Human vaccine targeting C. trachomatis or C. pneumoniae*	160
	C. trachomatis (60),		
	C. pneumoniae (14),		
	C. psittaci (8),		
	C. abortus (6),	Sheep vaccine targeting *C. abortus*	
	C. pecorum (1)	Sheep vaccine targeting *C. pecorum*	
Non-Human primates	*C. muridarum* (2), *C. trachomatis* (10)	Human vaccine targeting *C. trachomatis*	11
Guinea pigs	*C. psittaci* (4), *C. trachomatis* (3), *C. caviae* (1)	Human vaccine targeting *C. trachomatis* or *C. pneumoniae*	6
Humans	*C. trachomatis* (1)	Human vaccine targeting *C. trachomatis*	1
Rabbits	*C. trachomatis* (1)	Human vaccine targeting *C. trachomatis*	1
Pigs	*C. abortus* (2)	Pig vaccine targeting *C. abortus*	7
	C. trachomatis (5)	Human vaccine targeting *C. trachomatis*	
Cattle	*C. abortus* (1)	Cattle vaccine targeting *C. abortus*	1
Sheep	*C. abortus* (3), *C. pecorum* (1), *C. psittaci* (9)	Sheep vaccine targeting *C. abortus*, *C. pecorum,* or *C. psittaci*	13
Birds	*C. psittaci* (5)	Bird vaccine targeting *C. psittaci*	5
Cats	*C. felis* (1), *C. psittaci* (1)	Cat vaccine targeting *C. felis*	2
Koalas	*C. pecorum* (11)	Koala vaccine targeting *C. pecorum*	11

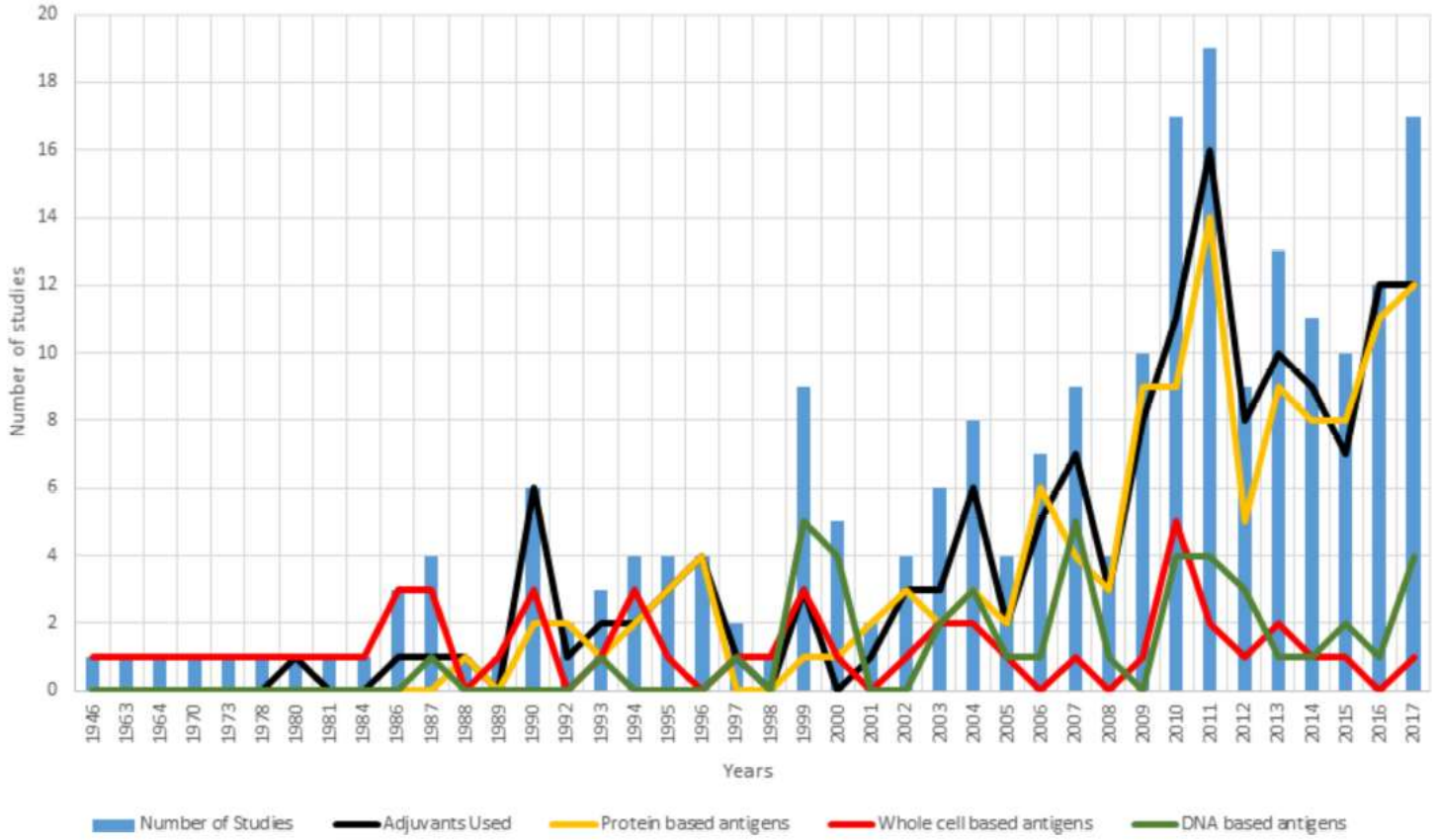


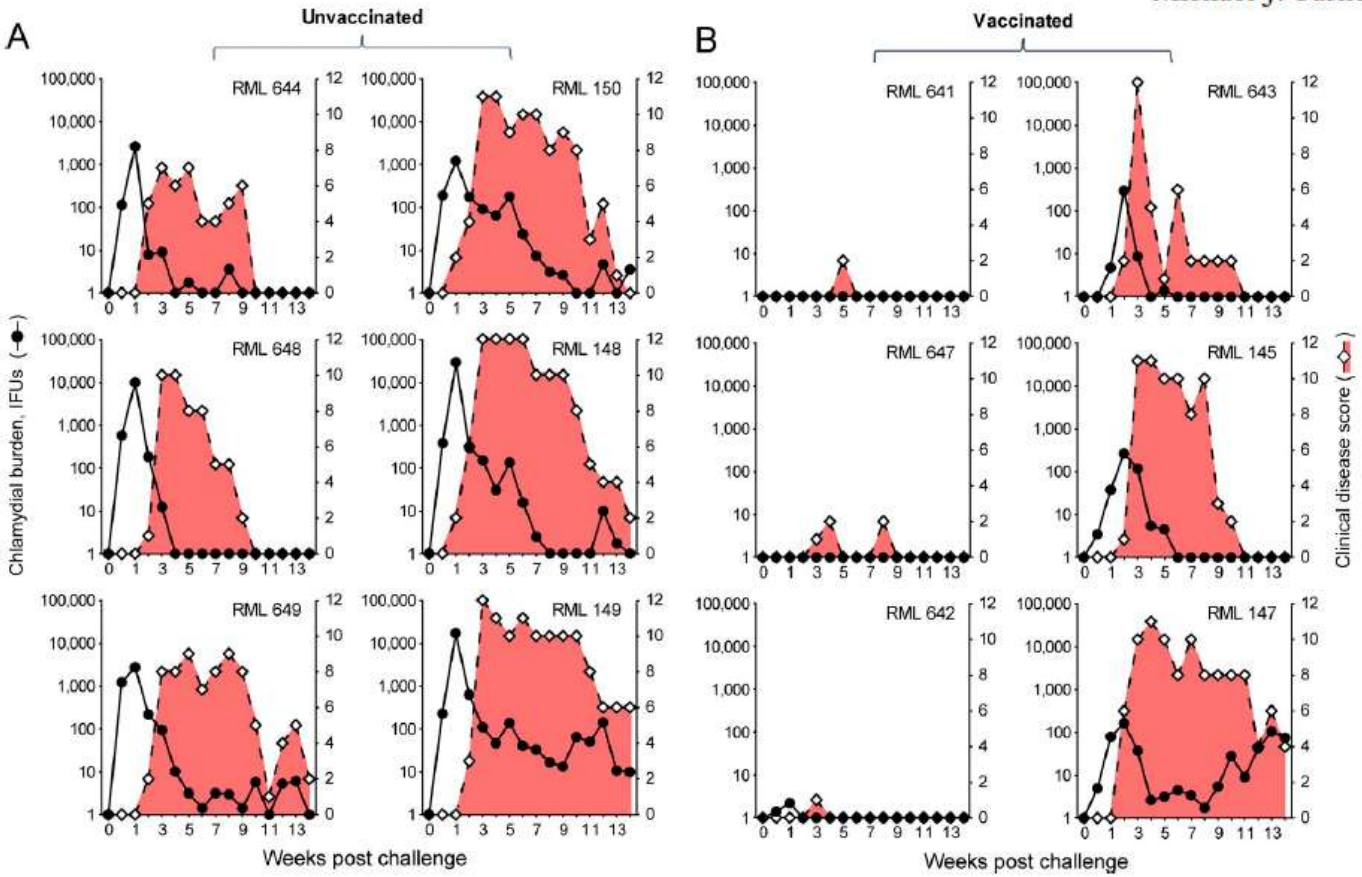
FIGURE 2 | Summary of vaccine formulations between 1946 and 2017. For each year examined, the blue bars represent the number of vaccine trials published that year. Overlayed on the trial numbers is a break down the vaccine formulation tested by inclusion of an adjuvant (black line) and the use of either a protein-based antigen (yellow line), a whole cell antigen (attenuated or in-active) (red line) or a DNA-based antigen (green line).

Vaccination par instillation
de la bactérie atténuée dans l'œil

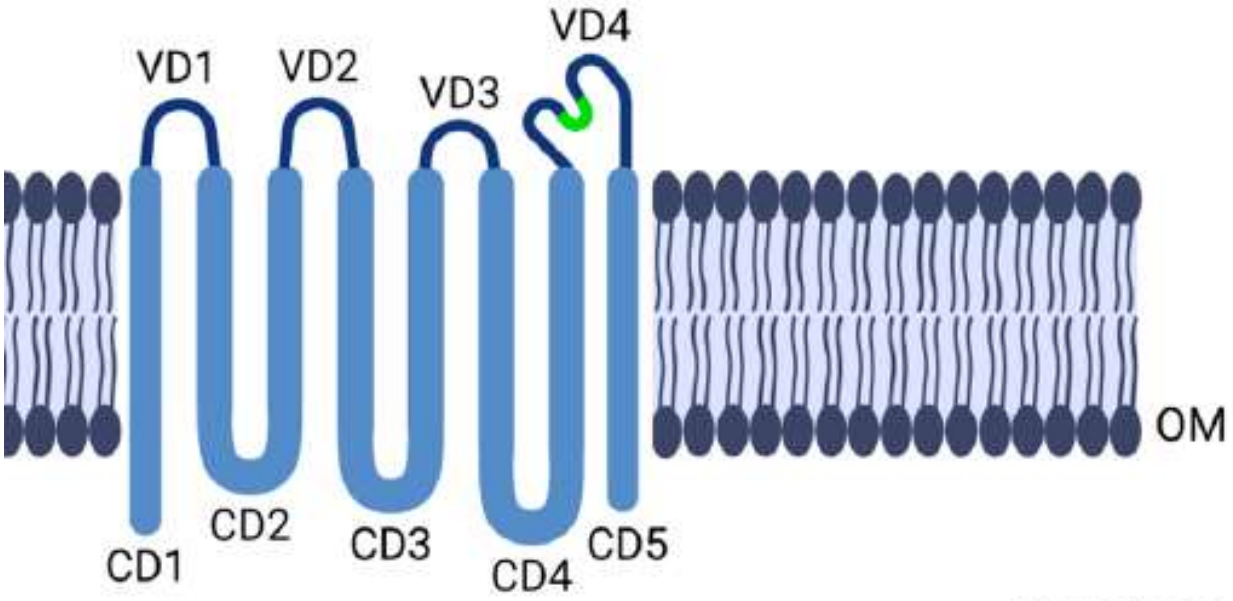
A live-attenuated chlamydial vaccine protects against trachoma in nonhuman primates

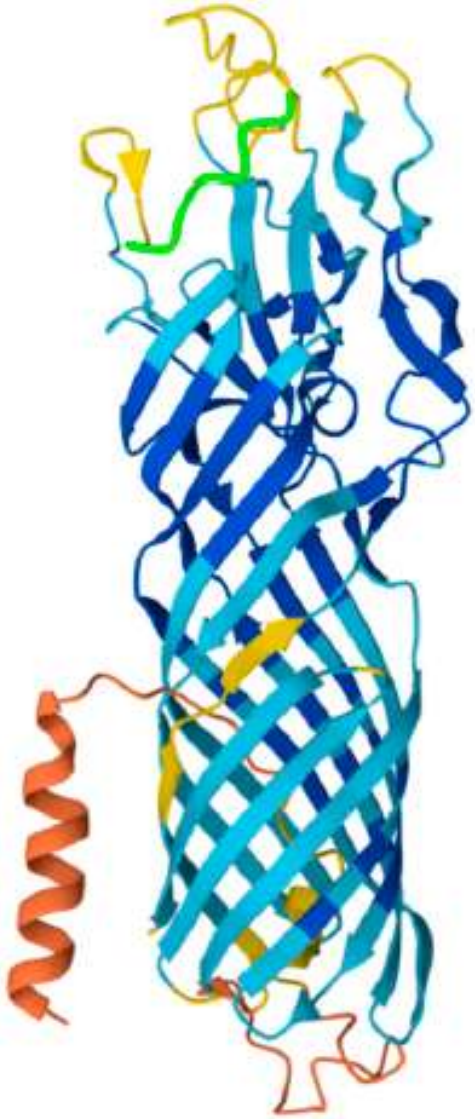
Laszlo Kari,[1] William M. Whitmire,[1] Norma Olivares-Zavaleta,[1]
Morgan M. Goheen,[1] Lacey D. Taylor,[1] John H. Carlson,[1]
Gail L. Sturdevant,[1] Chunxue Lu,[3] Lauren E. Bakios,[1] Linnell B. Randall,[1]
Michael J. Parnell,[2] Guangming Zhong,[3] and Harlan D. Caldwell[1]

2011



Major outer membrane protein

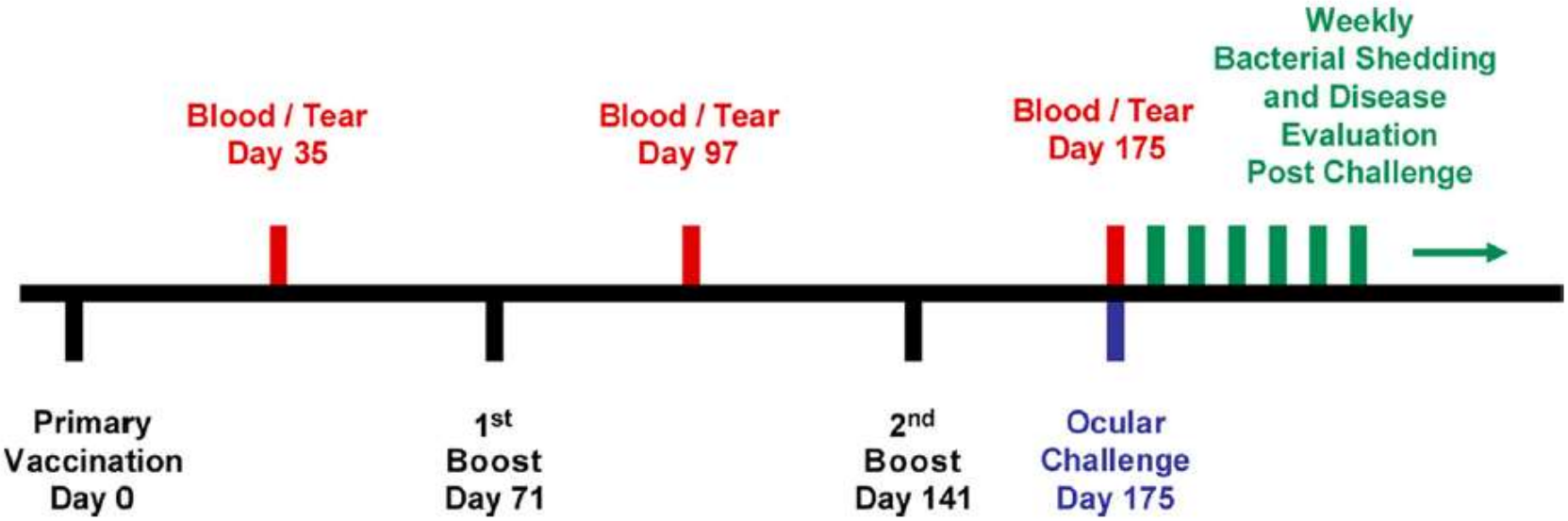




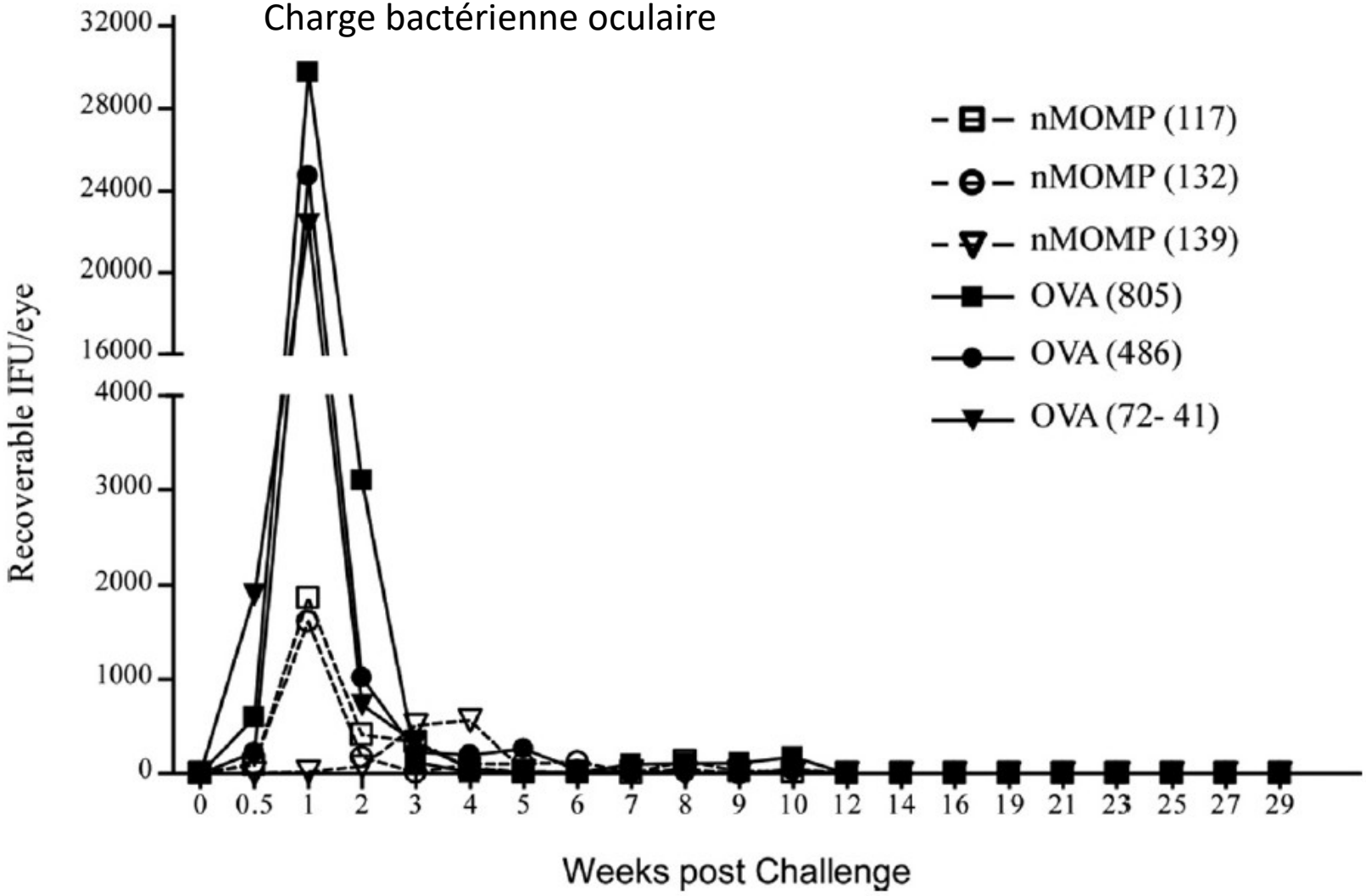
2008

Chlamydia trachomatis Native Major Outer Membrane Protein Induces Partial Protection in Nonhuman Primates: Implication for a Trachoma Transmission-Blocking Vaccine[1]

Laszlo Kari,* William M. Whitmire,* Deborah D. Crane,* Nathalie Reveneau,[2]* John H. Carlson,* Morgan M. Goheen,* Ellena M. Peterson,† Sukumar Pal,† Luis M. de la Maza,† and Harlan D. Caldwell[3]*



Charge bactérienne oculaire



The Journal of Infectious Diseases

Volume 212, Issue 6
15 September 2015

< Previous Next >

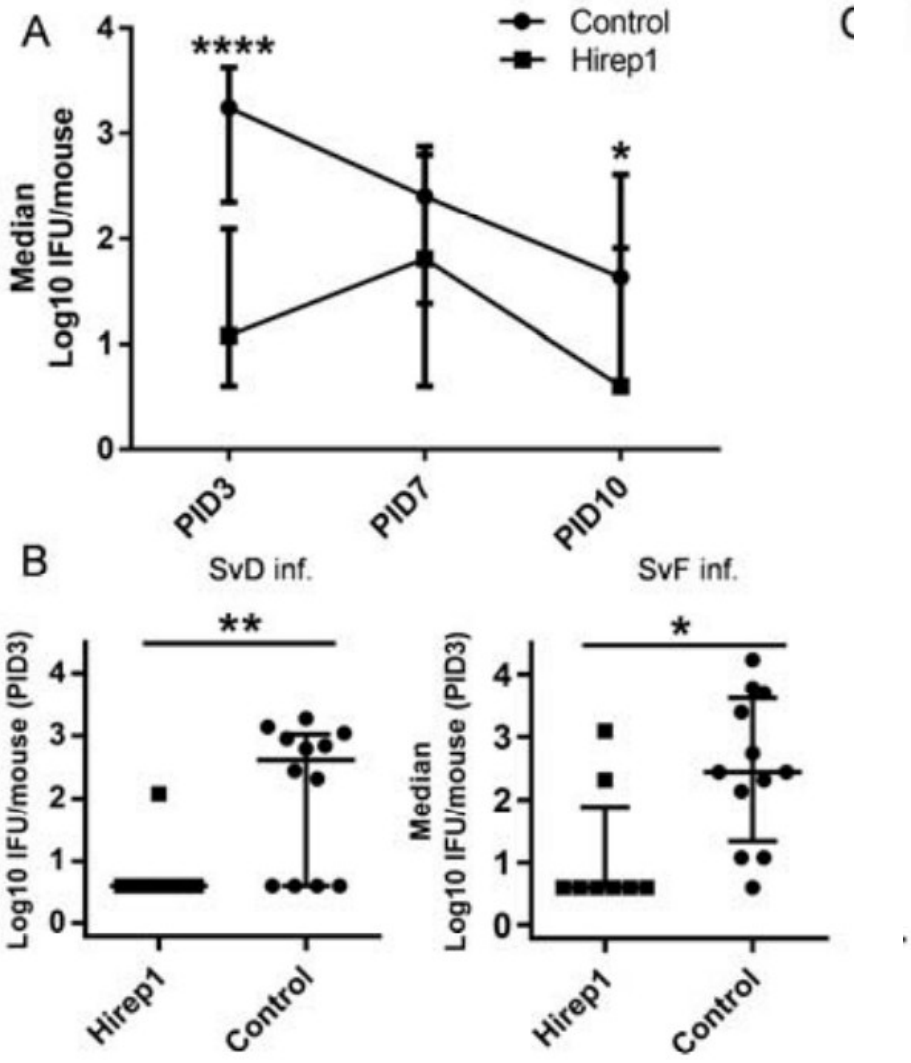
JOURNAL ARTICLE

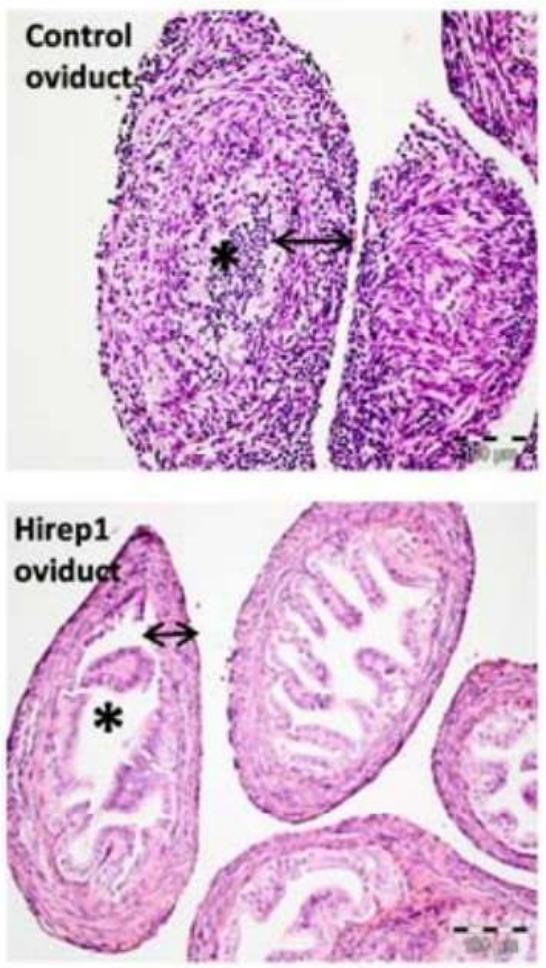
Protection Against *Chlamydia trachomatis* Infection and Upper Genital Tract Pathological Changes by Vaccine-Promoted Neutralizing Antibodies Directed to the VD4 of the Major Outer Membrane Protein

Anja W. Olsen ✉ , Frank Follmann , Karin Erneholm , Ida Rosenkrands , Peter Andersen

The Journal of Infectious Diseases, Volume 212, Issue 6, 15 September 2015, Pages 978–989, https://doi.org/10.1093/infdis/jiv137

Published: 06 March 2015 **Article history** ▾

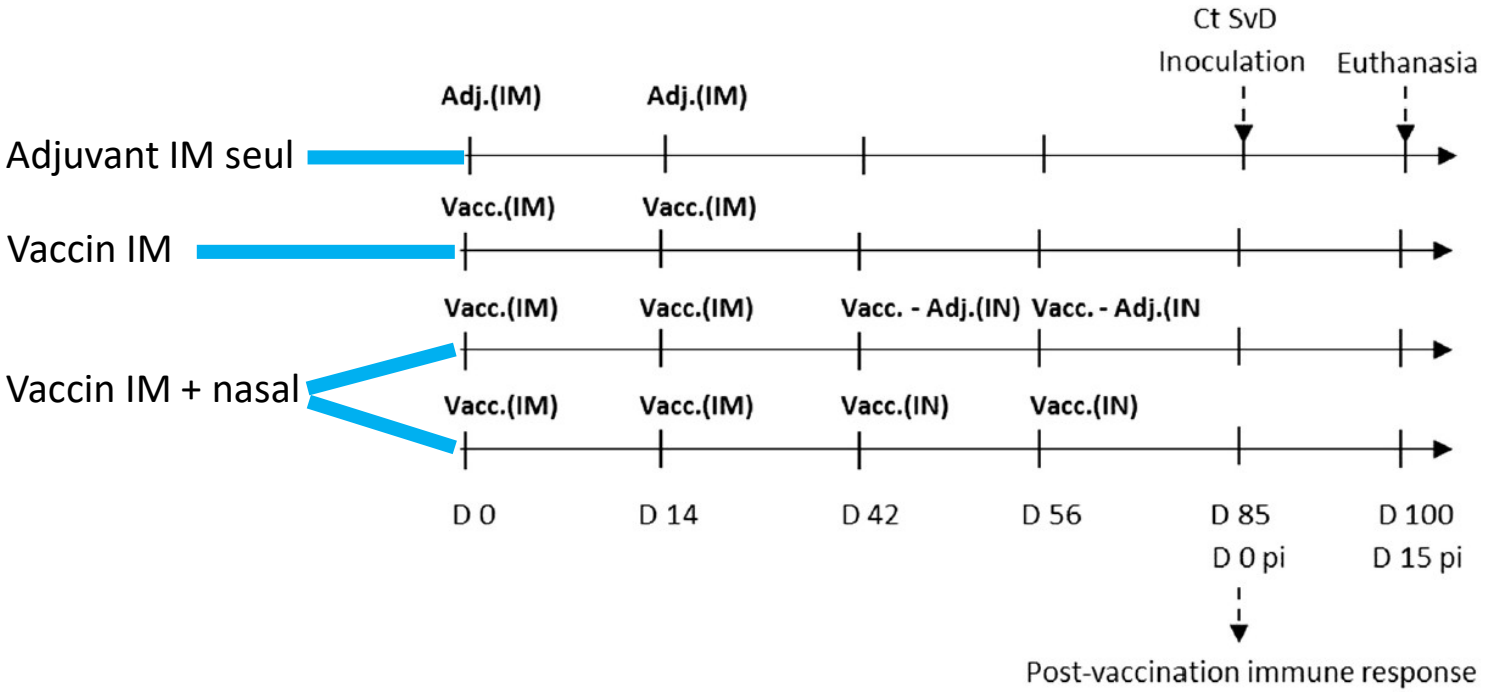




Hirep : construction protéique basée sur MOMP

Intramuscular Priming and Intranasal Boosting Induce Strong Genital Immunity Through Secretory IgA in Minipigs Infected with *Chlamydia trachomatis*

Emma Lorenzen[1,2], Frank Follmann[2], Sarah Bøje[1,2], Karin Erneholm[1,2], Anja Weinreich Olsen[2], Jørgen Steen Agerholm[1], Gregers Jungersen[3] and Peter Andersen[2]**



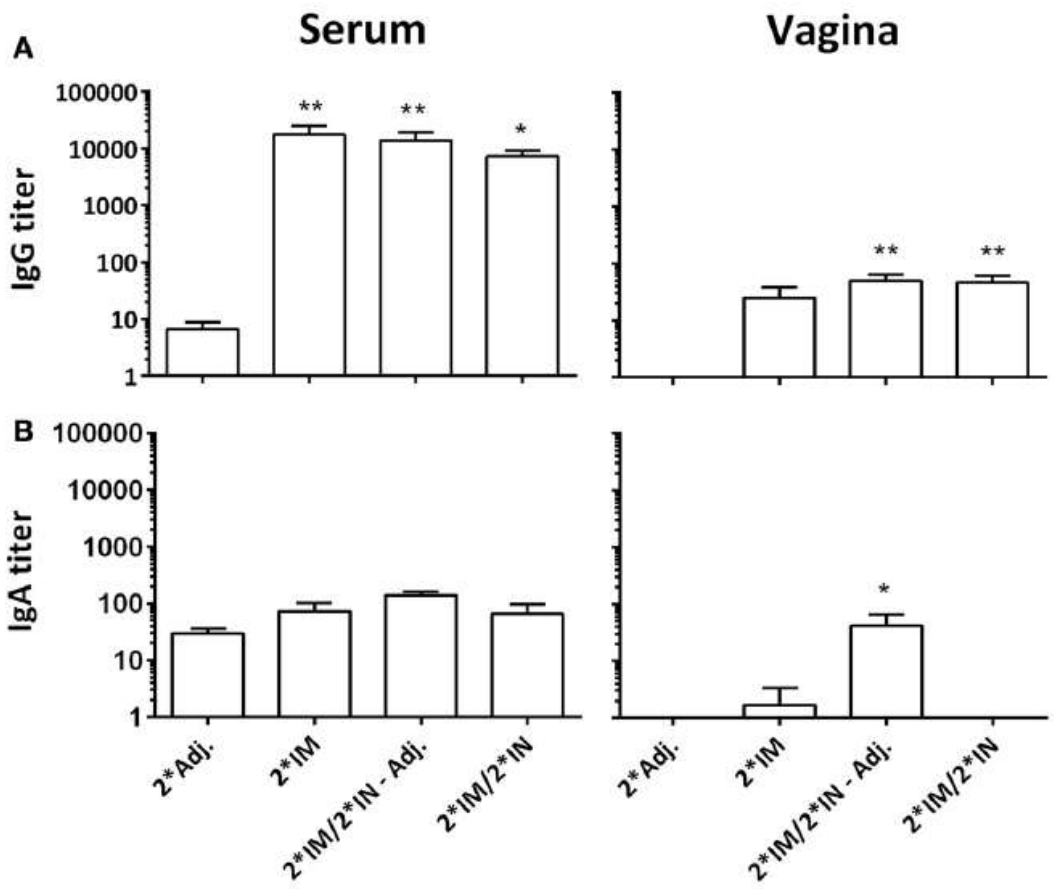
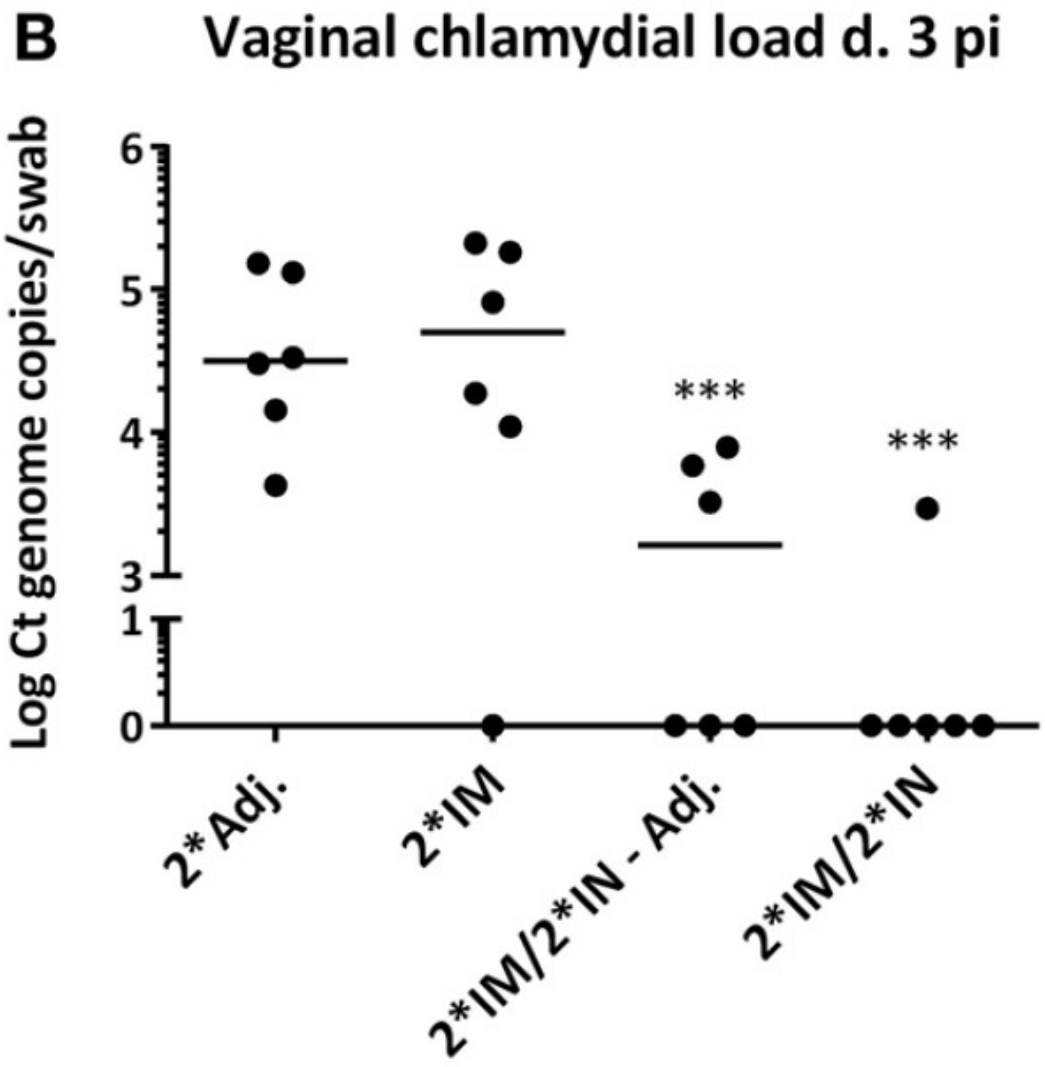


FIGURE 3 | Hirep1-specific antibody responses in serum and on the vaginal mucosa following the immunizations with Hirep1 and CTH93 as described in Figure 1. Serum and vaginal swabs from day 85 after the first immunization were assayed for antigen-specific IgG and IgA responses by ELISA. **(A)** Hirep1-specific IgG in serum and vagina. **(B)** Hirep1 specific IgA in serum and vagina. The response against CTH93 was almost identical and therefore not shown. Bars show mean ± SEM. Statistics: Dunn's multiple comparisons. Asterisks (*) indicate significance compared to the 2*Adj. group.


B
Vaginal chlamydial load d. 3 pi
Log Ct genome copies/swab
6
5
4
3
1
0
***
***
2*Adj.
2*IM
2*IM/2*IN - Adj.
2*IM/2*IN

2019

Safety and immunogenicity of the chlamydia vaccine candidate CTH522 adjuvanted with CAF01 liposomes or aluminium hydroxide: a first-in-human, randomised, double-blind, placebo-controlled, phase 1 trial

Sonya Abraham, Helene B Juel*, Peter Bang, Hannah M Cheeseman, Rebecca B Dohn, Tom Cole, Max P Kristiansen, Karen S Korsholm, David Lewis, Anja W Olsen, Leon R McFarlane, Suzanne Day, Sara Knudsen, Kjersti Moen, Morten Ruhwald, Ingrid Kromann, Peter Andersen, Robin J Shattock, Frank Follmann*

- 3 injections de 85 µg de vaccin (+ adjuvant) ou placebo
  - En IM
  - À 0, 1, et 4 mois
- Puis 2 administrations intranasales de 30 µg de vaccin (sans adjuvant) ou placebo
  - à 4·5 et 5 mois

Anticorps totaux (serum)

Anticorps neutralisants (serum)

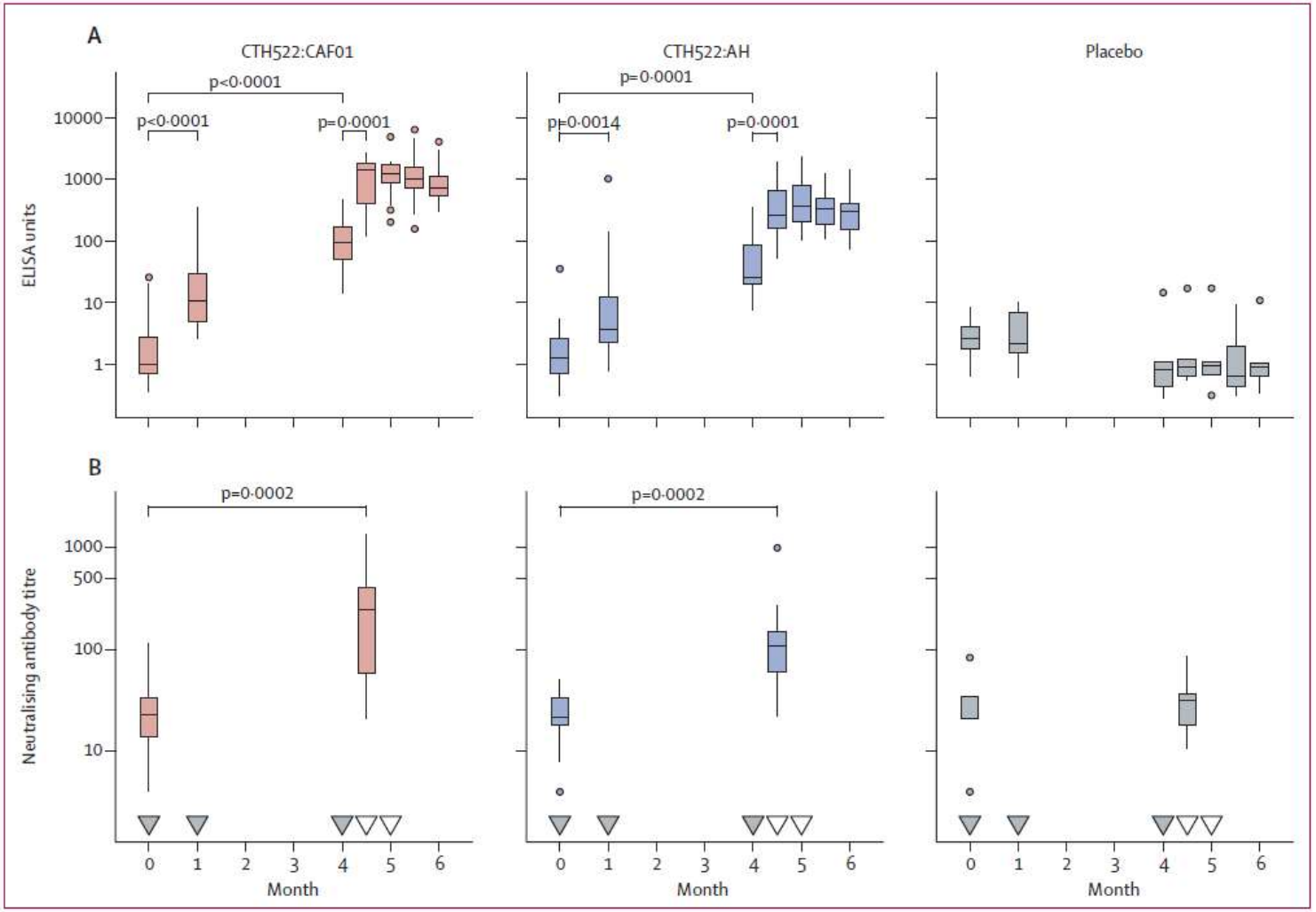
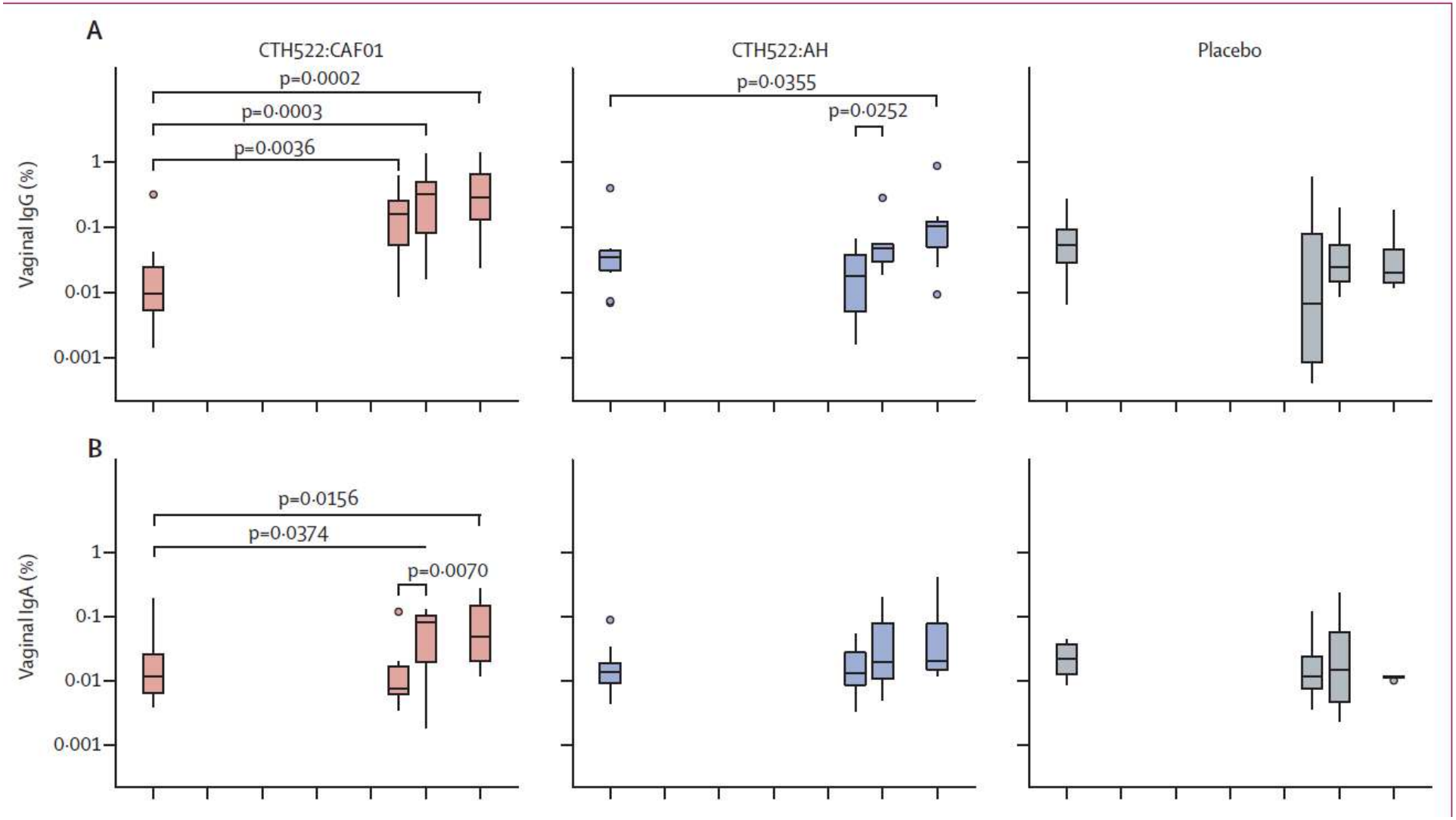


Figure 2: **Serology measurements**

Change in (A) anti-CTH522 serum IgG ELISA units and (B) neutralising antibody titres over time. The box illustrates the IQR, with a horizontal line at the median value; whiskers show 1·5 × IQR, and dots represent outliers. Wilcoxon signed rank test p values are shown. For serum IgG, the titres remained significantly higher than baseline for the duration of the study for both active vaccines, but for clarity only selected comparisons are indicated. The vaccine schedule is shown above the x-axis, with grey triangles indicating intramuscular immunisations, and white triangles indicating intranasal immunisation. AH=aluminium hydroxide.

IgG (vagin)

IgA (vagin)



Réponse lymphocytaire T
dans le sang

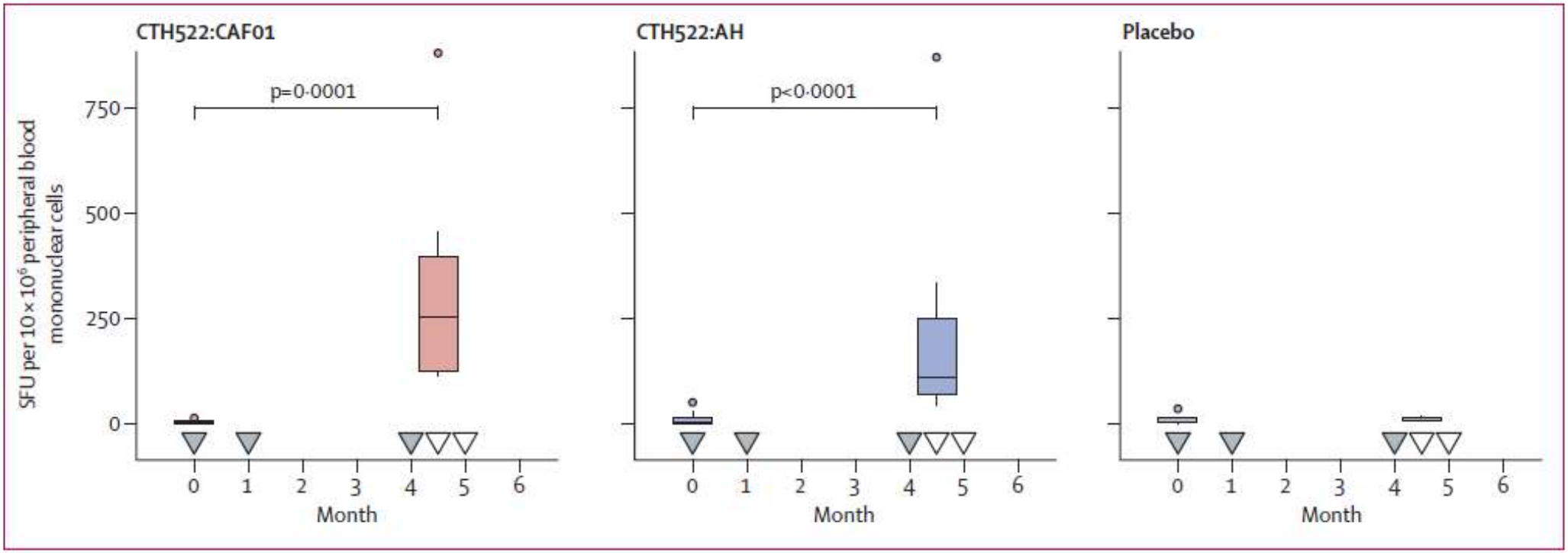


Figure 4: Cell-mediated immune responses

An investigation of trachoma vaccine regimens by the chlamydia vaccine CTH522 administered with cationic liposomes in healthy adults (CHLM-02): a phase 1, double-blind trial

Katrina M Pollock, Álvaro H Borges*, Hannah M Cheeseman, Ida Rosenkrands, Kirstine L Schmidt, Rie E Søndergaard, Suzanne Day, Abbey Evans, Leon R McFarlane, Jennifer Joypooranachandran, Fahimah Amini, Per Skallerup, Rebecca B Dohn, Charlotte G Jensen, Anja W Olsen, Peter Bang, Tom Cole, Joanna Schronce, Nana-Marie Lemm, Max P Kristiansen, Peter L Andersen, Jes Dietrich, Robin J Shattock, Frank Follmann*

Différents groupes avec administration IM et/ou intra-oculaire du vaccin

Anticorps dans le serum

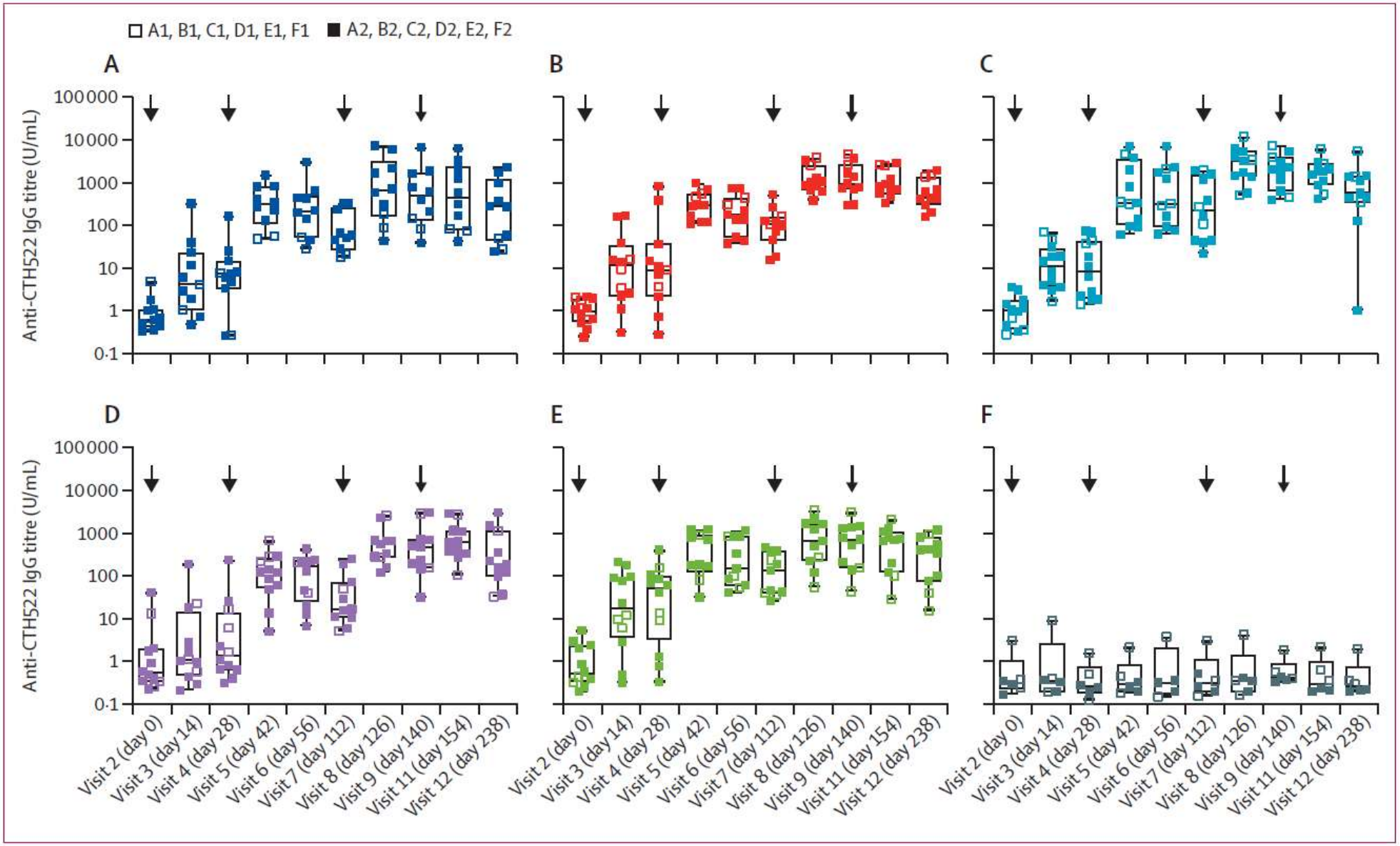


Figure 2: Median (IQR) anti-CTH522 serum IgG titre (intention to treat)

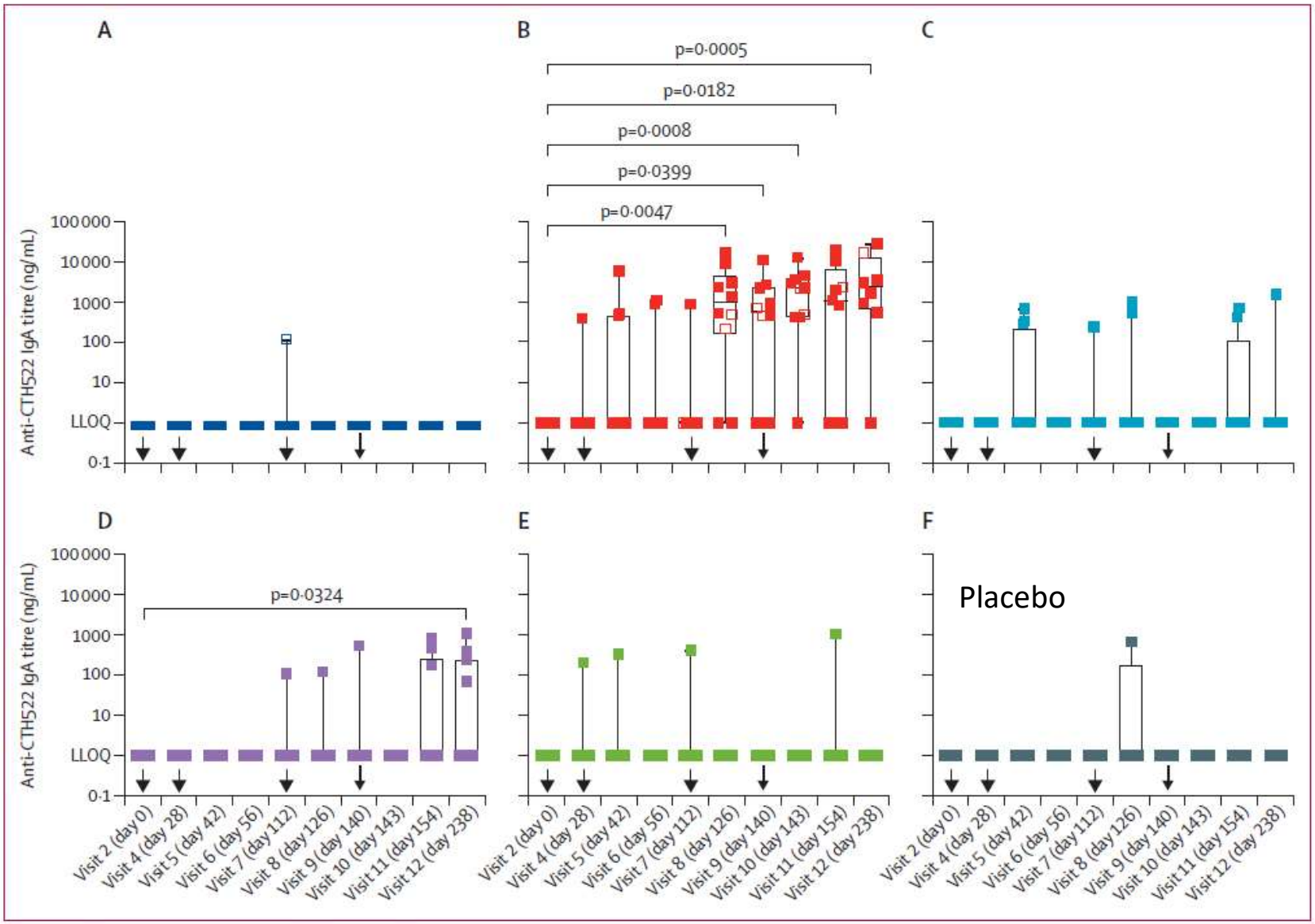


Figure 3: CHLM-02 trial: total ocular IgA (intention to treat)

Anticorps IgA dans les larmes

B :
IM J0
IM + IO J28
IM+ IO J112
IO J 140

Press Release

Chlamydia vaccine candidate granted fast track designation by the US FDA

- Chlamydia infection can contribute to pelvic inflammatory diseases in women, which can lead to pregnancy complications or infertility
- A phase 1/2 clinical study evaluating the immunogenicity and safety of the vaccine candidate is due to start in coming days

Paris, March 26, 2025. The US Food and Drug Administration has granted fast track designation to Sanofi's mRNA vaccine candidate for the prevention of chlamydia infection. The decision was based on the potential of the vaccine candidate to address a serious condition and address an unmet public health need.

The chlamydia vaccine candidate has been designed to protect against primary genital tract infection and reinfection by the bacterium *Chlamydia trachomatis*. Following a promising pre-clinical program, Sanofi is planning a phase 1/2 randomized, clinical study designed to evaluate the immunogenicity and safety of the chlamydia vaccine candidate in adults aged 18 to 29 years. The study is due to start in coming days.

Recruiting

Phase 1/2 Study of Chlamydia Trachomatis mRNA Vaccine in Adults Aged 18 to 29 Years

ClinicalTrials.gov ID NCT06891417

Sponsor Sanofi

Information provided by Sanofi (Responsible Party)

Last Update Posted 2025-03-30

Clinical Trials in Brisbane North and Moreton Bay

Research Studies » Potential new vaccine for preventing chlamydia infection

Potential new vaccine for preventing chlamydia infection

If you are aged 18 to 29 years, are in good general health and don't currently have chlamydia, you may be eligible to participate in the trial of an investigational chlamydia vaccine.

Application for Current Clinical Research Study

Research Study

Potential new vaccine for preventing chlamydia infection

Please enter your Full Legal Name

*First Name

*Last Name

Country

Australia

*Phone

vaccines

MDPI

Article

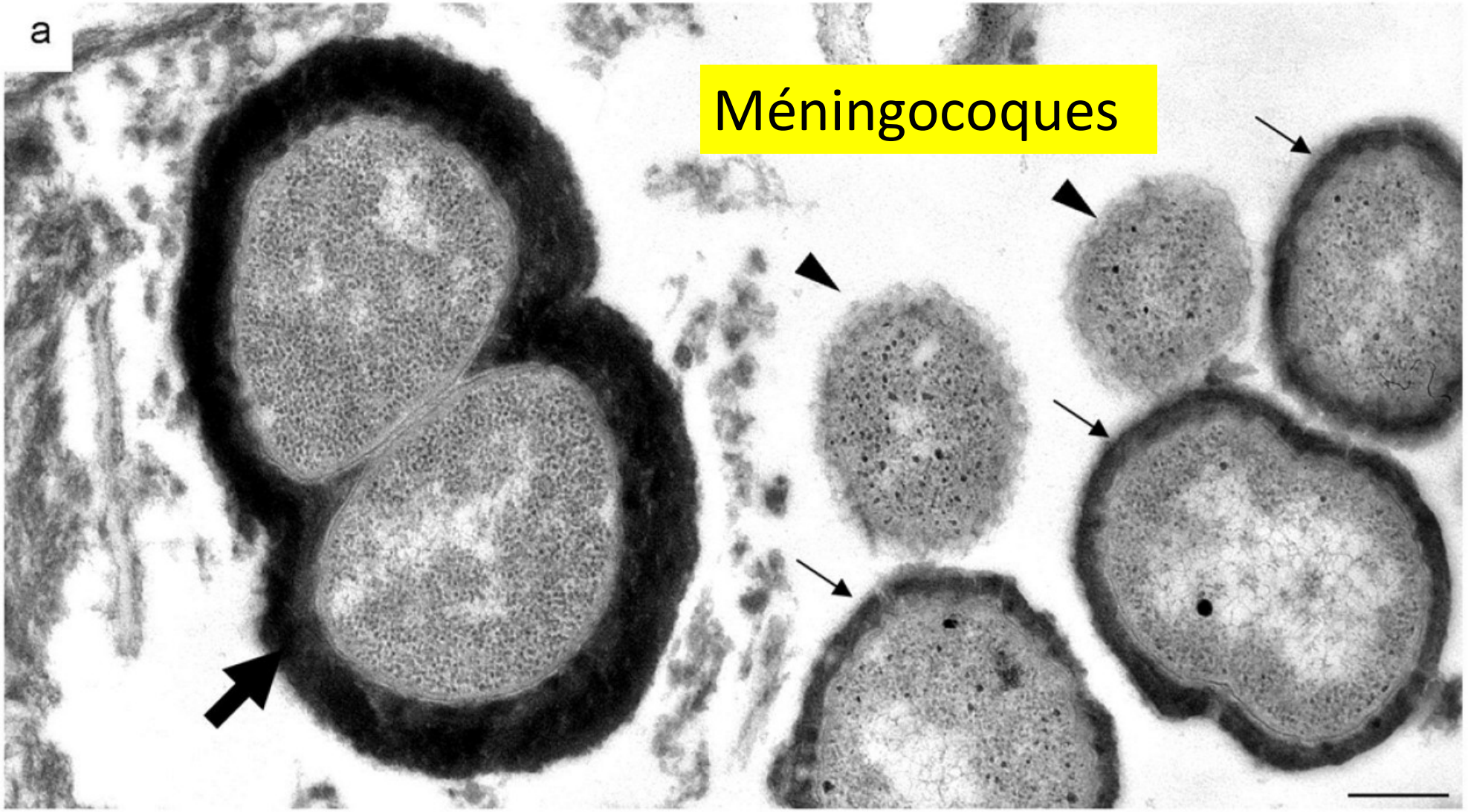
mRNA Galsomes Vaccine Protects Budgerigars Against Virulent *Chlamydia psittaci* Challenge

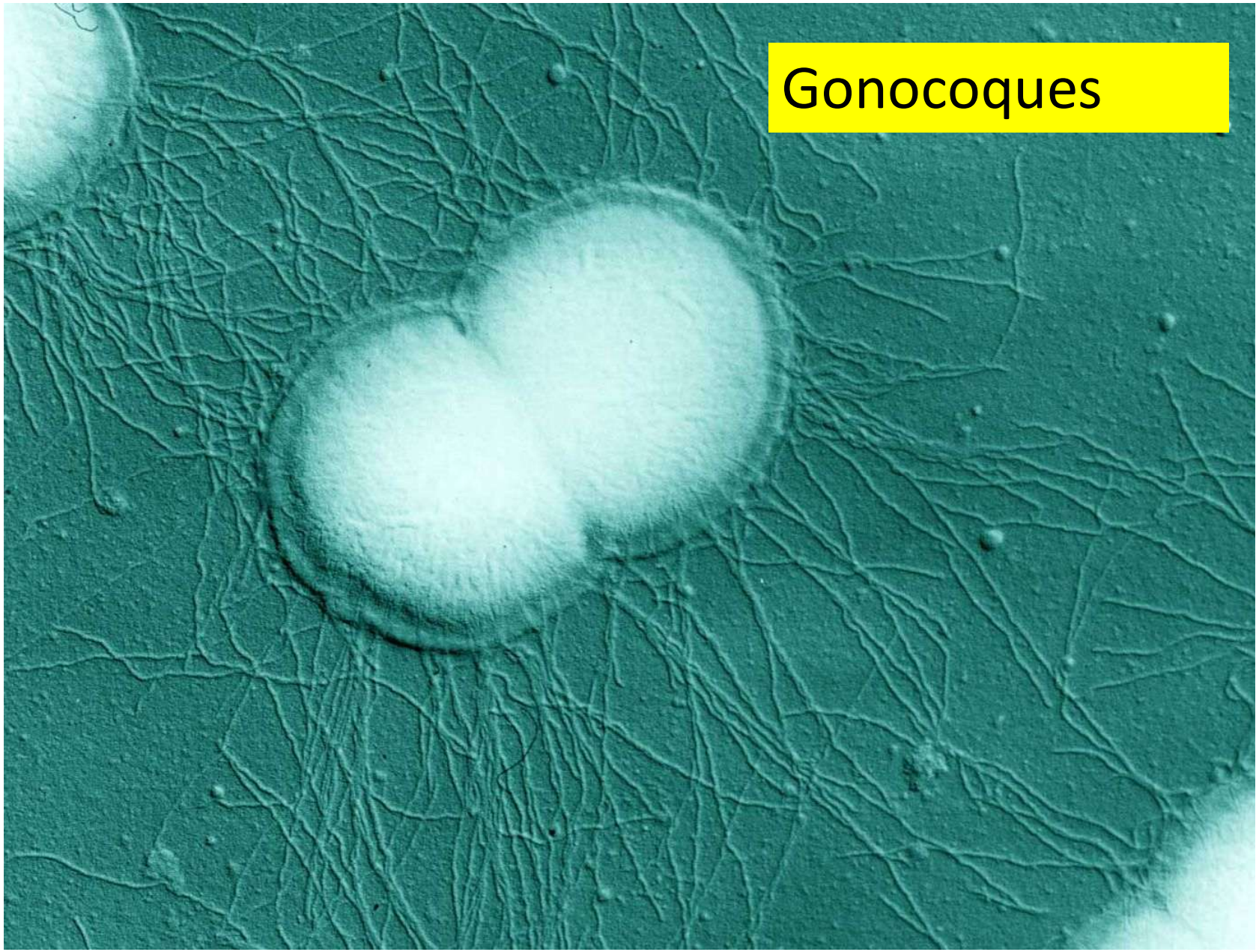
Anne De Meyst [1], Joeri Van Mieghem [1], Koen Chiers [2], Koen Raemdonck [3], Rein Verbeke [3], Ine Lentacker [3] and Daisy Vanrompay [1,*]

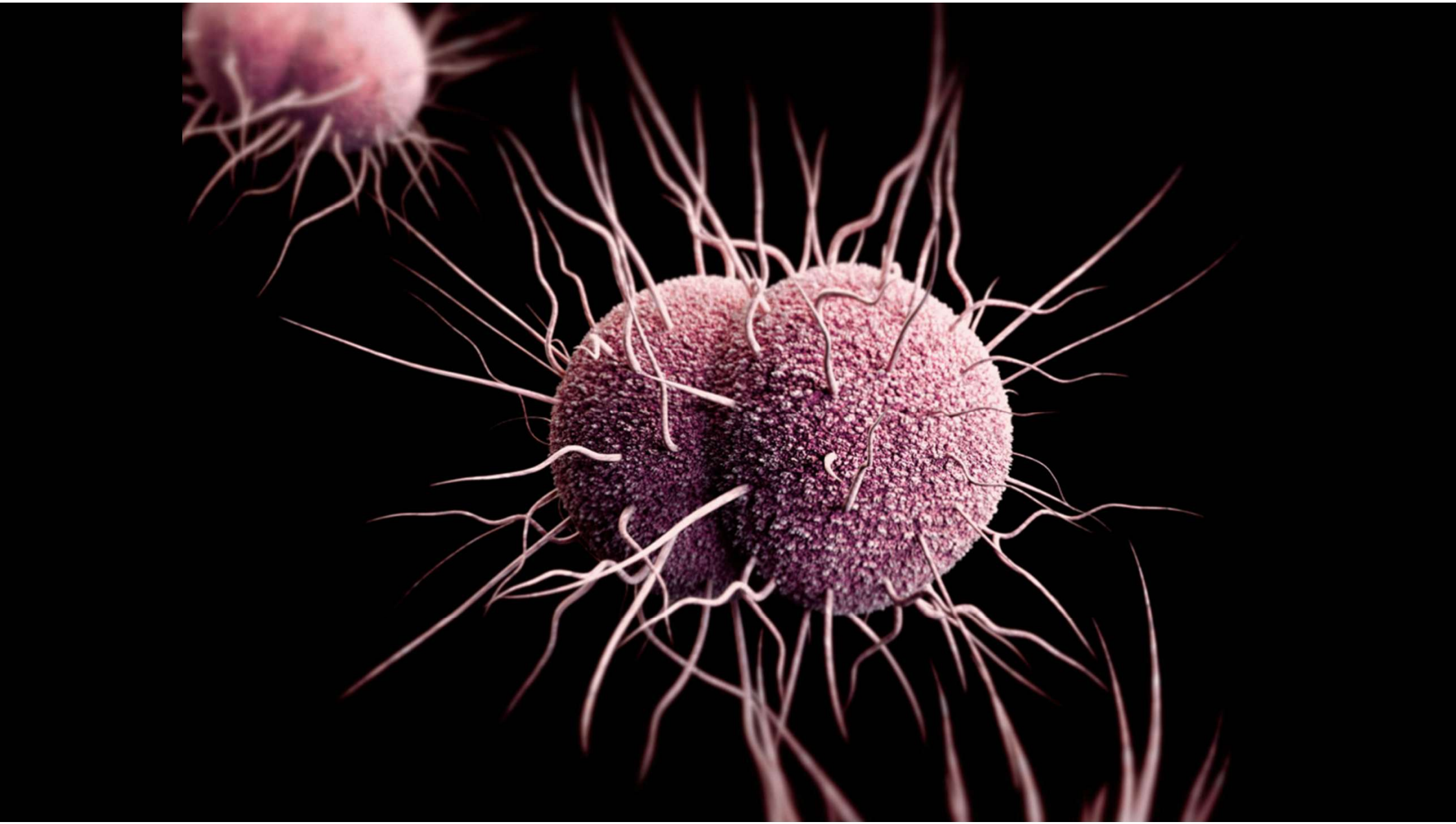
1 Department of Animal Sciences and Aquatic Ecology, Faculty of Bioscience Engineering, Ghent University, 9000 Ghent, Belgium; anne.demeyst@ugent.be (A.D.M.); jvanmieghem@3-14.com (J.V.M.)
2 Department of Pathobiology, Pharmacology and Zoological Medicine, Faculty of Veterinary Medicine, Ghent University, 9820 Merelbeke, Belgium; koen.chiers@ugent.be
3 Ghent Research Group on Nanomedicines, Department of Pharmaceutics, Faculty of Pharmaceutical Sciences, Ghent University, 9000 Ghent, Belgium; koen.raemdonck@ugent.be (K.R.); rein.verbeke@ugent.be (R.V.); ine.lentacker@ugent.be (I.L.)
* Correspondence: daisy.vanrompay@ugent.be

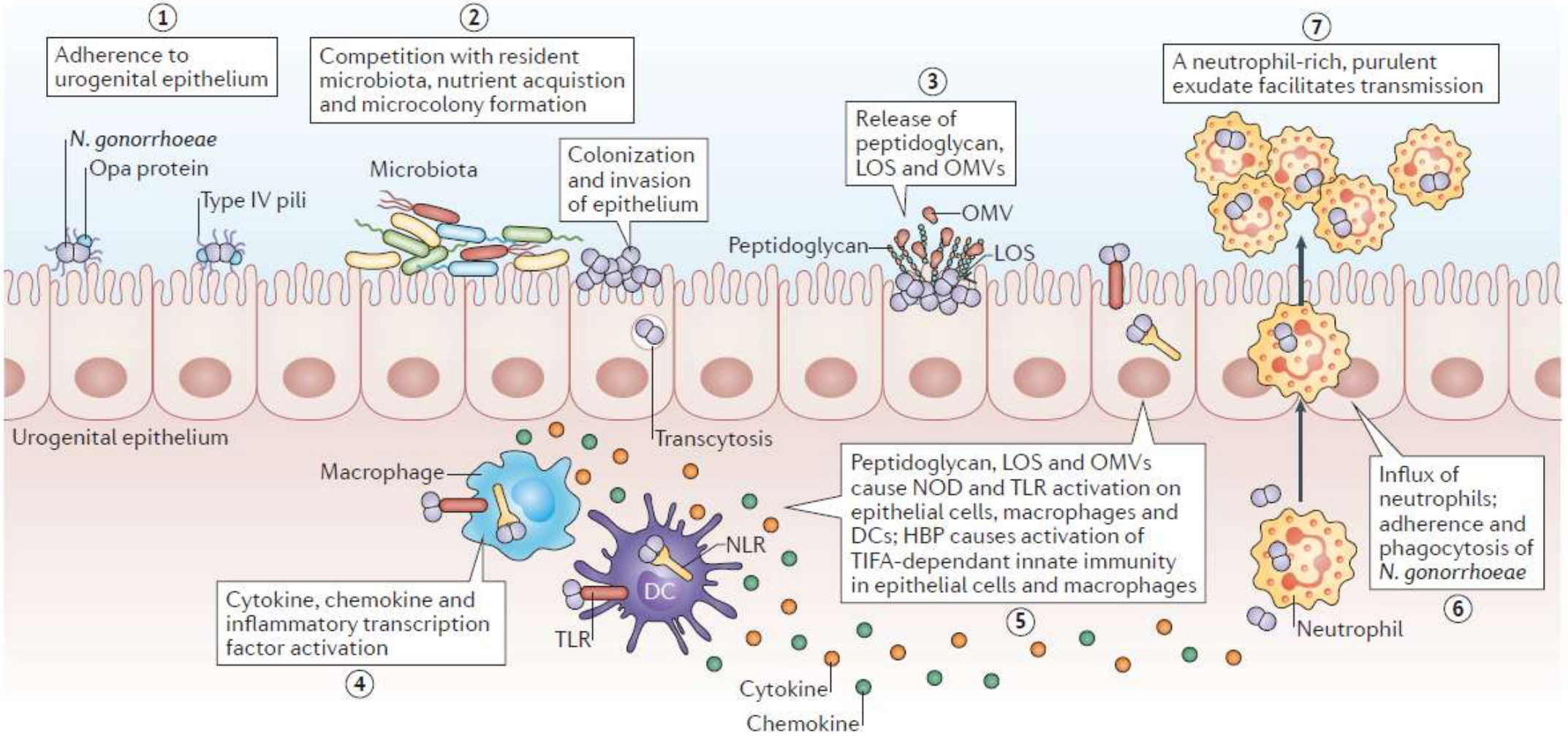
Vaccin : ARNm de la MOMP

Gonocoque


a
Méningocoques


Gonocoques




1
Adherence to urogenital epithelium
2
Competition with resident microbiota, nutrient acquistion and microcolony formation
3
Release of peptidoglycan, LOS and OMVs
7
A neutrophil-rich, purulent exudate facilitates transmission
N. gonorrhoeae
Opa protein
Type IV pili
Microbiota
Colonization and invasion of epithelium
OMV
Peptidoglycan
LOS
Urogenital epithelium
Transcytosis
Macrophage
NLR
DC
TLR
Cytokine, chemokine and inflammatory transcription factor activation
4
Peptidoglycan, LOS and OMVs cause NOD and TLR activation on epithelial cells, macrophages and DCs; HBP causes activation of TIFA-dependant innate immunity in epithelial cells and macrophages
5
Influx of neutrophils; adherence and phagocytosis of N. gonorrhoeae
6
Neutrophil
Cytokine
Chemokine

Clinical Microbiology Reviews
AMERICAN SOCIETY FOR MICROBIOLOGY
Bacteriology | Review

Neisseria gonorrhoeae vaccines: a contemporary overview

Eloise Williams,[1,2] Kate L. Seib,[3] Christopher K. Fairley,[4,5] Georgina L. Pollock,[1] Jane S. Hocking,[6] James S. McCarthy,[1,7,8] Deborah A. Williamson[1,2,7]

Gene	Protein/ antigen name	Function	Location	Conservation[a]	Immunogenicity	Data
opcA	OpcA	Adhesion and invasion of host epithelial and endothelial cells	Outer membrane	Antigenically variable	Antibodies elicited by *N. meningitidis* homologs are bactericidal	Preclinical
ompA	Outer membrane protein A (OmpA)	Adhesion and invasion of host epithelial and endothelial cells	Outer membrane	Highly conserved	No data	Preclinical
nhba	*Neisseria* heparin binding antigen (NHBA)	Involved in adherence to epithelial cells and serum survival	Outer membrane	Highly conserved	Antibodies are bactericidal, opsonophagocytotic, and block gonococcal adherence to epithelial cells	Preclinica
Nutrient acquisition and metabolism						
Iron metabolism						
tbpA	Transferrin-binding protein A (TbpA)	Essential receptor for iron uptake from transferrin	Outer membrane	Highly conserved	Antibodies are bactericidal	Preclinical and controlled human challenge studies
tbpB	Transferrin-binding protein B (TbpB)	Increases efficiency of iron uptake from transferrin	Outer membrane	Antigenically variable with conserved segments	Antibodies are bactericidal	Preclinical and controlled human challenge studies
lbpA	Lactoferrin-binding protein A (LbpA)	Essential receptor for iron uptake from lactoferrin	Outer membrane	Highly conserved. Present in approximately half of the isolates.	Antibodies elicited by *N. meningitidis* homologs are bactericidal but cross-reactivity (in *N. meningitidis*) is limited	Preclinical and controlled human challenge studies
lbpB	Lactoferrin-binding protein B (LbpB)	Increases the efficiency of iron transport from lactoferrin	Outer membrane	Antigenically variable with conserved segments. Phase variable. Present in approximately half of the isolates	Antibodies elicited by *N. meningitidis* homologs are bactericidal but cross-reactivity (in *N. meningitidis*) is limited	Preclinical and controlled human challenge studies
fetA	Ferric entero-bactin transporter A (FetA)	Involved in iron uptake through scavenging siderophores from other bacteria *via* binding and transport of ferric enterobactin	Outer membrane	Antigenically variable. Phase variable	Antibodies elicited by *N. meningitidis* homologs are bactericidal but cross-reactivity (in *N. meningitidis*) is limited	Preclinical

Efficacy trial of a parenteral gonococcal pilus vaccine in men

1991

John W. Boslego*, Edmund C. Tramont*‡, Raymond C. Chung*, Daniel G. McChesney*, Jennie Ciak*, Jerald C. Sadoff*, Myron V. Piziak*, Joel D. Brown*, Charles C. Brinton, Jr†, Sarah W. Wood† and James R. Bryan†

3123 volontaires recevant le vaccin ou le placebo

Table 3 Rates of infection by week after entry into study

Week	Vaccine		Placebo		
	Number of infections	Rate[a]	Number of infections	Rate[a]	P^b
0–2	23	15.4	21	14.1	n.s.
2–4	36	24.8	19	13.0	0.021[b]
4–6	29	20.5	32	22.6	n.s.
6–8	20	16.3	27	21.9	n.s.

[a]Number of volunteers infected/1000 volunteers at risk/2 weeks
[b]p = Fisher's exact test
n.s. = not significant

TABLE 1 Historical *Neisseria gonorrhoeae* vaccine trials in humans[a]

Clinical trial design	Vaccine	Immunization schedule	Study population	Result
Randomized double-blind placebo-controlled trial	Inactivated whole-cell vaccine prepared from three strains of *N. gonorrhoeae*	1 mL dose of intramuscular immunization 3 times at 1-week interval	62 participants were recruited from an indigenous population of Inuit in northern Canada (background yearly *N. gonorrhoeae* infection incidence of 25%)	Cumulative infection rate of 30% in immunized participants compared to 24% in placebo in the 12-month follow-up period following immunization (ns)
Randomized double-blind placebo-controlled trial	Single-antigen pilus protein vaccine prepared from a single strain of *N. gonorrhoeae*	0.1 mL dose of intradermal immunization 2 times at 2-week interval	3,250 US military personnel stationed in Korea (96% men; 39% with the self-reported history of prior *N. gonorrhoeae* infection)	The cumulative infection rate of 6.9% in immunized participants compared to 6.5% in placebo in an 8-week follow-up period following immunization (ns)
Placebo-controlled human challenge trial	Outer membranes vaccine prepared from a single strain of *N. gonorrhoeae*	Participants were vaccinated (dosing schedule not available) and then inoculated with homologous *N. gonorrhoeae* strain per urethra 2–4 weeks later	63 male participants	Post-challenge infection rate of 54% in immunized participants compared to 64% in placebo (ns)

[a]ns, not significant; US, United States.

Williams 2024

Le vaccin méningocoque B à 4 composants (4CMenB)

- Peptide ***Neisserial heparin-binding antigen*** **NHBA** de *Neisseria meningitidis* groupe B
- Protéine recombinante **Neisseria *adhesin A*** **NadA** de *Neisseria meningitidis* groupe B
- Protéine ***facteur H binding protein*** **fHbp** de *Neisseria meningitidis* groupe B
- Vésicules de membrane externe (OMV) de *Neisseria meningitidis* groupe B (contenant entre autres protéines **PorA**).

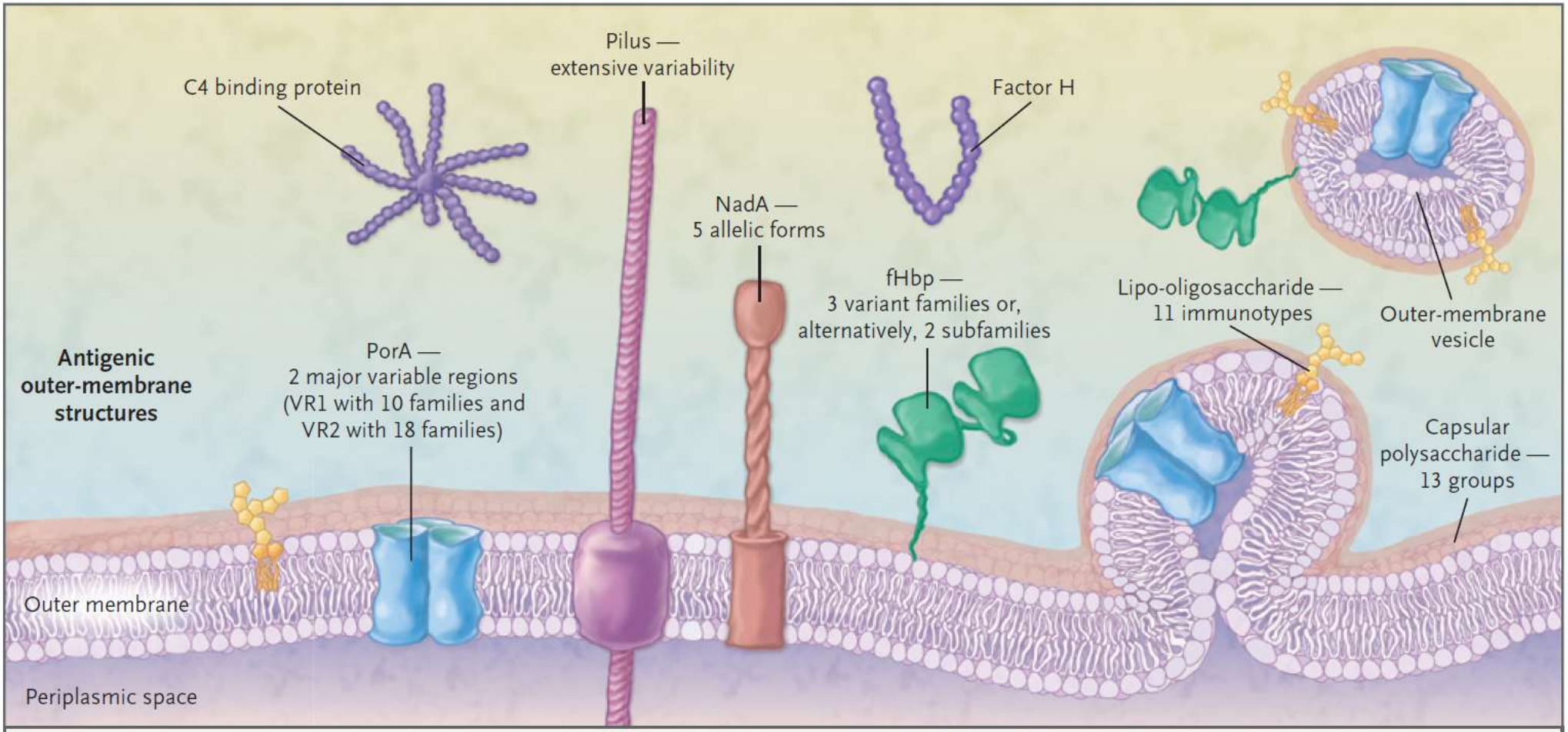


Figure 1. Structure of Meningococcal Outer Membrane, Showing Variability of Outer-Membrane Proteins and Capsule Used in Vaccines and Interaction with Complement.

Tan 2010

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RESEARCH ARTICLE
Host-Microbe Biology

2019

Genetic Similarity of Gonococcal Homologs to Meningococcal Outer Membrane Proteins of Serogroup B Vaccine

Henju Marjuki,[a] Nadav Topaz,[a] Sandeep J. Joseph,[b] Kim M. Gernert,[c] Ellen N. Kersh,[c] Antimicrobial-Resistant *Neisseria gonorrhoeae* Working Group, Xin Wang[a]

TABLE 1 Sequence analysis and subcellular localization of MenB-4C vaccine antigens[a]

		NmB strains ($n = 4$)		*N. gonorrhoeae* strains ($n = 970$)	
Vaccine antigen	NEIS no.	No. of isolates with full-length protein	Predicted OMP	No. of isolates with full-length protein	Predicted OMP
FHbp	NEIS0349	4	+	970	–
NhbA	NEIS2109	4	+	970	+
NadA	NEIS1969	2	+	0	NA
OMV (PorA)	NEIS1364	4	+	0	NA
GNA2091	NEIS2071	4	+	970	+/–
GNA1030	NEIS1183	4	+	970	+

[a]Cellular localization and signal peptide predictions were determined using the *in silico* tools BUSCA, Cello2GO, PSORTdb, and SignalP. OMP, outer membrane protein; +, predicted as OMP by at least 2 tools; –, not predicted as OMP by any of the tools; +/–, predicted as OMP by 1 tool; NA, not applicable due to the absence of an ORF.

Vaccine 56 (2025) 127180

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

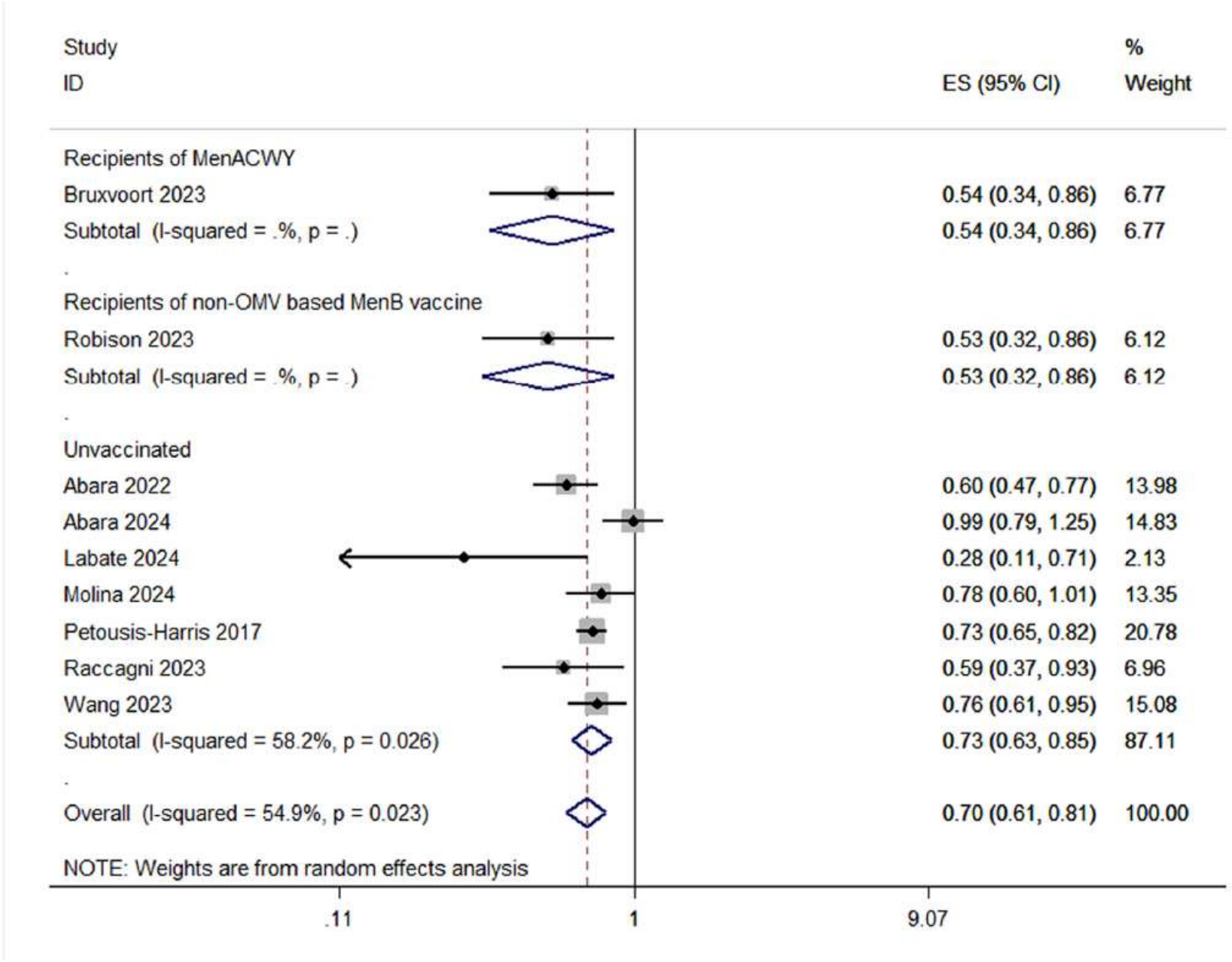
Review

Cross-protection of meningococcal B vaccines against gonorrhea: A systematic review and Meta-analysis

Nikolaos Georgiadis [a], Andreas Katsimpris [b], Georgina Tzanakaki [a], Sotirios Tsiodras [c], Apostolos Beloukas [a,d,e], Tonia Vassilakou [a,1], Theodoros N. Sergentanis [a,*,1]

[a] Department of Public Health Policy, School of Public Health, University of West Attica, Athens, Greece
[b] Princess Alexandra Eye Pavilion, Edinburgh, Scotland, UK
[c] 4th Department of Internal Medicine, Medical School, University General Hospital Attikon, National and Kapodistrian University of Athens, 12462 Athens, Greece
[d] Department of Biomedical Sciences, University of West Attica, Athens, Greece
[e] National AIDS Reference Centre of Southern Greece, School of Public Health, University of West Attica, Athens, Greece

Efficacité sur le gonocoque : 30%



2021

The Journal of Infectious Diseases

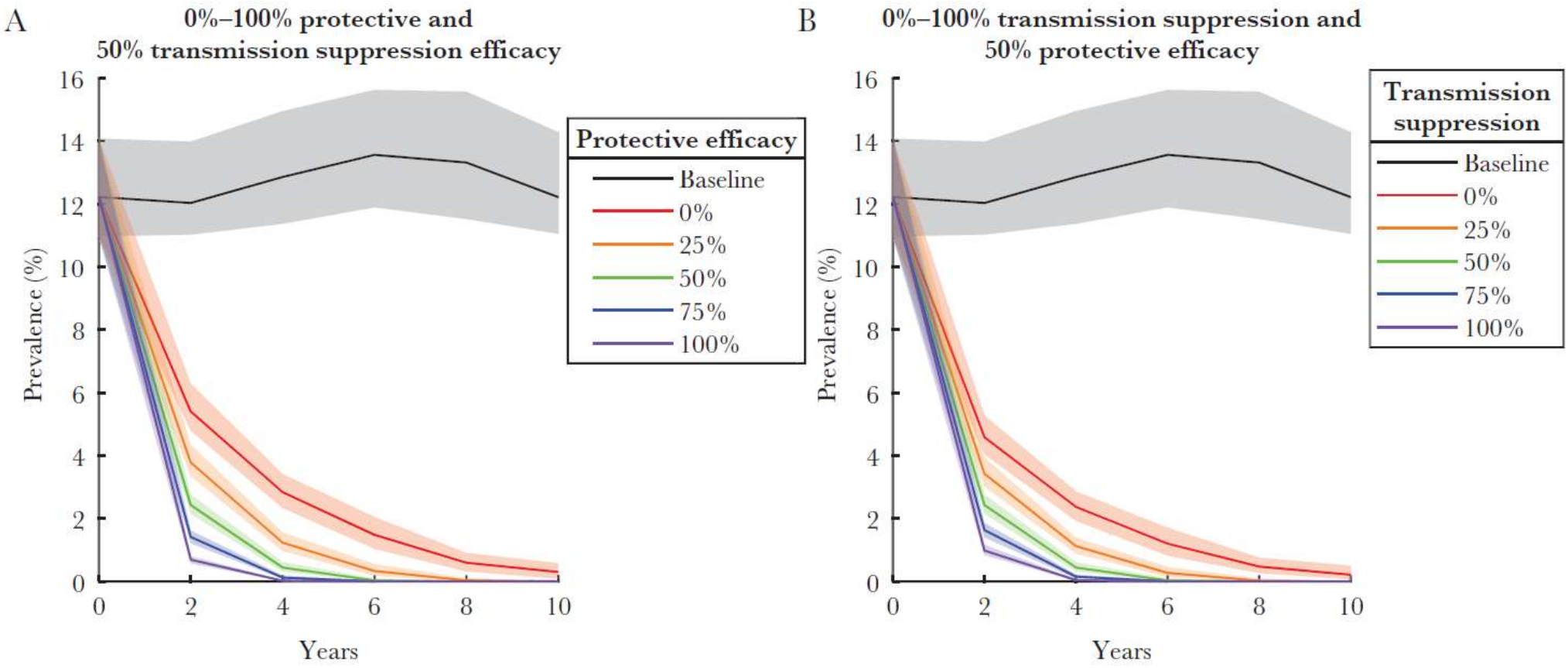
MAJOR ARTICLE

A Gonococcal Vaccine Has the Potential to Rapidly Reduce the Incidence of *Neisseria gonorrhoeae* Infection Among Urban Men Who Have Sex With Men

Ben B. Hui,[1,a] Thilini N. Padeniya,[1] Nic Rebuli,[1] Richard T. Gray,[1] James G. Wood,[2] Basil Donovan,[1] Qibin Duan,[1,3] Rebecca Guy,[1] Jane S. Hocking,[4] Monica M. Lahra,[5,6] David A. Lewis,[7,8,9] David M. Whiley,[10] David G. Regan,[1,a] and Kate L. Seib[11,a]

[1]The Kirby Institute, University of New South Wales, Sydney, New South Wales, Australia, [2]School of Population Health, University of New South Wales, Sydney, New South Wales, Australia, [3]School of Mathematical Sciences, Queensland University of Technology, Brisbane, Queensland, Australia, [4]Melbourne School of Population and Global Health, University of Melbourne, Melbourne, Victoria, Australia, [5]Microbiology Department, New South Wales Health Pathology, The Prince of Wales Hospital, Randwick, New South Wales, Australia, [6]School of Medical Sciences, University of New South Wales, Sydney, New South Wales, Australia, [7]Western Sydney Sexual Health Centre, Western Sydney Local Health District, Parramatta, New South Wales, Australia, [8]Westmead Clinical School, Faculty of Health and Medicine & Marie Bashir Institute for Infectious Diseases and Biosecurity, University of Sydney, Sydney, Australia, [9]Division of Medical Virology, Department of Pathology, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa, [10]Centre for Clinical Research, University of Queensland, Brisbane, Queensland, Australia, and [11]Institute for Glycomics, Griffith University, Gold Coast, Queensland, Australia

(See the Editorial Commentary by Christensen and Vickerman, on pages 931–3.)


A
0%–100% protective and
50% transmission suppression efficacy
Prevalence (%)
Years
Protective efficacy
Baseline
0%
25%
50%
75%
100%
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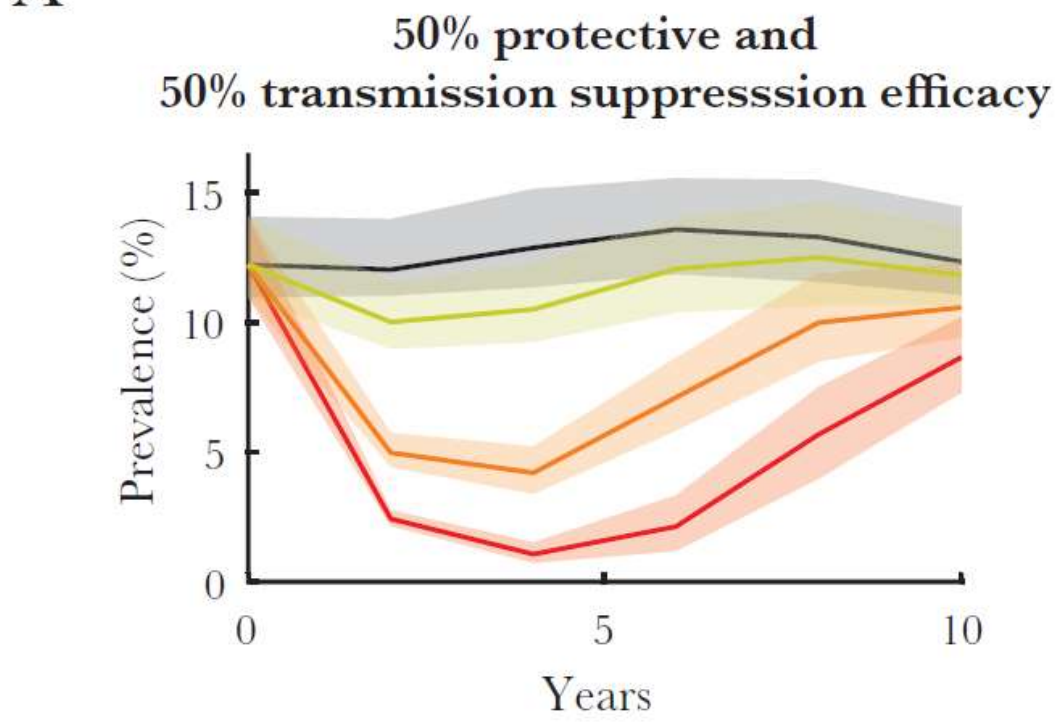
0%–100% transmission suppression and
50% protective efficacy
Prevalence (%)
Years
Transmission
suppression
Baseline
0%
25%
50%
75%
100%

A


50% protective and
50% transmission suppresssion efficacy
Prevalence (%)
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5
0
0
5
10
Years
Site of protection
Baseline
Vaccine effective at all anatomical sites
Vaccine efficacy at pharynx reduced by 50%
Vaccine ineffective at pharynx

Les enseignements du vaccin méningo B

- La vaccination par des vésicules de membrane externe peut être immunisante

- La vaccination par des protéines de la membrane externe peut être immunisante

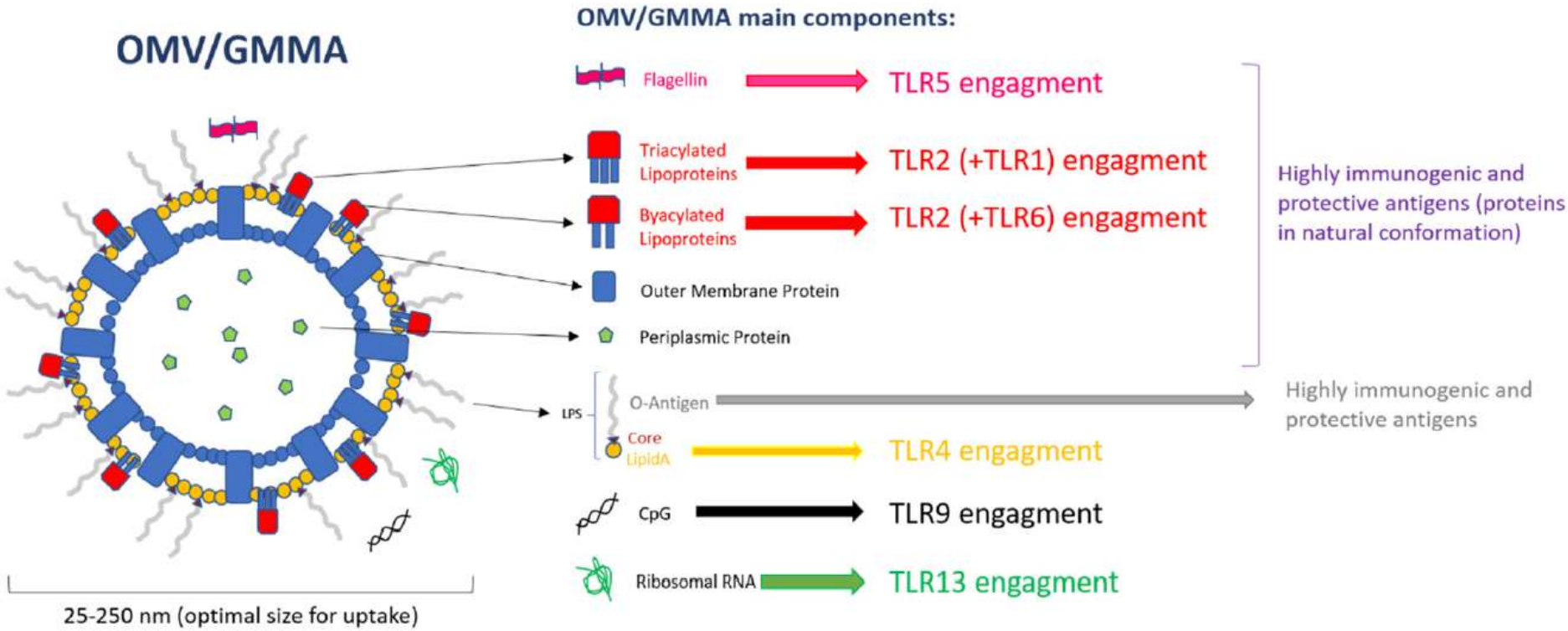
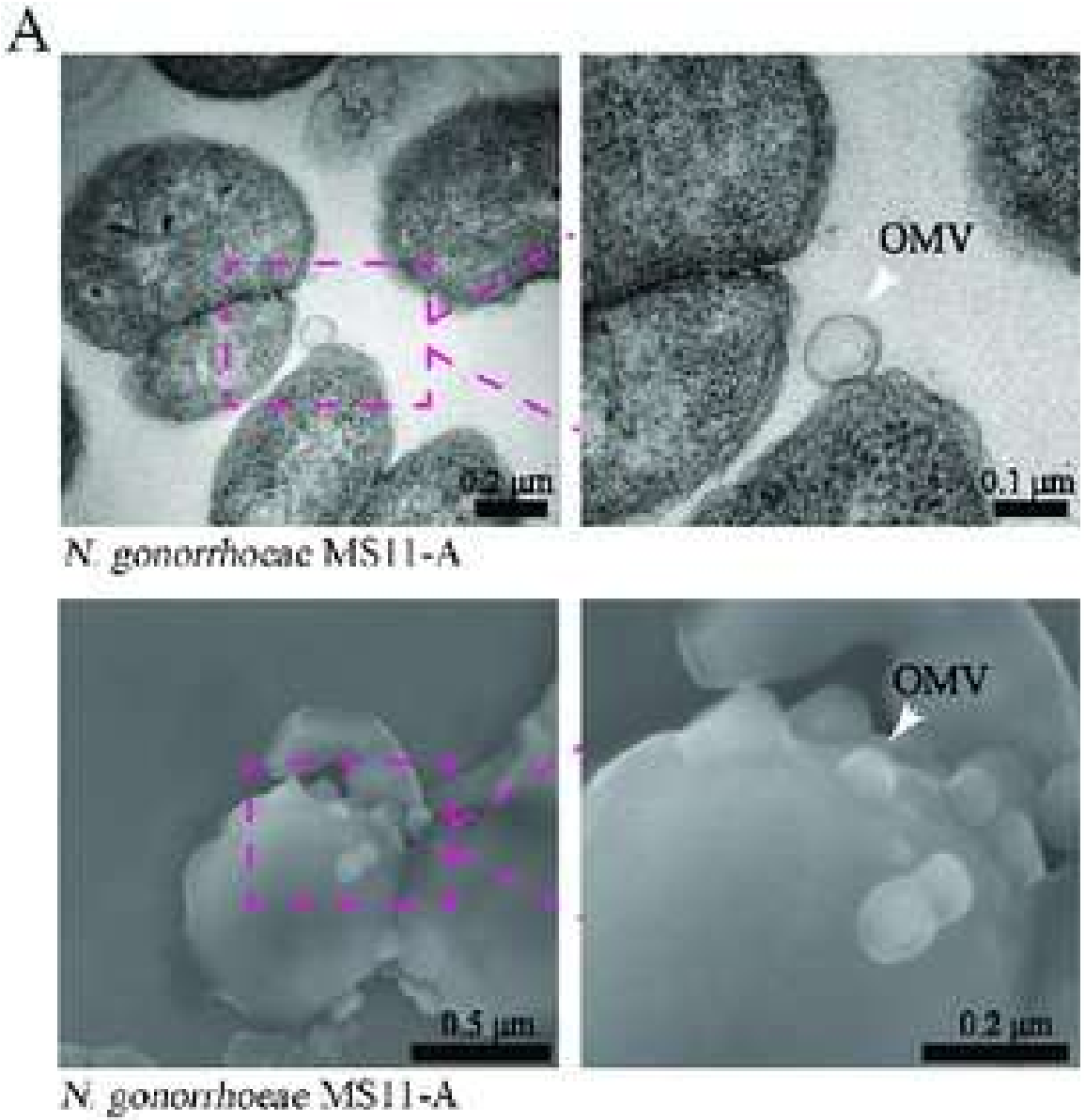


Figure 1. Outer Membrane Vesicle (OMV) components and Toll-like receptor (TLR) engagement.



Advancing a native outer membrane vesicle vaccine against gonorrhoea towards clinical development

Summary

Gonorrhoea, a sexual transmitted infection, is a global problem disproportionately affecting women and infants in LMICs. Complications include pelvic inflammatory disease, ectopic pregnancy, infertility and infant blindness. The problem is exacerbated by increasing resistance to antibiotics which threatens to make gonorrhoea untreatable. There is no licensed gonococcal vaccine. However, a retrospective study of the MenZB meningococcal outer membrane vesicle (OMV) vaccine in New

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Active, not recruiting

Safety and Efficacy of GSK Neisseria Gonorrhoeae GMMA (NgG) Investigational Vaccine When Administered to Healthy Adults 18 to 50 Years of Age.

ClinicalTrials.gov ID NCT05630859

Sponsor GlaxoSmithKline

Information provided by GlaxoSmithKline (Responsible Party)

Last Update Posted 2024-04-22

frontiers | Frontiers in Immunology

TYPE Original Research
PUBLISHED 26 November 2024
DOI 10.3389/fimmu.2024.1473193

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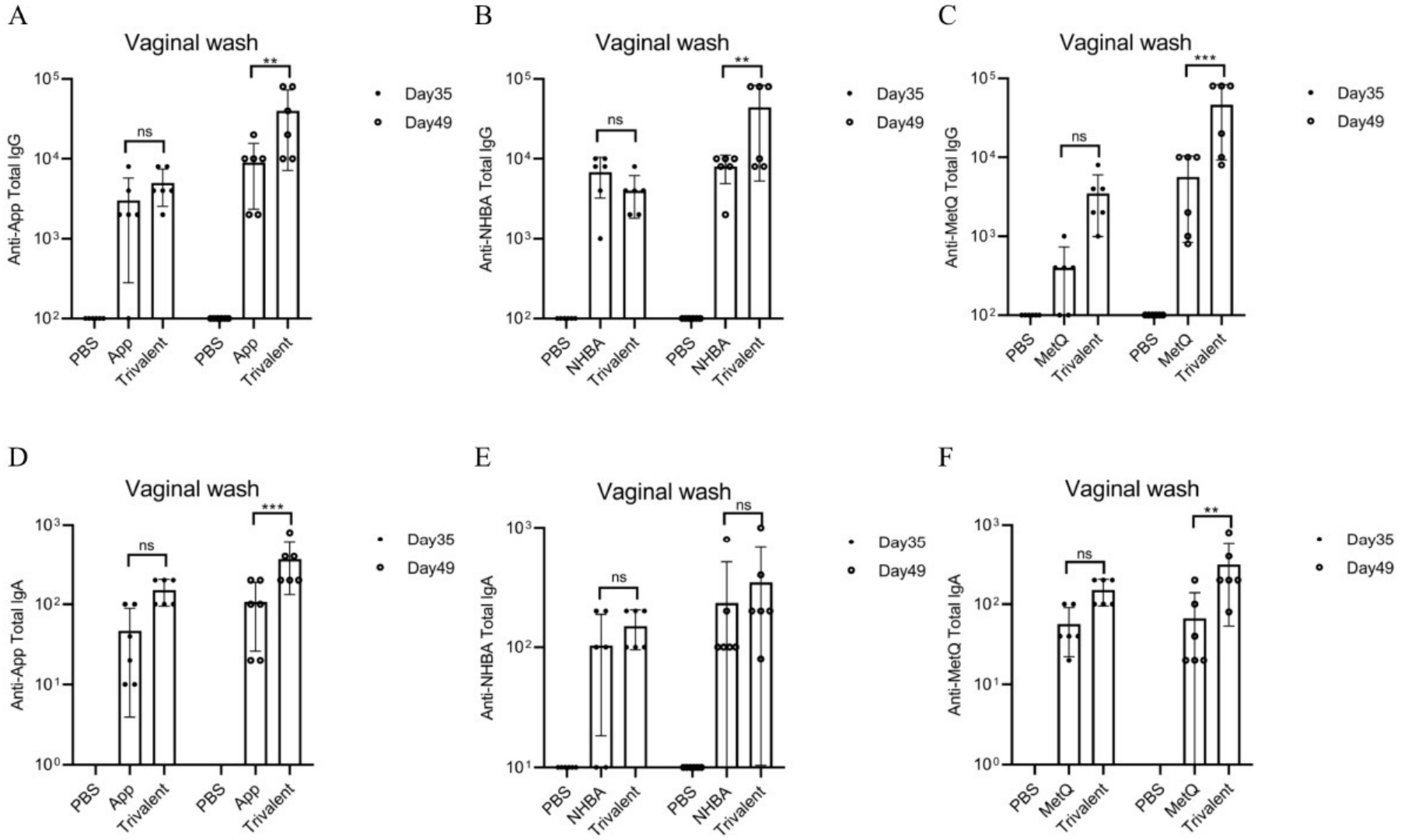
Intranasal trivalent candidate vaccine induces strong mucosal and systemic immune responses against *Neisseria gonorrhoeae*

Qin Lu[1†], Hui Yang[1,2†], Yanfeng Peng[1,2], Zeling Dong[1,2], Pujing Nie[1,2], Guangli Wang[1,2], Shilu Luo[1,2], Xun Min[1,2], Jian Huang[1,2*] and Meirong Huang[3*]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Anti-MetQ Total IgG
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Vaginal wash
Anti-App Total IgA
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Vaginal wash
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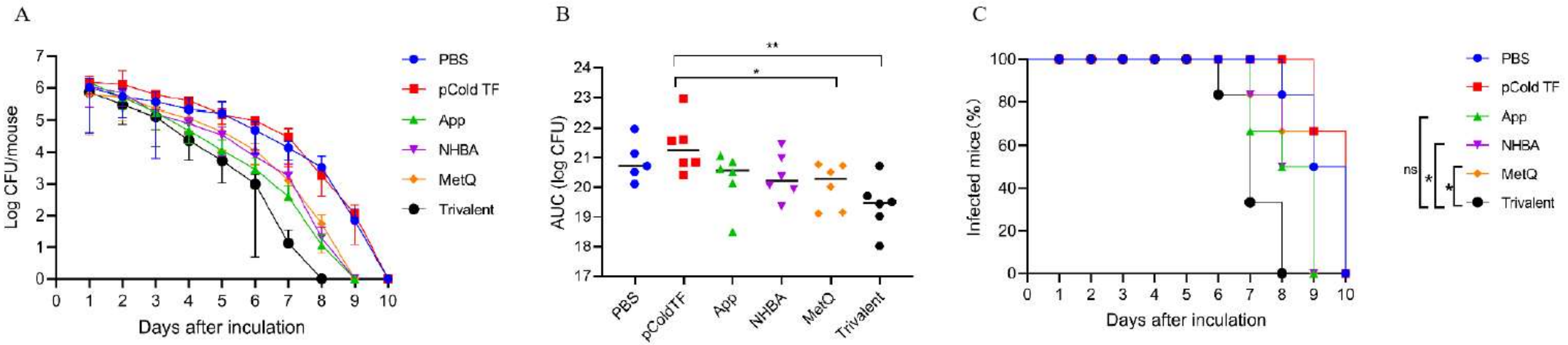
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pCold TF
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MetQ
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B
AUC (log CFU)
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NHBA
MetQ
Trivalent
C
Infected mice (%)
Days after inculation
ns
*
*
PBS
pCold TF
App
NHBA
MetQ
Trivalent

Syphilis

1956

INOCULATION SYPHILIS IN HUMAN VOLUNTEERS

HAROLD J. MAGNUSON, M.D.[1], EVAN W. THOMAS, M.D.[2], SIDNEY OLANSKY, M.D.[1], BERNARD I. KAPLAN, M.D.[3], LOPO DE MELLO, M.D.[2], AND JOHN C. CUTLER, M.D.[1]

Clinical Infectious Diseases

MAJOR ARTICLE

2022

IDSA Infectious Diseases Society of America · hivma hiv medicine association · OXFORD

Previous Syphilis Alters the Course of Subsequent Episodes of Syphilis

Christina M. Marra,[1,2] Clare L. Maxwell,[1] Sharon K. Sahi,[1] Lauren C. Tantalo,[1] Shelia B. Dunaway,[2] and Sheila A. Lukehart[2,3]

[1]University of Washington School of Medicine, Departments of Neurology, Seattle, WA, USA, [2]Medicine (Infectious Diseases), Seattle, WA, USA, and [3]Global Health, Seattle, WA, USA

RESEARCH ARTICLE Open Access

Syphilis reinfection is associated with an attenuated immune profile in the same individual: a prospective observational cohort study

2018

Chris Kenyon[1,2*], Kara Krista Osbak[1], Tania Crucitti[3] and Luc Kestens[4,5]

La syphilis du lapin de compagnie (par le Dr Pouyol et P-M. Delattre)

Syphilis chez un lapin (Treponema paraluiscuniculi)

The Journal of Immunology

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Volume 110, Issue 5
May 1973

JOURNAL ARTICLE

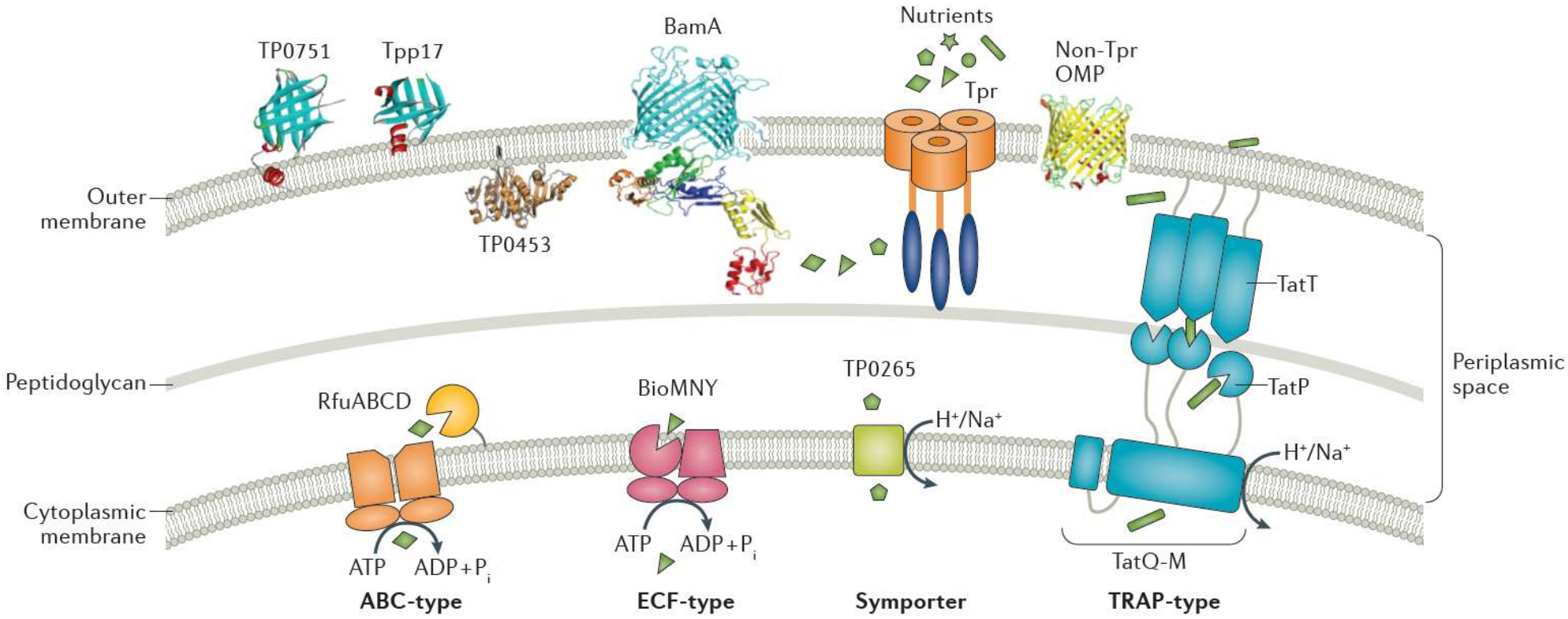
Immunity in Experimental Syphilis: VI. Successful Vaccination of Rabbits with Treponema Pallidum, Nichols Strain, Attenuated by γ-Irradiation

Get access

James N Miller

The Journal of Immunology, Volume 110, Issue 5, May 1973, Pages 1206–1215,
https://doi.org/10.4049/jimmunol.110.5.1206
Published: 01 May 1973 **Article history**

- T. pallidum irradié
- 60 injections (!) chez le lapin en 37 semaines
- Injection intradermique ensuite du tréponème non irradié
- **Protection complète des animaux immunisés**



Peeling 2017

Vaccine 40 (2022) 7676–7692

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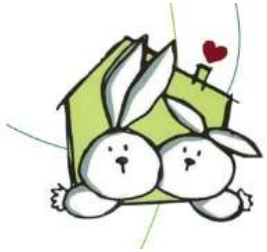
Vaccine

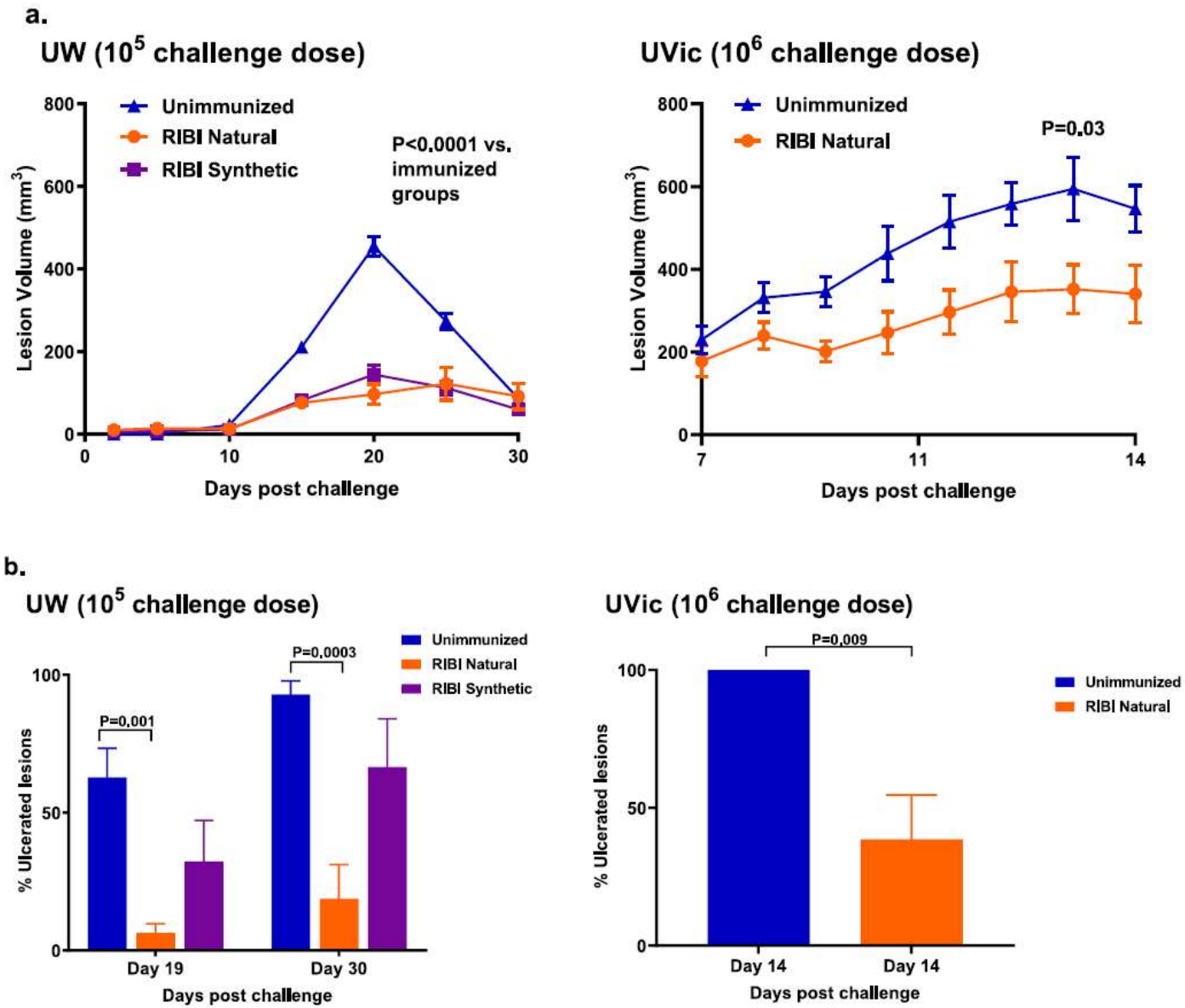
journal homepage: www.elsevier.com/locate/vaccine



Immunization with a tri-antigen syphilis vaccine significantly attenuates chancre development, reduces bacterial load, and inhibits dissemination of *Treponema pallidum*

Sheila A. Lukehart [a,b], Barbara Molini [a], Alloysius Gomez [c], Charmie Godornes [a], Rebecca Hof [c,1], Mark C. Fernandez [a], Ragan A. Pitner [d], Sean A. Gray [d], Darrick Carter [d], Lorenzo Giacani [a], Caroline E. Cameron [a,c,*]

- Portion N-terminal de la protéine Tpr
- Portion N-terminal de la protéine TprK
- Protéine Tp0751 entière


a.
UW (10^5 challenge dose)
Unimmunized
RIBI Natural
RIBI Synthetic
P<0.0001 vs. immunized groups
Lesion Volume (mm^3)
Days post challenge
UVic (10^6 challenge dose)
Unimmunized
RIBI Natural
P=0.03
Lesion Volume (mm^3)
Days post challenge
b.
UW (10^5 challenge dose)
Unimmunized
RIBI Natural
RIBI Synthetic
P=0,001
P=0,0003
% Ulcerated lesions
Day 19
Day 30
Days post challenge
UVic (10^6 challenge dose)
P=0,009
Unimmunized
RIBI Natural
% Ulcerated lesions
Day 14
Day 14
Days post challenge

ClinicalTrials.gov

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Condition/disease

syphilis

Other terms

Intervention/treatment

Vaccine

Clear Filters (2) | Apply Filters

None Selected | RSS

NCT01300689 Unknown status *

Human Papillomavirus Infection and Knowledge and Attitudes About HPV Vaccines Among Men Who Have Sex With Men (MSM)

Conditions

Syphilis | HIV Infection | HPV Infection

Locations

Beijing, Beijing, China

* Study has passed its completion date and status has not been verified in more than two years.

En résumé …

- *Chlamydia* :
  - Le vaccin basé sur la protéine de membrane externe fait son chemin …
  - Résultats attendus d'un essai clinique en cours
  - Pour le trachome, pour l'infertilité tubaire

- Gonocoque :
  - Le vaccin méningocoque B n'est pas une solution satisfaisante
  - Mais il montre une voie : les vésicules de membrane externe
  - Résultats attendus d'un essai clinique en cours

- Syphilis
  - Pas de candidat-vaccin particulièrement intéressant
  - Pas d'essai clinique en cours