

Vaccination et antibiorésistance

Pr Elisabeth Botelho-Nevers

*Service d'Infectiologie, CHU de Saint-Etienne
Inserm CIC 1408- Axe Vaccinologie, I-Reivac
Team GIMAP, CIRI, Inserm, U1111, CNRS, UMR530
Chaire Prévention, Vaccination, Contrôle de l'Infection PRESAGE*

Vaccins et antibiorésistance?

- **Vaccins reconnus depuis longtemps comme une stratégie pour lutter contre ATB**



Goal 1: Slow the Emergence of Resistant Bacteria and Prevent the Spread of Resistant Infections



Goal 2: Strengthen National One Health Surveillance Efforts to Combat Resistance



Goal 3: Advance Development and Use of Rapid and Innovative Diagnostic Tests for Identification and Characterization of Resistant Bacteria

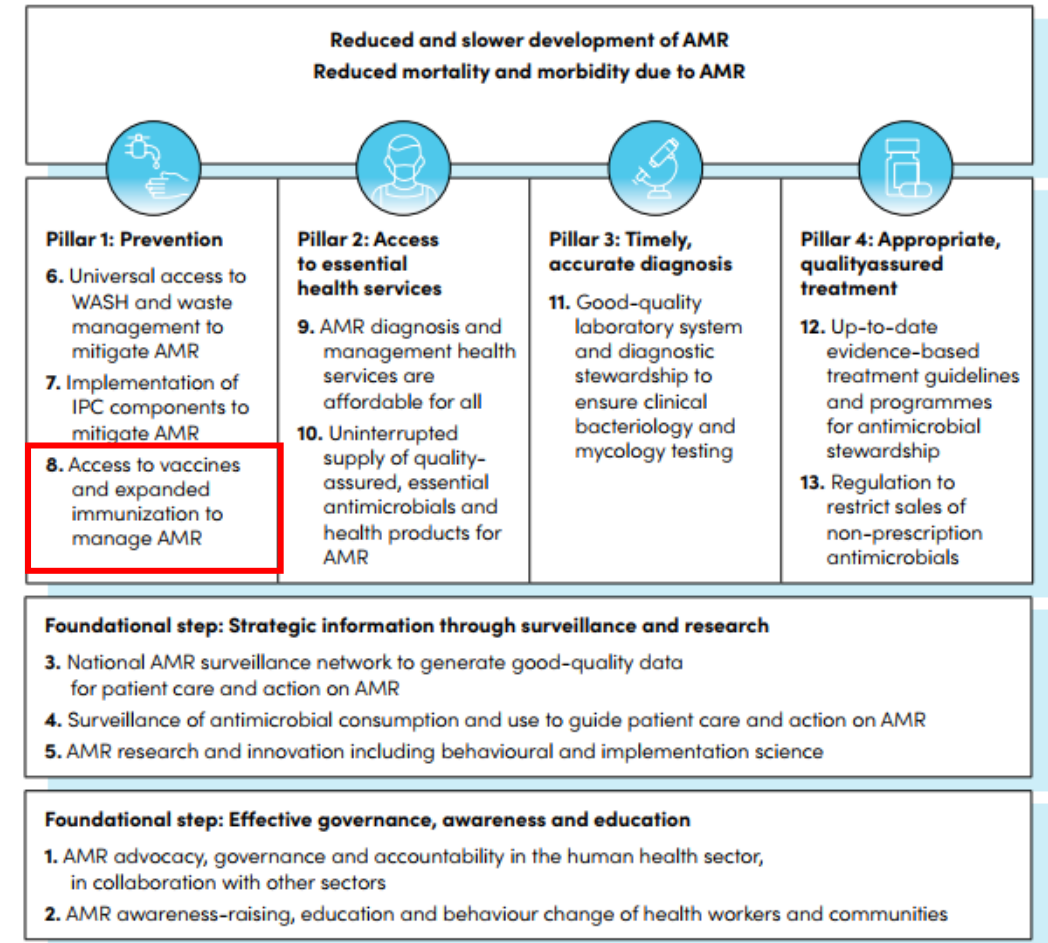


Goal 4: Accelerate Basic and Applied Research and Development for New Antibiotics, Other Therapeutics, and Vaccines



Goal 5: Improve International Collaboration and Capacities for Antibiotic-resistance Prevention, Surveillance, Control and Antibiotic Research and Development.

Fig. 1.1. The WHO core package of interventions to manage AMR in human health



AMR: antimicrobial resistance; IPC: infection prevention and control; WASH: water, sanitation and hygiene; WHO: World Health Organization.

Source: Reproduced with permission from WHO, 2023 (7).

<https://www.who.int/publications/i/item/9789240098787>

https://aspe.hhs.gov/sites/default/files/migrated_legacy_files//196436/CARB-National-Action-Plan-2020-2025.pdf

Vaccins et antibiorésistance

- Passer de la théorie à la pratique+++
 - Seuls 13% (14/108) des plans d'actions nationaux intègre la vaccination comme un élément clé.
 - Même si tous reconnaissent le besoin de prévention et de contrôle des infections

Other recognised priorities in NAPs

Vaccination as an important measure in preventing infections (included in 14 NAPs)

Vaccination programme strengthening was recognised as an intervention to support efforts tackling AMR; a need for implementing campaigns supporting vaccination uptake; a need for research and development into new vaccines and alternatives

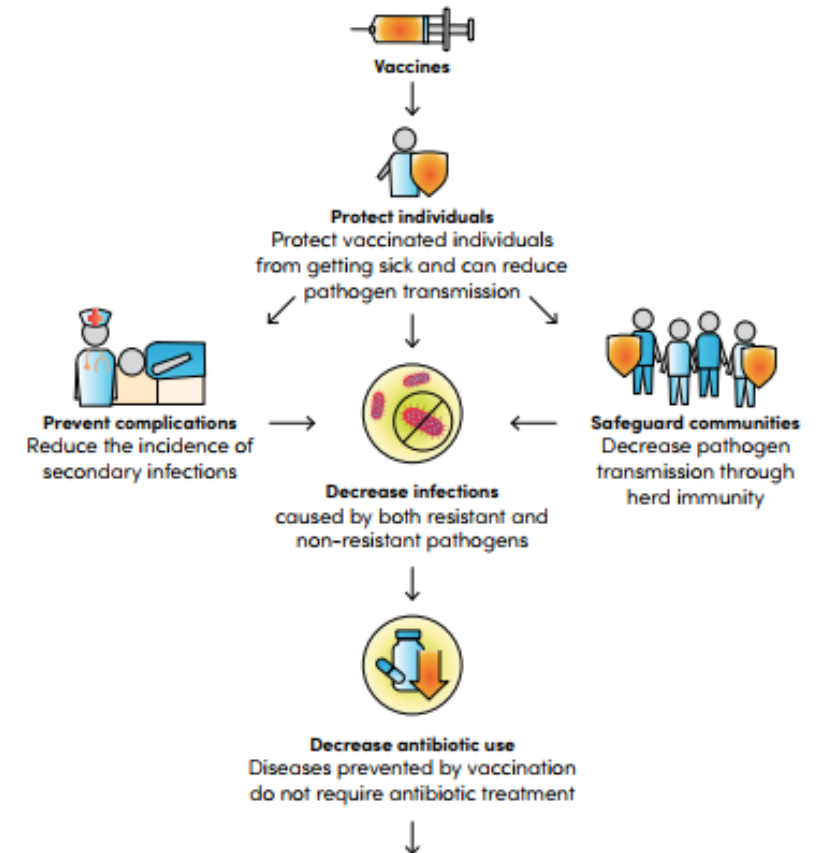
Investigate how to develop a strategy for implementing sustainable vaccination campaigns that target those least likely to be vaccinated; conduct research to investigate how to increase vaccine uptake in health-care worker populations as well as populations with socioeconomic disadvantages

- Les programmes de lutte contre l'AMR et ceux de vaccination évoluent souvent en silo
- Souvent mention que des vaccins contre les bactéries multirésistantes
- L'effet des vaccins sur l'AMR est peu surveillé+++
- Difficulté de financement des programmes de vaccination dans les LMICs
- Rôle de l'hésitation vaccinale

Vaccins et antibiorésistance

- Double impact des vaccins pour diminuer l'antibiorésistance:
 - **Impact DIRECT**: réduction des infections bactériennes et donc de la consommation d'ATB
 - **Impact DIRECT'**: réductions des infections virales et donc diminution de la consommation d'ATB utilisés du fait des surinfections bactériennes mais aussi du fait d'un mésusage d'ATB en cas d'infection virale
 - **Impact INDIRECT**: rôle de l'immunité de groupe, diminution de la transmission d'infections dont BMR

Fig. 1.2. Impact of vaccines on AMR in humans: a schematic pathway



Changing Priorities in Vaccinology: Antibiotic Resistance Moving to the Top

Aldo Tagliabue^{1*} and Rino Rappuoli²

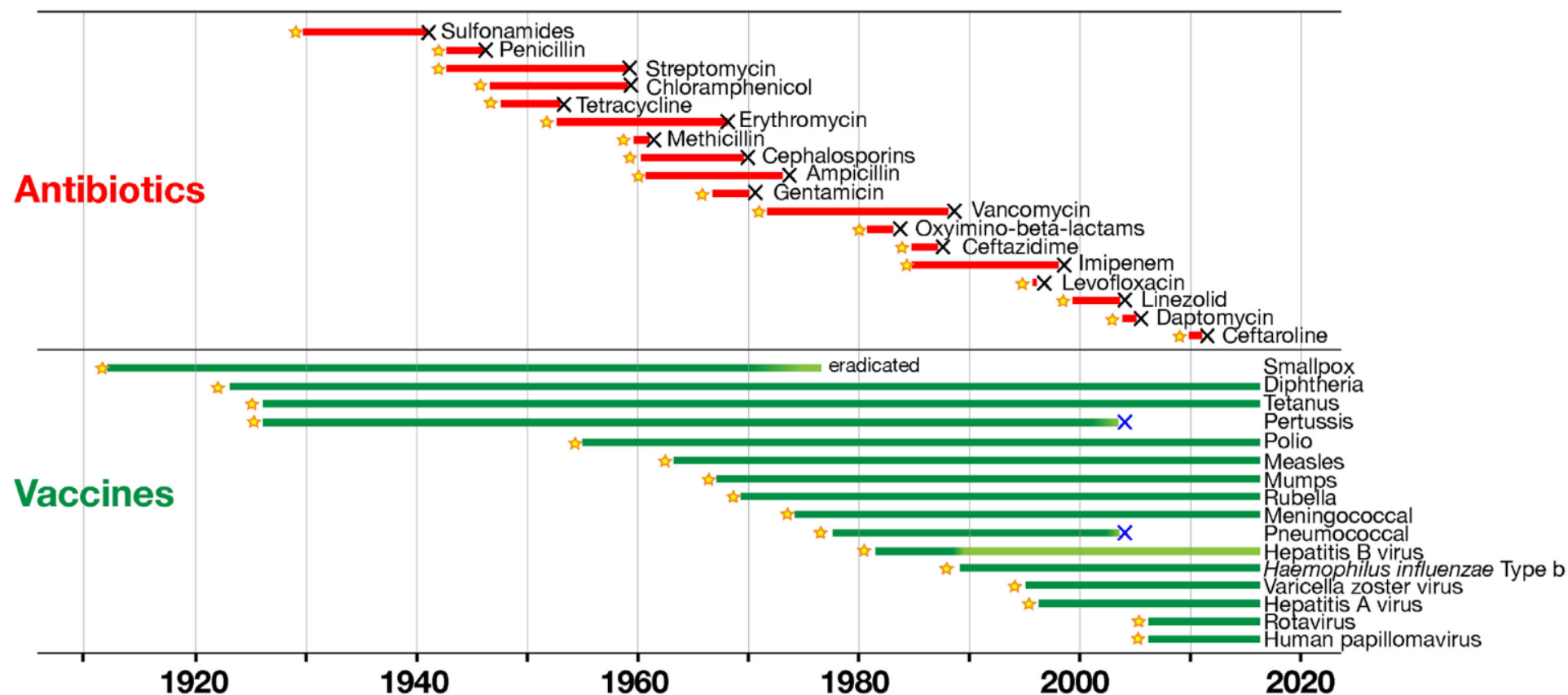
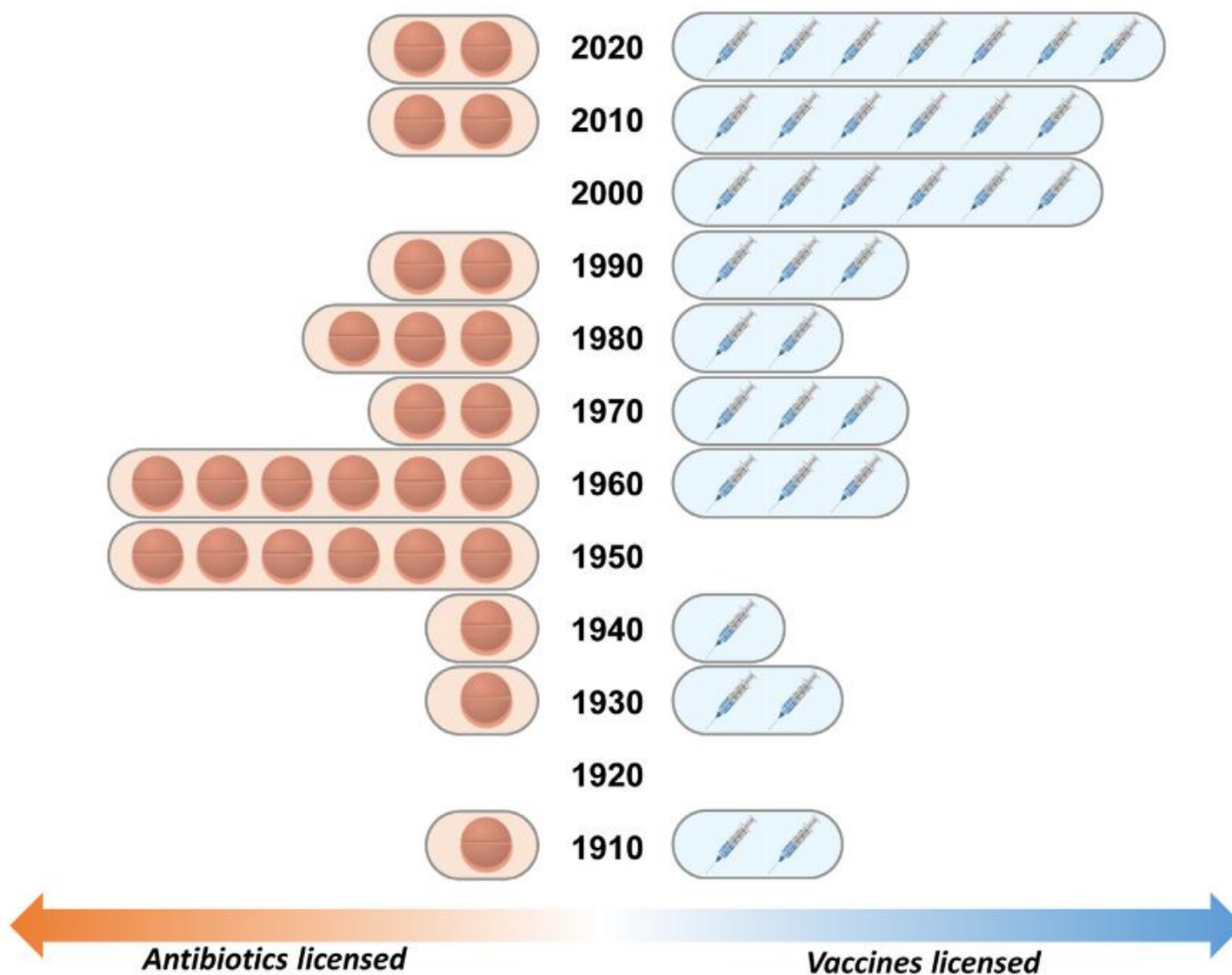


FIGURE 1 | Time to detection of resistance of human pathogens to antimicrobials (in red) and to vaccines (in green). Black X symbols indicate insurgence of resistance, with lines starting at product introduction (yellow stars; except for smallpox vaccination that began much earlier; with modifications from Ref. (14)'



Vaccins et antibiorésistance

Burden of bacterial antimicrobial resistance in low-income and middle-income countries avertible by existing interventions: an evidence review and modelling analysis

Joseph A Lewnard, Esmita Charani, Alec Gleason, Li Yang Hsu, Wasif Ali Khan, Abhilasha Karkey, Clare I R Chandler, Tapfumaneni Mashe, Ejaz Ahmed Khan, Andre N H Bulabula, Pilar Donado-Godoy, Ramanan Laxminarayan

- Achieving universal coverage of high-priority paediatric vaccines, through new introduction or scale-up of existing coverage, could prevent 181 500 (95% CI 153 400–206 800) AMR-associated deaths annually in LMICs

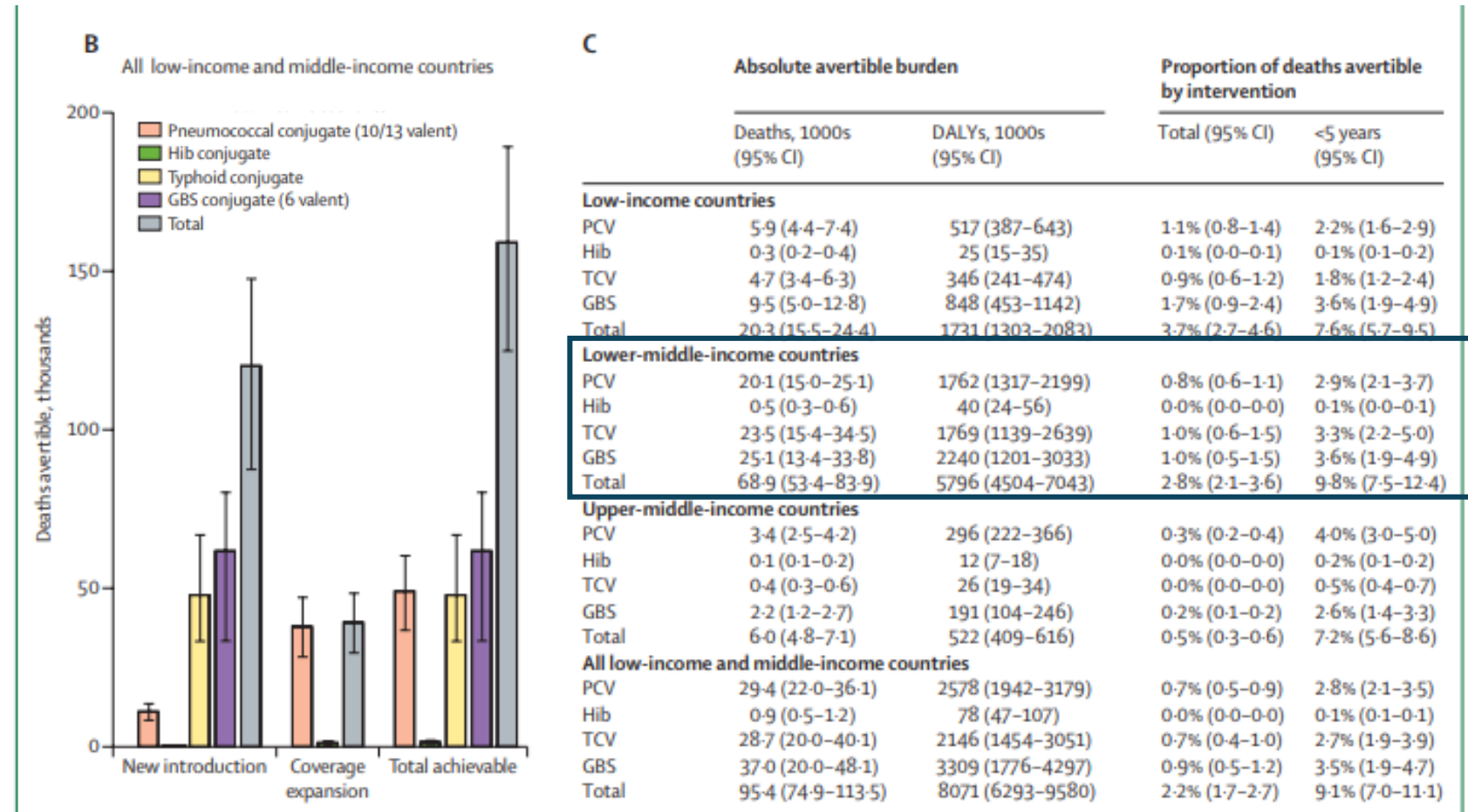


Figure 3: Burden of bacterial AMR avertible by direct prevention of acute infections through vaccination

DALY=disability-adjusted life year.

DOI: [10.1016/S0140-6736\(24\)00862-6](https://doi.org/10.1016/S0140-6736(24)00862-6)

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Burden of bacterial antimicrobial resistance in low-income and middle-income countries avertible by existing interventions: an evidence review and modelling analysis

Joseph A Lewnard, Esmira Charani, Alec Gleason, Li Yang Hsu, Wasif Ali Khan, Abhilasha Karkey, Clare I R Chandler, Tapfumaneni Mashe, Eliaz Ahmed Khan, Andre N H Bulabula, Pilar Donado-Godoy, Ramanan Laxminarayan

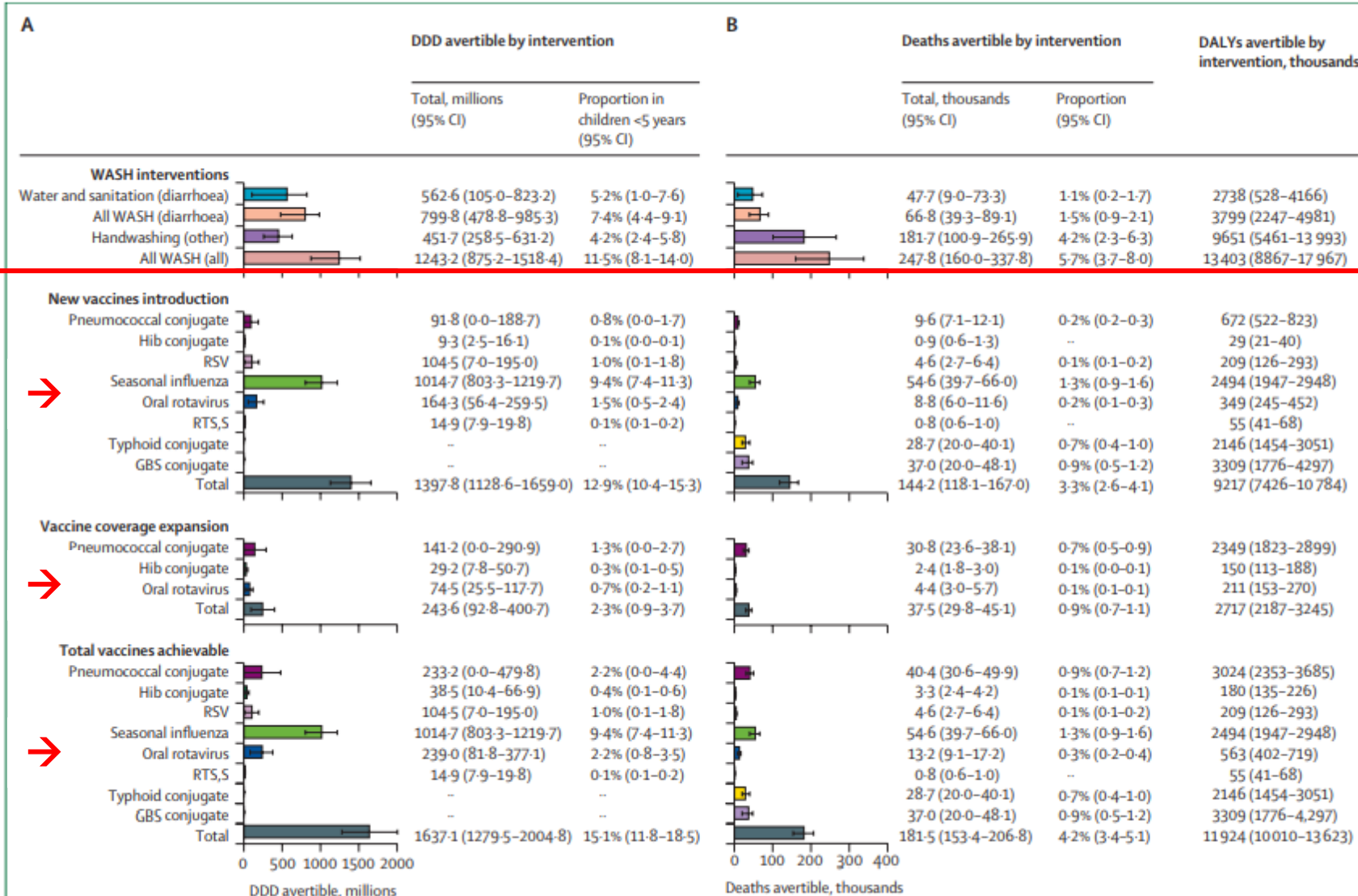


Figure 4: Burden of bacterial AMR avertible by direct prevention of acute infections and reduction in antibiotic use through WASH and vaccine interventions

DOI: [10.1016/S0140-6736\(24\)00862-6](https://doi.org/10.1016/S0140-6736(24)00862-6)

Antibiorésistance

Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050

GBD 2021 Antimicrobial Resistance Collaborators*

- Parmi les pathogènes les plus associés à de la mortalité attribuée à de l'AMR, le pneumocoque *S. pneumoniae* reste une cause importante et stable, notamment chez les > 5 ans
- Il existe des vaccins contre le pneumocoque!

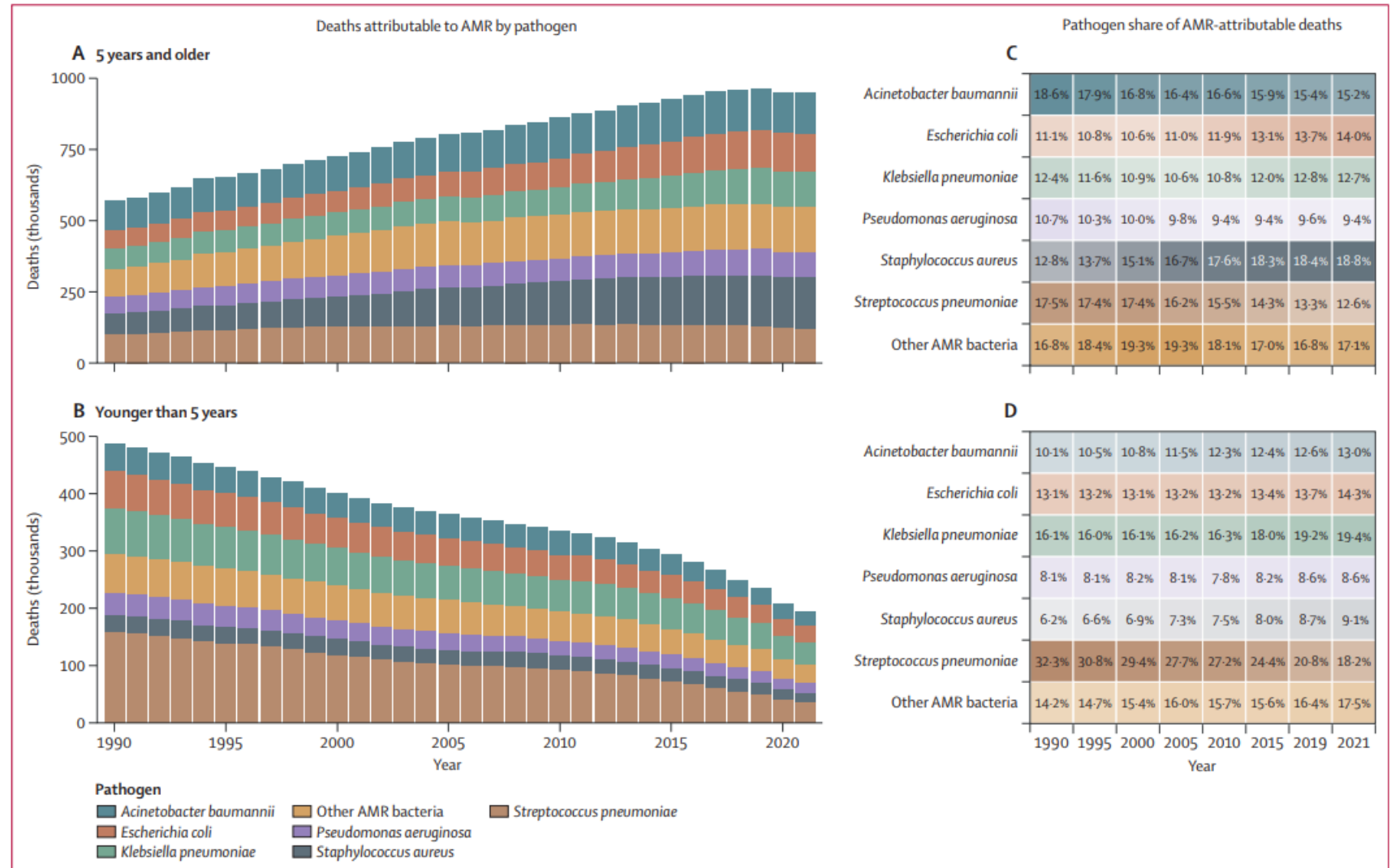


Figure 4: Deaths attributable to AMR by pathogen, global, 1990–2021, for people 5 years and older and those younger than 5 years

[https://doi.org/10.1016/S0140-6736\(24\)01867-1](https://doi.org/10.1016/S0140-6736(24)01867-1)

Vaccins antipneumococciques



Effect of Introduction of the Pneumococcal Conjugate Vaccine on Drug-Resistant *Streptococcus pneumoniae*

Moe H. Kyaw, Ph.D., M.P.H., Ruth Lynfield, M.D., William Schaffner, M.D., Allen S. Craig, M.D., James Hadler, M.D., M.P.H., Arthur Reingold, M.D., Ann R. Thomas, M.D., M.P.H., Lee H. Harrison, M.D., Nancy M. Bennett, M.D., Monica M. Farley, M.D., Richard R. Facklam, Ph.D., James H. Jorgensen, Ph.D., John Besser, M.S., Elizabeth R. Zell, M.Stat., Anne Schuchat, M.D., and Cynthia G. Whitney, M.D., M.P.H., for Active Bacterial Core Surveillance of the Emerging Infections Program Network

2006

US
Cas d'infections
invasives à
pneumocoques
identifiées entre Janvier
1, 1996, à Décembre 31,
2004

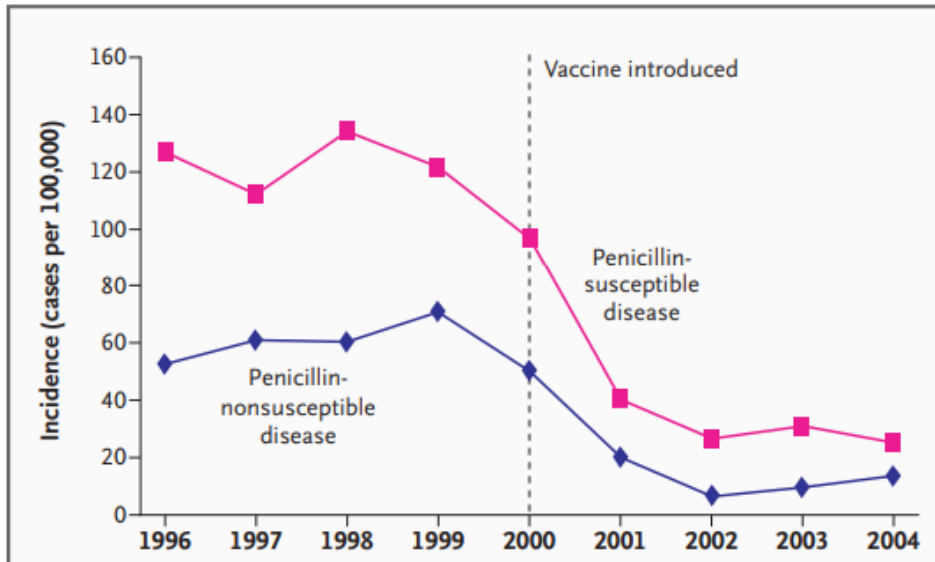


Figure 1. Annual Incidence of Invasive Disease Caused by Penicillin-Susceptible and Penicillin-Nonsusceptible Pneumococci among Children under Two Years of Age, 1996 to 2004.

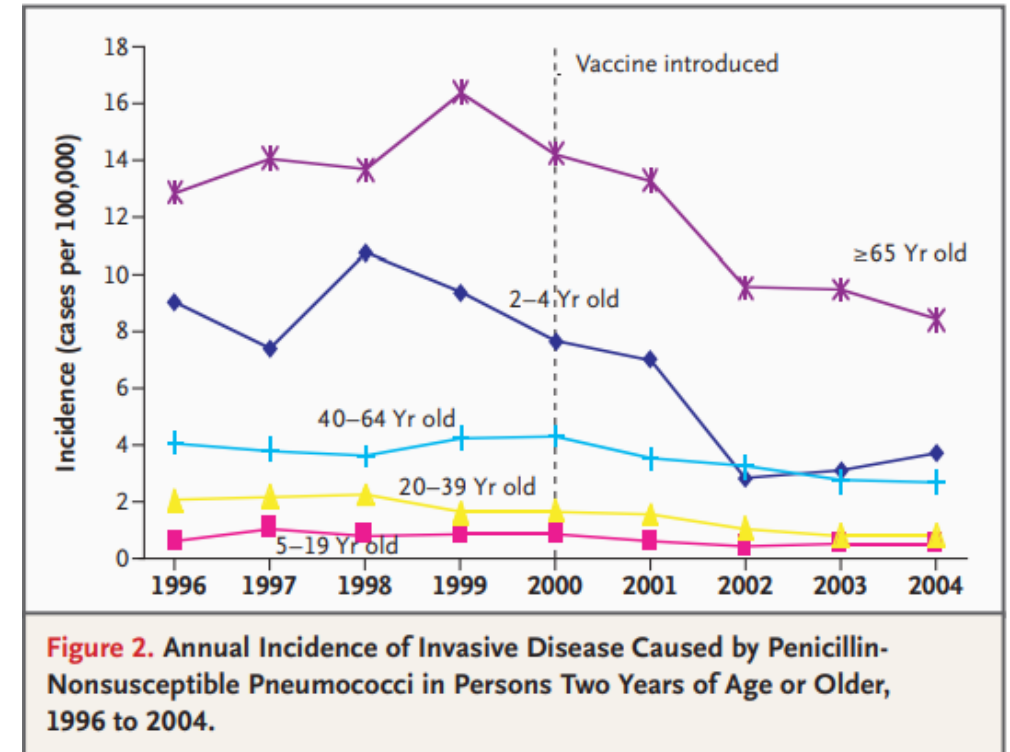
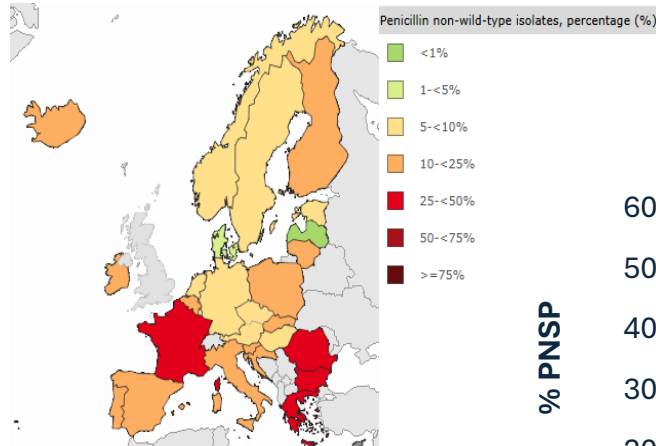


Figure 2. Annual Incidence of Invasive Disease Caused by Penicillin-Nonsusceptible Pneumococci in Persons Two Years of Age or Older, 1996 to 2004.

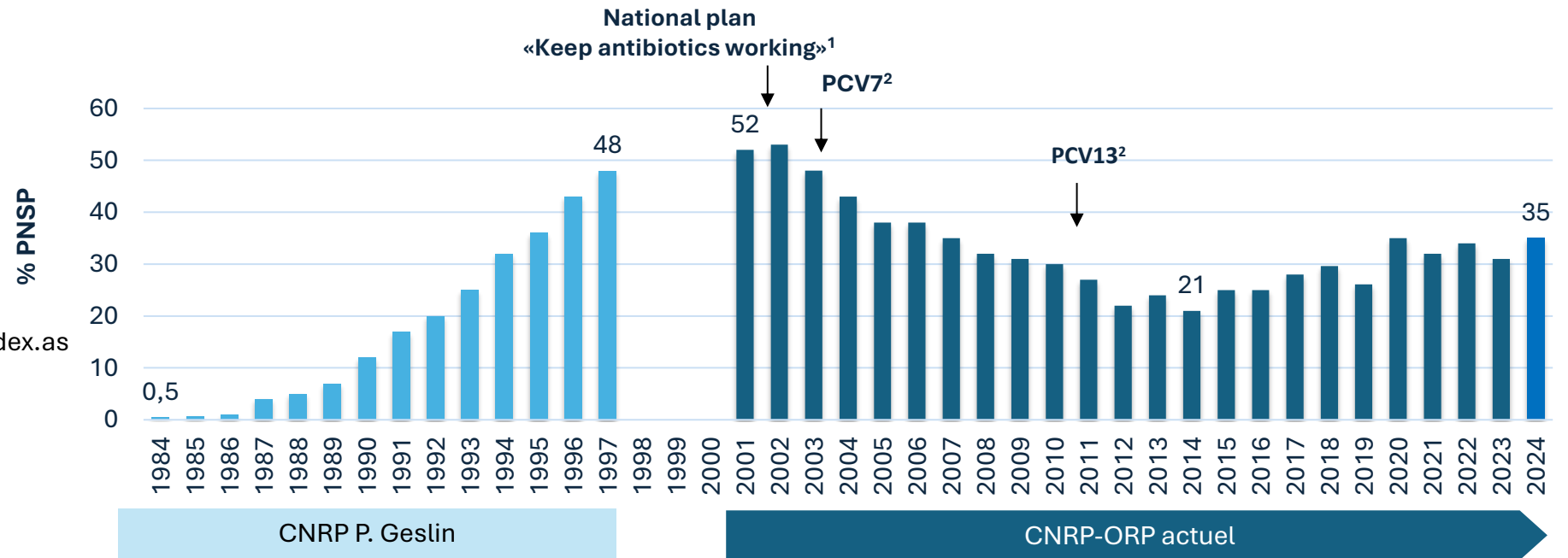
28 336 cas de 1996 à 2004; isolats étaient disponibles pour 24 825 (87,6%)

Penicillin non susceptible *S. pneumoniae* (PNSP) in France

EARS-net Annual Report **2024**



<http://atlas.ecdc.europa.eu/public/index.aspx>



1984-2024: 71 491 isolates

¹http://www.sante.gouv.fr/htm/actu/34_01.htm

²Pneumococcal conjugate vaccine (PCV)

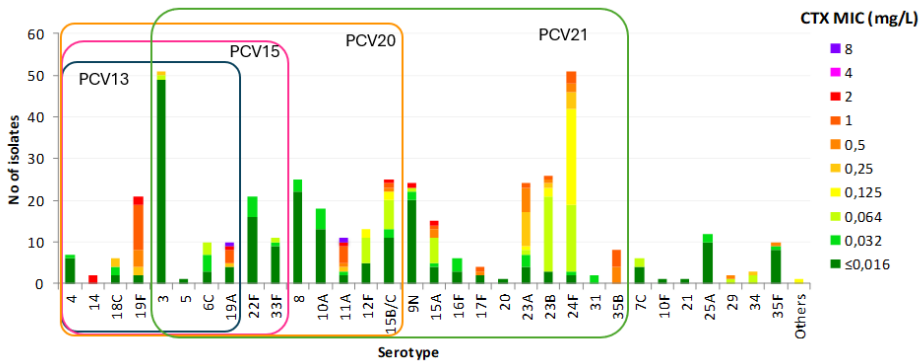
Varon, CNRP-ORP 2024, unpublished data

Higher valency vaccines' impact on antimicrobial resistance rates in *Streptococcus pneumoniae* causing invasive disease: a retrospective analysis based on national reference laboratory data, Belgium, 2018 to 2023

Helene Vermeulen¹, Lize Cuypers^{2,3}, Boudewijn Catry^{4,5}, Stefanie Desmet^{2,3}, Niel Hens^{1,6}

L'utilisation de vaccins conjugués couvrant les sérotypes associés à la résistance ATB a un impact plus important sur ATB résistance

Meningitis (n=429) : susceptibility to cefotaxime in 2024



Odds ratios with 95% confidence intervals describing associations between antibiotic resistance and serotype groups, according to the final multinomial model including resistance to erythromycin and amoxicillin, correcting for confounders, Belgium, 2018–2023 (n = 8,088 isolates)^a

Variable		Odds ratios of serotype groups (95% confidence intervals)		
		$P(\text{PCV13})/$ $P(\text{non-PCV20})$	$P(\text{PCV15-non-PCV13})/$ $P(\text{non-PCV20})$	$P(\text{PCV20-non-PCV15})/$ $P(\text{non-PCV20})$
Amoxicillin				
All ages	Susceptible	REF	NA	REF
	Resistant	7.65 (4.95–11.82)*	NA	9.45 (5.60–15.94)*
Trimethoprim/sulfamethoxazole				
All ages	Susceptible	REF	REF	REF
	Resistant	0.46 (0.36–0.60)*	0.11 (0.04–0.30)*	1.10 (0.85–1.43)
Penicillin				
< 2 years	Susceptible	REF	NA	REF
	Resistant	0.25 (0.14–0.44)*	NA	0.25 (0.13–0.47)*
2–15 years	Susceptible	REF	NA	REF
	Resistant	0.18 (0.10–0.34)*	NA	0.05 (0.02–0.13)*
16–65 years	Susceptible	REF	NA	REF
	Resistant	0.24 (0.17–0.34)*	NA	0.19 (0.12–0.28)*
> 65 years	Susceptible	REF	NA	REF
	Resistant	0.34 (0.25–0.46)*	NA	0.46 (0.31–0.68)*
Erythromycin				
< 2 years	Susceptible	REF	REF	REF
	Resistant	1.35 (0.78–2.31)	9.43 (4.71–18.88)*	0.18 (0.08–0.42)*
2–15 years	Susceptible	REF	REF	REF
	Resistant	2.10 (1.09–4.04)*	3.59 (1.00–12.86)	0.13 (0.03–0.58)*
16–65 years	Susceptible	REF	REF	REF
	Resistant	2.43 (1.74–3.40)*	3.69 (2.26–6.03)*	0.16 (0.10–0.28)*
> 65 years	Susceptible	REF	REF	REF
	Resistant	2.47 (1.92–3.19)*	3.61 (2.53–5.15)*	0.15 (0.10–0.24)*

Autres exemples

Vaccin anti-*Haemophilus influenzae* b

ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, June 2005, p. 2561–2564
0066-4804/05/\$08.00+0 doi:10.1128/AAC.49.6.2561–2564.2005
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Vol. 49, No. 6

Decreasing Prevalence of β -Lactamase Production among Respiratory Tract Isolates of *Haemophilus influenzae* in the United States

Kris P. Heilmann, Cassie L. Rice, Ashley L. Miller, Norma J. Miller, Susan E. Beekmann, Michael A. Pfaller, Sandra S. Richter, and Gary V. Doern*

TABLE 3. Comparison of resistant rates with *Haemophilus influenzae* during five study periods between 1994–1995 and 2002–2003

Antimicrobial agent or resistance factor	Percentage resistant in				
	1994–1995 ^a	1997–1998 ^b	1999–2000 ^c	2000–2001 ^d	2002–2003 ^e
β -Lactamase positive	36.4	31.1	30.8	28.9	26.2
BLNAR ^f	1.3	1.9	2.0	0.7	0.1
BLPACR ^g	3.0	2.0	0.2	0.7	0.4
Ampicillin	36.6	32.4	34.6	29.4	26.3
Amoxicillin-clavulanate	5.0	2.4	0.3	0.5	0.1
Cefprozime	0.1	0.0	0.1	0.1	0.0
Cefuroxime	1.5	1.0	1.1	0.5	0.1
Clarithromycin	1.8	4.2	6.8	6.3	1.7
Azithromycin	0.5	1.9	2.9	2.4	1.0
TMP-SMX	9.0	18.3	14.6	17.6	14.6
Chloramphenicol	0.5	0.5	0.5	0.6	0.4
Tetracycline	1.3	1.0	0.7	1.1	0.4

- Avant l'introduction des vaccins, augmentation des souches R aux betalactamines
- Introduction vaccin Vaccin anti-*Haemophilus influenza* conjugué aux USA en 1987.
- Reduction massive des infections à Hib

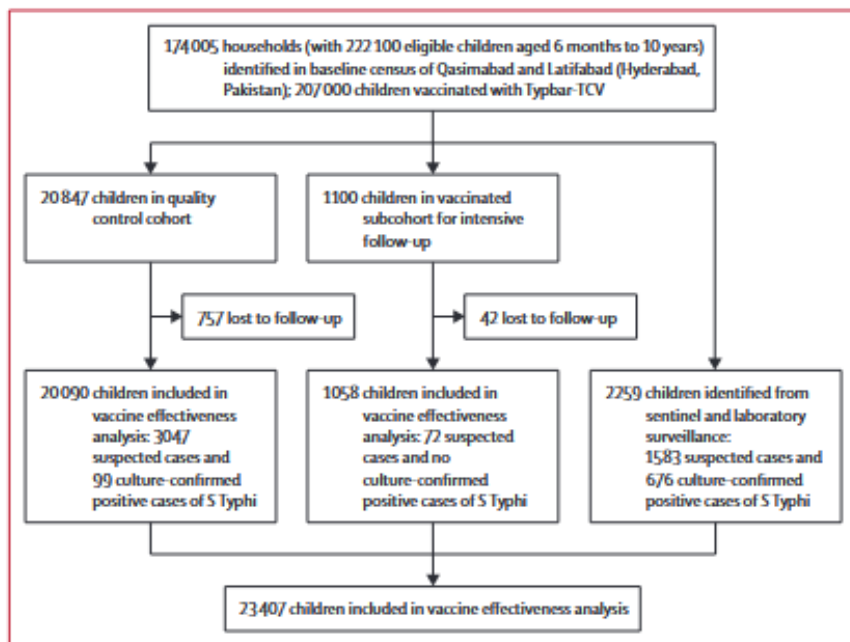
Idem en Italie: doi:10.1016/j.vaccine.2011.03.059

Idem en Espagne: DOI: [10.1128/AAC.01674-07](https://doi.org/10.1128/AAC.01674-07)

Vaccin Typhoide

Effectiveness of typhoid conjugate vaccine against culture-confirmed *Salmonella enterica* serotype Typhi in an extensively drug-resistant outbreak setting of Hyderabad, Pakistan: a cohort study

Mohammad Tahir Yousafzai, Sultan Karim, Sonia Qureshi, Momin Kazi, Hina Memon, Amber Junejo, Zohra Khawaja, Najeeb Ur Rehman, Muhammad Sajid Ansari, Rafey Ali, Ikram Uddin Ujjan, Heera Mani Lohana, Naveed M Memon, Mudassar Hussain, Roohi Nigar, Naor Bar-Zeev, Farah Naz Qamar



	Number of participants (n)	At-risk population (n)	Total person-time at risk, years*	S Typhi incidence; number of cases per 100 000 population (95% CI)	S Typhi incidence; number of cases per 100 000 person-years (95% CI)	S Typhi incidence rate ratio (95% CI)	Vaccine effectiveness* (95% CI)
Both culture-confirmed and suspected S Typhi cases							
Age 6–59 months							
Vaccinated	940	5521	8646	17 025.9 (16 034.4–18 017.4)	10 872.2 (10 643.0–11 101.3)	0.50 (0.46–0.54)	50.0 (45.8–53.9)
Unvaccinated	1653	4647	7599	35 571.3 (34 194.9–36 947.8)	21 752.1 (21 263.0–22 241.1)	–	–
Age ≥5 years							
Vaccinated	1029	7915	12103	13 000.6 (12 259.7–13 741.5)	8502.2 (8350.7–8653.6)	0.42 (0.39–0.46)	57.8 (54.4–60.9)
Unvaccinated	1756	5324	8722	32 982.7 (31 719.8–34 245.6)	20 132.0 (19 709.5–20 554.5)	–	–
Overall							
Vaccinated	1969	13436	20749	14 654.7 (14 056.7–15 252.7)	9489.7 (9360.6–9618.9)	0.45 (0.43–0.48)	54.6 (52.0–57.0)
Unvaccinated	3409	9971	16322	34 189.1 (33 258.1–35 120.2)	20 886.3 (20 565.9–21 206.7)	–	–
Suspected typhoid fever cases							
Age 6–59 months							
Vaccinated	918	5521	8646	16 627.4 (15 645.3–17 609.6)	10 617.7 (10 393.9–10 841.5)	0.62 (0.57–0.67)	38.1 (32.6–43.2)
Unvaccinated	1304	4647	7599	28 061.1 (26 769.3–29 352.9)	17 159.5 (16 773.7–17 545.3)	–	–
Age ≥5 years							
Vaccinated	1004	7915	12 103	12 684.8 (11 951.6–13 418.0)	8295.6 (8147.8–8443.4)	0.53 (0.48–0.57)	47.5 (43.0–51.6)
Unvaccinated	1377	5324	8722	25 864.0 (24 687.8–27 040.3)	15 786.9 (15 455.6–16 118.2)	–	–
Overall							
Vaccinated	1922	13 436	20 749	14 304.9 (13 712.8–14 896.9)	9263.2 (9137.2–9389.2)	0.56 (0.53–0.60)	43.6 (40.2–46.8)
Unvaccinated	2681	9971	16 322	26 888.0 (26 017.7–27 758.3)	16 426.0 (16 174.0–16 678.0)	–	–
Culture-confirmed S Typhi cases							
Age 6–59 months							
Vaccinated	22	5521	8646	398.5 (232.3–564.7)	254.5 (249.1–259.8)	0.06 (0.03–0.09)	94.5 (91.5–96.6)
Unvaccinated	349	4647	7599	7510.2 (6752.4–8268.0)	4592.5 (4489.3–4695.8)	–	–
Age ≥5 years							
Vaccinated	25	7915	12 103	315.9 (192.2–439.5)	206.6 (202.9–210.2)	0.05 (0.03–0.07)	95.2 (92.9–97.0)
Unvaccinated	379	5324	8722	7118.7 (6428.0–7809.4)	4345.1 (4253.9–4436.3)	–	–
Overall							
Vaccinated	47	13 436	20 749	349.8 (250.0–449.6)	226.5 (223.4–229.6)	0.05 (0.04–0.07)	94.9 (93.2–96.3)
Unvaccinated	728	9971	16 322	7301.2 (6790.5–7811.8)	4460.3 (4391.9–4528.8)	–	–
XDR S Typhi cases							
Age 6–59 months							
Vaccinated	14	5521	8646	253.6 (120.9–386.2)	161.9 (158.5–165.3)	0.06 (0.03–0.10)	94.4 (90.4–97.0)
Unvaccinated	220	4647	7599	4734.2 (4123.6–5344.8)	2895.0 (2829.9–2960.1)	–	–
Age ≥5 years							
Vaccinated	4	7915	12 103	50.5 (1.0–100.1)	33.1 (32.5–33.6)	0.01 (0.00–0.04)	98.6 (96.4–99.6)
Unvaccinated	206	5324	8722	3869.3 (3351.2–4387.3)	2361.7 (2312.2–2411.3)	–	–
Overall							
Vaccinated	18	13 436	20 749	134.0 (72.1–195.8)	86.8 (85.6–87.9)	0.03 (0.02–0.05)	96.7 (94.7–98.0)
Unvaccinated	426	9971	16 322	4272.4 (3875.4–4669.3)	2610.0 (2570.0–2650.1)	–	–

(Table 2 continues on next page)

Vaccin rotavirus

Estimation that rotavirus would cause 21.6% (2.1–40.3%) of antibiotic-treated diarrhoea among children aged 0–23 months in unvaccinated LMIC populations.

Roughly 77.3% of age-eligible children in LMICs in which rotavirus vaccination has been implemented received a full rotavirus vaccine series as of 2018²³. We estimated that direct effects of rotavirus vaccination currently prevent 13.6 (3.6–23.7) million episodes of antibiotic-treated diarrhoea annually among children aged 0–23 months in LMICs (Supplementary Table 26). This effect reflects only 31.0% (17.7–35.2%) of all antibiotic-treated diarrhoea episodes that we would expect rotavirus to cause annually among children aged 0–23 months who live in LMICs, in the absence of vaccination. We estimated that an additional

18.3 (4.2–32.6) million episodes of antibiotic-treated diarrhoea could be prevented annually by the direct effects of rotavirus vaccination among children aged 0–23 months under a scenario of universal vaccine coverage, representing 42.1% (14.6% to 50.7%) of all antibiotic use that we estimated to be attributable to rotavirus in this population.

Childhood vaccines and antibiotic use in low- and middle-income countries

<https://doi.org/10.1038/s41586-020-2238-4>

Received: 3 December 2019

Joseph A. Lewnard^{1,2,3}, Nathan C. Lo⁴, Nimalan Arinaminpathy⁵, Isabel Frost^{5,6} & Ramanan Laxminarayan^{6,7}

(b) antibiotic-treated diarrhoea attributable to rotavirus in children aged 0–23 months

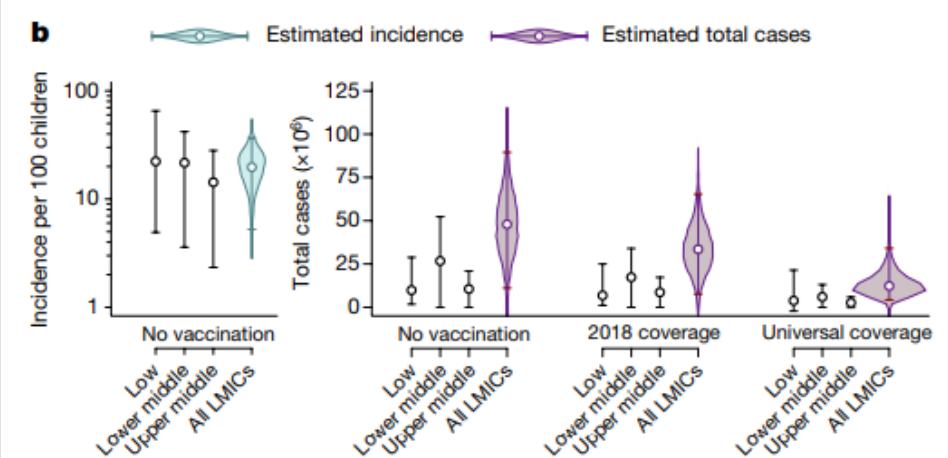


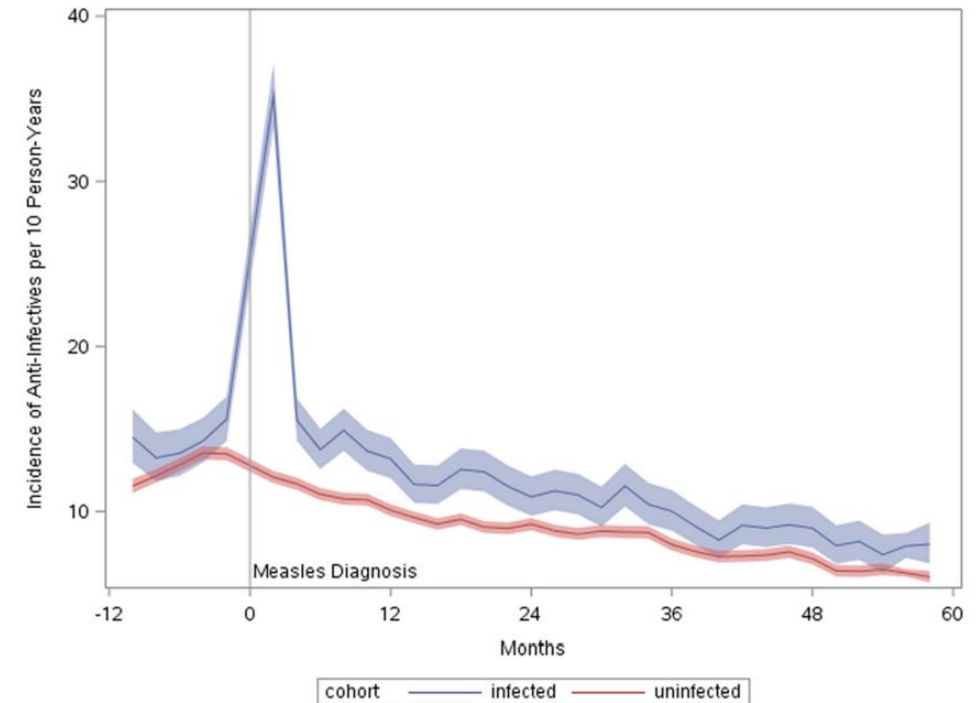
Fig. 4 | Total vaccine-preventable antibiotic consumption and incidence per 100 children. a, b, We estimated the incidence and total number of

Vaccin rougeole?

BMJ Open Impact and longevity of measles-associated immune suppression: a matched cohort study using data from the THIN general practice database in the UK

Kartini Gadroen,¹ Caitlin N Dodd,¹ Gwen M C Masclee,¹ Maria A J de Ridder,¹ Daniel Weibel,¹ Michael J Mina,² Bryan T Grenfell,³ Miriam C J M Sturkenboom,¹ David A M C van de Vijver,⁴ Rik L de Swart⁴

This study examined **children aged 1–15 years** in The Health Improvement Network UK general practice medical records database. Participants included **2228 patients diagnosed with measles between 1990 and 2014**, which were **matched on age, sex, general practitioner practice and calendar year with 19 930 children without measles**



doi:10.1136/ bmjopen-2017-021465

Table 3 Incidence rate ratios (IRRs) of events of interest in predefined time periods following measles infection

Time period	Analysis*	IRR (95% CI)		
		Infections	Anti-infective prescriptions	Hospitalisation
Days 0–31	Primary	1.43 (1.22 to 1.68)	3.60 (3.31 to 3.91)	2.83 (1.72 to 4.67)
	Unadjusted	1.57 (1.34 to 1.84)	3.77 (3.48 to 4.08)	3.24 (2.03 to 5.19)
	Sensitivity (vaccinated measles subjects only)	1.47 (1.17 to 1.86)	4.65 (4.20 to 5.14)	1.92 (0.89 to 4.14)
	Sensitivity (unvaccinated measles subjects only)	1.33 (1.07 to 1.65)	2.45 (2.12 to 2.82)	3.30 (1.60 to 6.82)
Days 32–365	Primary	1.22 (1.14 to 1.31)	1.25 (1.18 to 1.32)	1.14 (0.88 to 1.48)
	Unadjusted	1.31 (1.21 to 1.41)	1.31 (1.24 to 1.39)	1.29 (0.94 to 1.77)
	Sensitivity (vaccinated measles subjects only)	1.15 (1.04 to 1.27)	1.25 (1.16 to 1.35)	0.95 (0.61 to 1.46)
	Sensitivity (unvaccinated measles subjects only)	1.26 (1.15 to 1.39)	1.24 (1.15 to 1.35)	1.29 (0.92 to 1.81)
Days 366–913	Primary	1.10 (1.02 to 1.19)	1.21 (1.13 to 1.29)	1.08 (0.80 to 1.47)
	Unadjusted	1.15 (1.06 to 1.24)	1.25 (1.17 to 1.34)	1.19 (0.85 to 1.66)
	Sensitivity (vaccinated measles subjects only)	1.10 (0.99 to 1.22)	1.21 (1.11 to 1.32)	1.26 (0.79 to 2.04)
	Sensitivity (unvaccinated measles subjects only)	1.09 (0.99 to 1.21)	1.22 (1.12 to 1.34)	0.93 (0.64 to 1.35)
Days 914–1826	Primary	1.15 (1.06 to 1.25)	1.15 (1.07 to 1.24)	1.24 (0.92 to 1.67)
	Unadjusted	1.23 (1.13 to 1.35)	1.22 (1.13 to 1.31)	1.38 (1.07 to 1.78)
	Sensitivity (vaccinated measles subjects only)	1.06 (0.94 to 1.20)	1.25 (1.13 to 1.37)	1.08 (0.76 to 1.54)
	Sensitivity (unvaccinated measles subjects only)	1.21 (1.07 to 1.35)	1.07 (0.96 to 1.19)	1.37 (0.87 to 2.17)

Vaccins infections respiratoires

- **Vaccination Grippe** associée à 13-50% de réduction de consommation ATB

Efficacy studies of influenza vaccine impact on antibiotic use

Turkey	Influenza	Episodes of acute otitis media and otitis media with effusions occurred in 2.3% and 22.8% of influenza vaccine recipients, respectively, vs. 5.2% and 31.1% of controls during influenza season; $P < 0.001$ (26)
Italy	Influenza	In a control study of influenza vaccination, vaccinated children had 13.2% fewer antibiotic prescriptions during the 6-mo observation period in their study; study children had 54.8% fewer otitis media episodes, which likely contributed to the reduction in antibiotic use (27)
Europe	Influenza	In this randomized, controlled study in 6- to 36-mo-old children, influenza vaccinees had 50% fewer antibiotic prescriptions and 47% fewer confirmed influenza infections during five consecutive seasons (28)

Observational studies of influenza vaccine impact on antibiotic use

Canada	Influenza	Influenza vaccine recipients had 64% fewer antibiotic prescriptions than controls (29)
United Kingdom	Influenza (live attenuated virus vaccine)	In vaccinated children, 14.5% fewer amoxicillin prescriptions were given during the period of influenza virus circulation compared with other time periods (30)

Systematic review

Impact of vaccination on antibiotic usage: a systematic review and meta-analysis

B.S. Buckley^{1,2}, N. Henschke^{2,*}, H. Bergman², B. Skidmore³, E.J. Klemm⁴,
G. Villanueva², C. Garritty⁵, M. Paul⁶

(a)

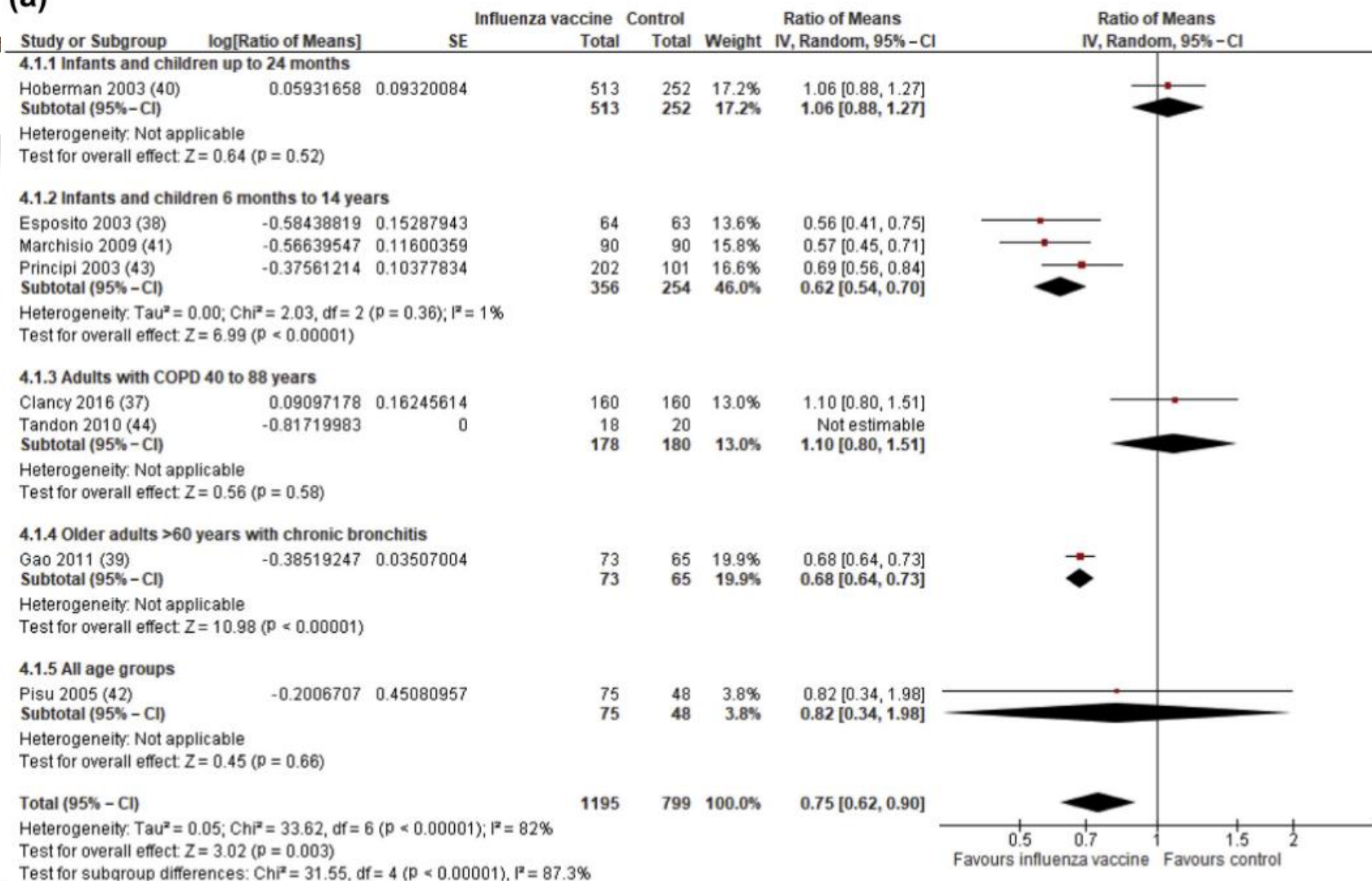


fig. 4. Forest plots for influenza vaccine. (a) Number of antibiotic courses or prescriptions (follow up: 4 months to 2 years);

Effet de la vaccination sur la consommation ATB

- Cohorte US, 37 487 cas d'IRA ambulatoires, 26% grippe positive, 50-60 centres, 5 saisons (2013-2018)
- Y compris en ambulatoire, **vaccination antigrippale** évite 1 prescription d'ATB sur 25 chez les patients (> 6 mois) avec IRA

Table 3. Estimated Proportion of Each Acute Respiratory Illness Syndrome Prevented Through Influenza Vaccination and the Proportion of Antibiotic Prescriptions for Tiers of Acute Respiratory Illnesses Averted Through Influenza Vaccination: US Flu VE Network, 2013–2018

Tier/Syndrome ^a	(1) Adjusted VE Against Influenza, ^b % (95% CI)	(2) Prevalence of Influenza in Unvaccinated Persons, ^c %	(3) Percentage Vaccinated Among Influenza-negative Patients	(4) Prevalence of Antibiotic Prescriptions Among Unvaccinated Influenza-positive Persons, %	(5) Prevalence of Antibiotic Prescriptions in All Persons With ARI, %	(1 × 2 × 3) Proportion of Total ARI Visits Prevented by Influenza Vaccination, %	((1 × 2 × 3 × 4)/5) Overall Proportion of Antibiotic Prescriptions Averted From Influenza Vaccination, % (95% Uncertainty Bound)
Overall	35 (32–39)	30.0	53.0	24.3	35.5	5.6	3.8 (3.6–4.1)
Tier 1	56 (39–68)	25.5	59.1	78.4	79.3	...	8.3 (6.9–9.8)
Pneumonia	56 (39–68)	25.5	59.1	NA	NA	8.4	NA
Tier 2	35 (29–41)	22.2	48.9	42.9	54.7	NA	3.0 (2.8–3.3)
Pharyngitis	33 (25–41)	26.1	45.6	NA	NA	3.9	NA
Sinusitis	30 (16–43)	17.2	53.9	NA	NA	2.8	NA
Otitis media	39 (24–52)	15.6	49.5	NA	NA	3.0	NA
Tier 3	36 (32–40)	35.0	55.3	15.3	22.8	NA	4.7 (4.3–5.1)
VURTI	33 (28–38)	27.9	54.4	NA	NA	5.0	NA
Bronchitis	23 (9–35)	25.4	57.3	NA	NA	3.3	NA
Allergy or asthma	28 (15–39)	21.9	56.8	NA	NA	3.5	NA
Clinical influenza	33 (22–43)	67.7	49.4	NA	NA	11.0	NA
Other	35 (30–40)	30.0	54.1	NA	NA	5.7	NA

REVIEW

Open Access

The impact of influenza and pneumococcal vaccination on antibiotic use: an updated systematic review and meta-analysis



Lotte van Heuvel¹, John Paget^{1*}, Michel Dückers^{1,2,3} and Saverio Caini¹

« [comparative studies] show that the effect of influenza vaccination on the number of antibiotic prescriptions or days of antibiotic use (Ratio of Means (RoM) 0.71, 95% CI 0.62–0.83) **is stronger compared to the effect of pneumococcal vaccination** (RoM 0.92, 95% CI 0.85–1.00)»

Effet de la vaccination sur la consommation ATB

• Impact de la vaccination COVID-19

Clinical Infectious Diseases
MAJOR ARTICLE

AIDS
Infectious Diseases Society of America
hivma
The medicine association
OXFORD

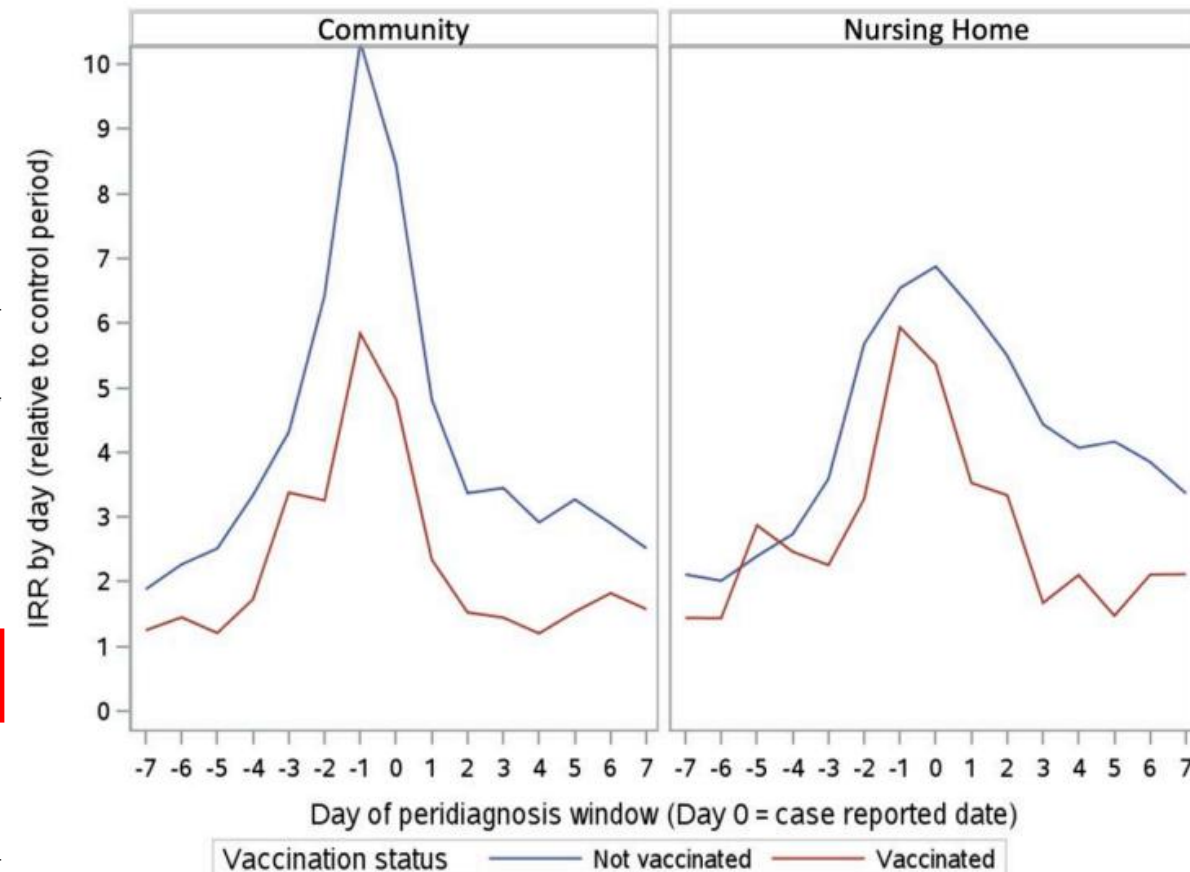
Coronavirus Disease 2019 Vaccination Is Associated With Reduced Outpatient Antibiotic Prescribing in Older Adults With Confirmed Severe Acute Respiratory Syndrome Coronavirus 2: A Population-Wide Cohort Study

Derek R. MacFadden,^{1,2,3} Colleen Maxwell,^{2,4,5} Dawn Bowdish,⁶ Susan Bronskill,⁷ James Brooks,⁸ Kevin Brown,^{9,10} Lori L. Burrows,⁶ Anna Clarke,² Bradley Langford,^{11,12} Elizabeth Leung,¹³ Valerie Leung,^{1,14} Doug Manuel,¹⁵ Allison McGeer,¹⁶ Sharmista Mishra,^{2,4,17,18} Andrew M. Morris,¹¹ Caroline Nott,⁹ Sumit Raybardhan,^{1,19} Mia Sapin,¹⁰ Kevin L. Schwartz,^{2,4,18} Miranda So,^{1,19} Jean-Paul R. Soucy,⁹ and Nick Daneman¹⁹

Ontario, 13 529 eligible nursing home residents and 50 885 eligible community-dwelling adults with SARS-CoV-2 infection
2020-2021

Variable	Prediagnosis		Postdiagnosis		Control Period	
	Rate	IRR (95% CI)	Rate	IRR (95% CI)	Rate	IRR
All	14.97	3.52 (3.28–3.77)	20.92	4.92 (4.59–5.27)	4.25	Ref
Age, y						
65–74	15.92	3.41 (2.83–4.10)	22.02	4.71 (3.89–5.70)	4.67	Ref
75–84	15.76	3.57 (3.15–4.06)	20.33	4.61 (4.05–5.24)	4.41	Ref
≥85	14.37	3.52 (3.21–3.86)	20.99	5.14 (4.70–5.63)	4.08	Ref
Sex						
Female	13.98	3.29 (3.03–3.58)	19.06	4.49 (4.13–4.88)	4.24	Ref
Male	17.13	4.01 (3.53–4.55)	25.14	5.88 (5.20–6.65)	4.27	Ref
COVID-19 vaccine						
<2 doses	15.00	3.59 (3.34–3.85)	21.43	5.12 (4.77–5.50)	4.19	Ref
≥2 doses	14.56	2.81 (2.18–3.63)	14.40	2.78 (2.13–3.64)	5.18	Ref
Index period						
January–June 2020	18.33	4.31 (3.86–4.83)	18.71	4.40 (3.91–4.96)	4.25	Ref
July–December 2020	12.75	3.11 (2.75–3.51)	20.58	5.02 (4.45–5.66)	4.10	Ref
January–June 2021	13.34	3.14 (2.71–3.63)	26.54	6.24 (5.46–7.14)	4.25	Ref
July–December 2021	13.95	2.66 (2.03–3.50)	13.17	2.52 (1.87–3.38)	5.23	Ref

Abbreviations: CI, confidence interval; COVID-19, coronavirus disease 2019; IRR, incidence rate ratio; Ref, reference.

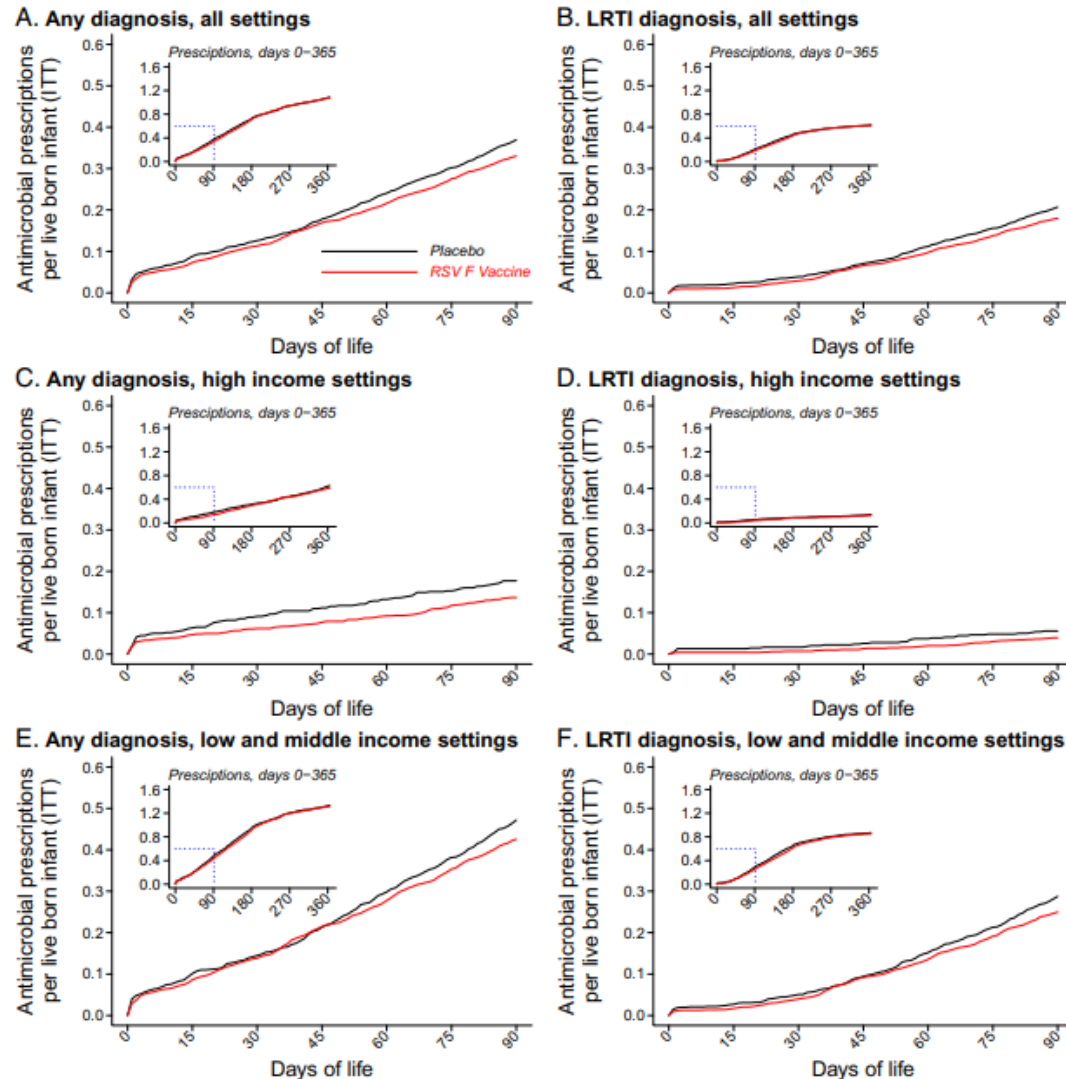


MacFadden DR, et al., Clin Infect Dis. 2023 Aug 14;77(3):362-370.

Vaccin VRS

Prevention of antimicrobial prescribing among infants following maternal vaccination against respiratory syncytial virus

Joseph A. Lewnard^{a,b,c,1}, Louis F. Fries^d, Iksung Cho^d, Janice Chen^d, and Ramanan Laxminarayan^{e,f}



Pas que les enfants

Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050

GBD 2021 Antimicrobial Resistance Collaborators*

- Problème majeur d'AMR chez les > 70 ans
- Population avec un élargissement des vaccins recommandés
- Couverture vaccinale très faible chez les sujets adultes

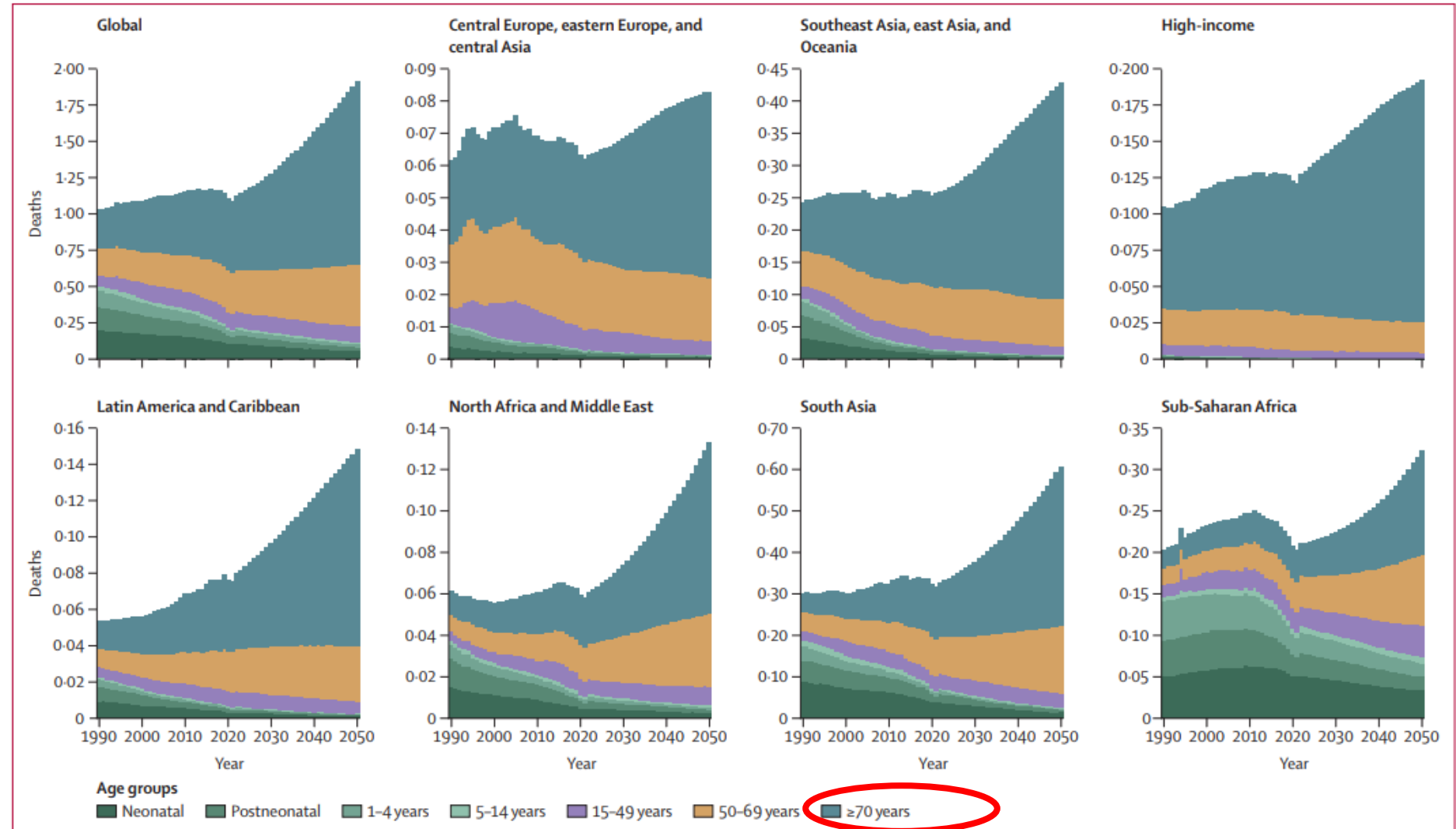


Figure 7: Deaths attributable to AMR by age group and location in the reference scenario, 2022–2050 Units are in millions.

The role of bacterial vaccines in the fight against antimicrobial resistance: an analysis of the preclinical and clinical development pipeline

Isabel Frost, Hatim Sati, Pilar Garcia-Vello, Mateusz Hasso-Agopsowicz, Christian Lienhardt, Valeria Gigante, Peter Beyer

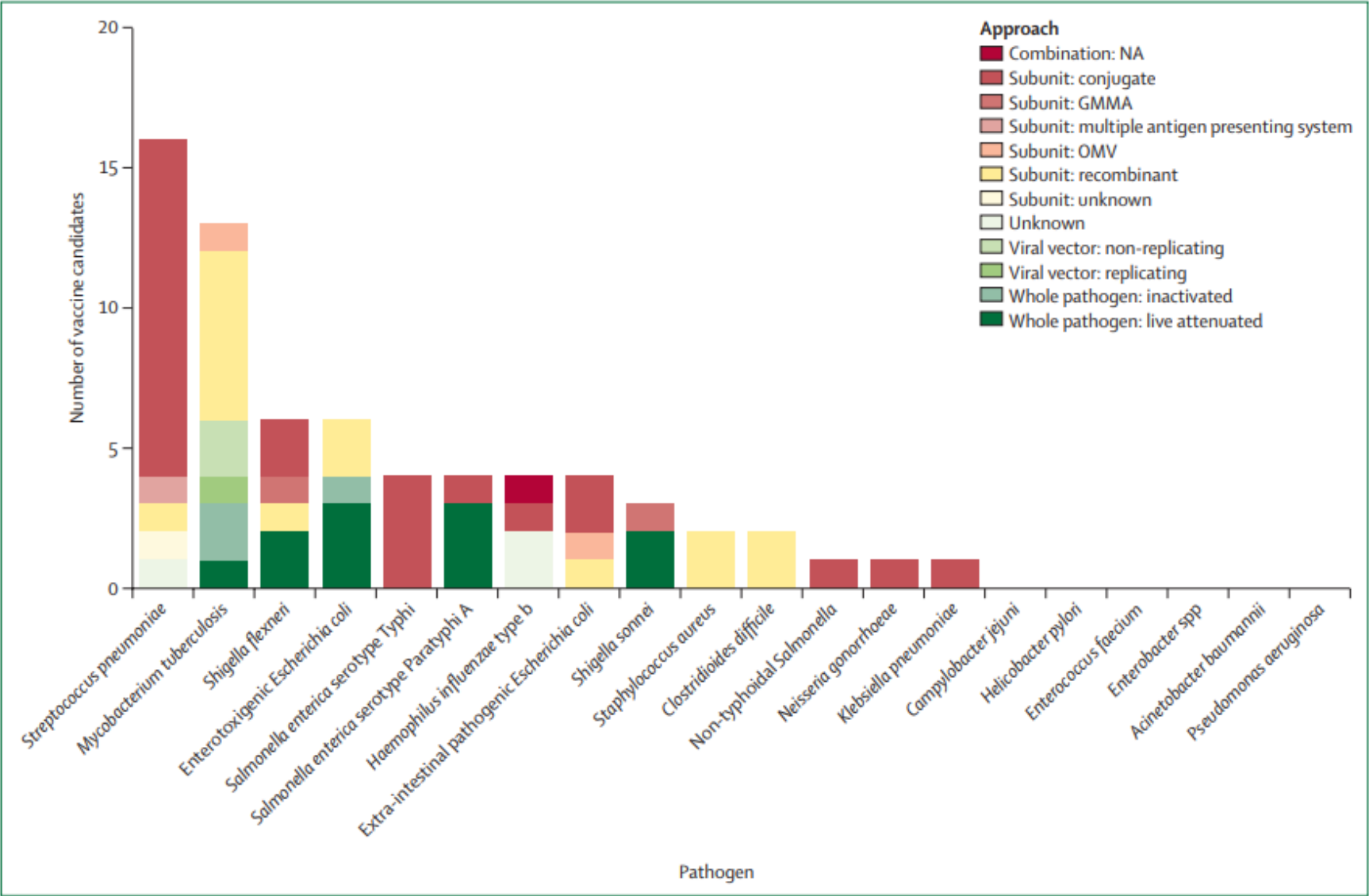


Figure 4: Number of vaccine candidates in active clinical development by approach

Vaccines and monoclonal antibodies to prevent healthcare-associated bacterial infections

Léo Sauvat ^{ID} 1,2,3,4, Paul O. Verhoeven ^{ID} 1,2,5, Julie Gagnaire ^{3,4}, Philippe Berthelot ^{ID} 1,2,3,4, Stéphane Paul ^{ID} 1,2,6, Elisabeth Botelho-Nevers ^{ID} 1,2,4,6, Amandine Gagneux-Brunon ^{ID} 1,2,4,6

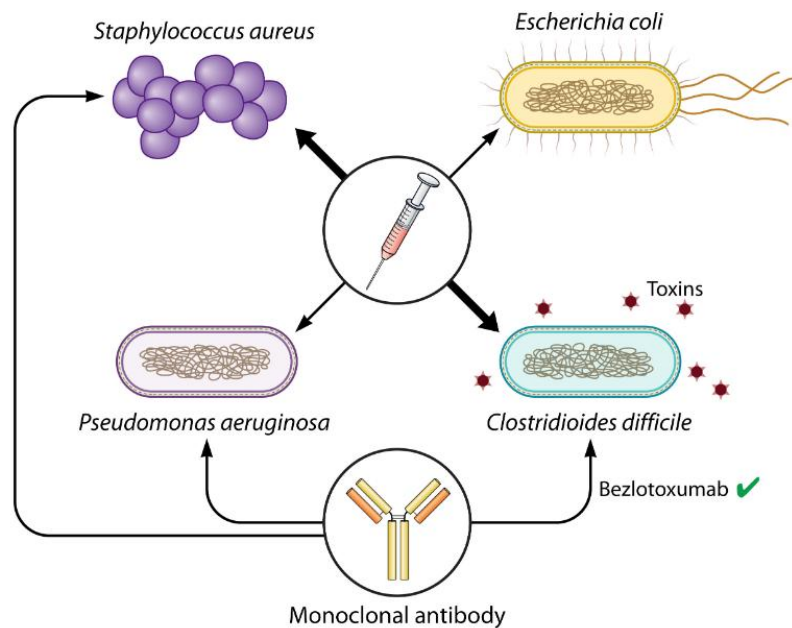


TABLE 4 Pathogen clusters according to the vaccines for AMR initiative (in bold, pathogens responsible for HAs) (Table view)

Increase uptake for existing, effective vaccines	Bring to market new vaccines for pathogens where protective immunity is understood, by accelerating clinical development	Advance early R&D for high impact pathogens with unclear R&D feasibility, by investing in early stage research	Collect data and explore alternatives for those pathogens on the list less well-suited to vaccine development due to significant outstanding epidemiological questions, low incidence and associated mortality and morbidity, or preferable alternative strategies
<i>Haemophilus influenzae</i>	<i>E. coli</i> (enteric)	<i>E. coli</i> (urinary)	<i>Acinetobacter baumannii</i>
<i>S. pneumoniae</i>	Nontyphoidal <i>Salmonella</i>	<i>P. aeruginosa</i>	<i>Campylobacter</i> spp.
<i>Salmonella typhi</i>	<i>Shigella</i>	<i>S. aureus</i>	<i>E. faecium</i>
		<i>N. gonorrhoeae</i>	<i>Enterobacteriaceae</i>
		<i>Mycobacterium tuberculosis</i>	<i>Helicobacter pylori</i>
			<i>K. pneumoniae</i>
			<i>Salmonella paratyphi</i>

Discontinuation

- SANOFI Pasteur: *Cdiffense*

Vaccin toxoïde à base de toxine A et de toxine B inactivées, adjuvanté par l'alun. 3 injections (J0, J7, J30) pour obtenir le taux d'AC.
Population cible 50-85 ans



Defining the optimal formulation and schedule of a candidate toxoid vaccine against *Clostridium difficile* infection: A randomized Phase 2 clinical trial^a

Guy de Bruyn^{a,*}, Jamshid Salek^b, David Workman^c, Richard Pollak^d, Victor Elimeff^e, Neil J. Fraser^f, Gigi Leibovici^g, Mark Mertens^h, Richard E. Millsⁱ, Richard Narayan^j, Miguel Treviño^k, Martin van Cheeff^l, Gineamarie Foglia^m, Ayca Ozol-Godfreyⁿ, Dhaval M. Patel^o, Patricia J. Pietroski^p, Richard Gesser^q, On behalf of the H-030-012 Clinical Investigator Study Team



Interim analysis

November 2017

Following an external analysis of study data the **Independent Data Monitoring Committee (IDMC)** has recommended that the *Cdiffense* study (Phase 3) be stopped for **futility** (non-efficacy). The planned interim analysis by the IDMC of the *Cdiffense* trial concluded that the probability the study would meet its primary objective is low.

INDEPENDENT DATA MONITORING COMMITTEE RECOMMENDS DISCONTINUATION OF THE PHASE 2B STRIVE CLINICAL TRIAL OF STAPHYLOCOCCUS AUREUS VACCINE FOLLOWING PLANNED INTERIM ANALYSIS

Thursday, December 20, 2018 - 4:30pm EST

NEW YORK—(BUSINESS WIRE)—Pfizer Inc. (NYSE:PFE) announced today that the Phase 2b trial STRIVE (*Staphylococcus aureus* Surgical Inpatient Vaccine Efficacy) evaluating the company's investigational *Staphylococcus aureus* (*S. aureus*) multi-antigen vaccine (PF-06290510) is being discontinued due to futility. This decision is based on a recommendation from an independent Data Monitoring Committee (DMC), composed of external experts, after conducting a pre-planned interim analysis.

A safety review by the DMC indicated that the investigational vaccine has been safe and well tolerated. STRIVE trial participants who are enrolled in the study will complete the study's follow-up evaluations.

Pfizer is evaluating next steps for the potential development of a *S. aureus* vaccine.

Pfizer

BREAKING NEWS, COLLABORATIONS & ALLIANCES, TRIALS & FILINGS

Sanofi, J&J Discontinue E.mbrace Study

Sanofi and Johnson & Johnson's *E. coli* vaccine candidate failed to prevent invasive *E. coli* disease effectively.

February 14, 2025

The poster features a photograph of an elderly couple sitting outdoors on a bench, smiling. The text on the right side of the poster is in French. It describes a study for adults aged 60 and over who are at risk of developing a blood infection caused by E. coli. The study is led by Janssen Research & Development. It mentions that E. coli is a common cause of urinary tract and invasive bacterial infections in older adults. The study aims to evaluate a vaccine candidate to prevent invasive E. coli infection. It lists eligibility criteria: aged 60 and over, medically stable, history of urinary tract infection (UTI) in the last 2 years, and ability to use a smartphone. It provides contact information for more details and a QR code for registration. The Janssen logo is at the bottom right.

Animal vaccines and antimicrobial resistance: an underutilized tool

Javier Yugueros-Marcos¹ and Floriane Etienne²

- Aux US, 70% des ATB importants médicalement sont utilisés en agriculture
- En Norvège, l'utilisation de vaccins chez les saumons a réduit la consommation de 99% en 1987 et 2024

REVIEW Open Access

Vaccines as alternatives to antibiotics for food producing animals. Part 1: challenges and needs

Karin Hoelzer^{1*}, Lisa Bielke², Damer P. Blake³, Eric Cox⁴, Simon M. Cutting⁵, Bert Devriendt⁴, Elisabeth Erlacher-Vindel⁶, Evy Goossens⁷, Kemal Karaca⁸, Stephane Lemiere⁹, Martin Metzner¹⁰, Margot Raicek⁶, Miquel Collell Suriñach¹¹, Nora M. Wong¹, Cyril Gay¹² and Filip Van Immerseel⁷

<https://doi.org/10.1098/rstb.2025.0009>
<https://doi.org/10.1186/s13567-018-0560-8>

Table 1: Infections for which new or improved vaccines would significantly reduce the need for antibiotic use in chickens

Key syndrome	Primary pathogen(s) (disease)	Antibiotic use	Commercial* Vaccine exists	Major constraints to use of vaccine / vaccine development	Vaccine research priority
Systemic (Broilers)	<i>Escherichia coli</i> (Yolk sac infection, airsaccuilitis, cellulitis)	High	Yes	• Omphalitis: a secondary bacterial infection - not a disease one can immunize against • Strain coverage limited • Aisaccuilitis, cellulitis: vaccines available, e.g. live aerosol vaccine. However, Serotype coverage limited and field efficacy variable	High
	<i>Infectious Bursal Disease virus</i> (secondary bacterial infection)	Medium	Yes	• Issues with vaccine application • Short window of opportunity to vaccinate • Maternal antibody interference	Medium
Systemic (Broilers, Layers)	<i>Escherichia coli</i> (airsaccuilitis, cellulitis, salpingitis, and peritonitis)	High	Yes	• Strain coverage limited	High
Enteric (Broilers, Breeders, and Layers)	<i>Clostridium perfringens</i> , type A (necrotic enteritis)	High	Yes	• Toxoid vaccine for layers providing only short-lasting passive immunity • Research needed to achieve active immunity • Improved and/or more convenient (mass vaccination) vaccine needed for broilers	High
	Coccidiosis (secondary bacterial infections)	High	Yes	• Lack of cross-protection • Strains ust be matched to infectious agent • Current vaccines are not attenuated and can produce low dose infection • Sub-unit vaccines have not been successful	High
	<i>Infectious Bronchitis virus</i> (secondary bacterial infection)	Medium	Yes	• Issues with strain matching and strain coverage • High mutation rate of virus	Medium

Au total,

- Vaccins sont rarement réellement intégrés dans les plans d'AMR
- Vaccins existants ont un potentiel important pour réduire l'AMR
 - Souvent pas assez utilisés (CV basses)
 - Ou non disponibles
 - Parfois pas/peu de données d'efficacité sur ce point
- Même avec des vaccins efficaces ne pas oublier tout le reste++
- Vaccins en développement +++ mais le chemin est assez lointain

- One health
- Au-delà de la résistance aux ATB

Box 1. Key outcomes.

- AMR is a One Health problem with devastating health and economic consequences, particularly in LMICs
- The importance of vaccines in addressing AMR is underappreciated
- Vaccines are an effective tool against AMR, both in humans and animals, but more evidence is needed
- Limited vaccines are available against the bacterial pathogens which are responsible for *1.27 million AMR deaths/year*
- There is limited funding to develop new vaccines, despite an estimated economic cost of *US\$3–7 trillion/year by 2050* from AMR
- The vaccine community must effectively communicate the role that vaccines play in reducing AMR
- The AMR community must integrate vaccines into AMR strategies, and actively implement them

Panel 1. Goals and objectives to leverage vaccines to prevent AMR.

Goal 1. Expand the use of licensed vaccines to maximize impact on AMR

Objective 1. Increase coverage of vaccines with impact on AMR

Objective 2. Update recommendations and normative guidance in both the vaccine and AMR sectors to include the role of vaccines to control AMR

Objective 3. Improve awareness and understanding of the role of vaccines in limiting AMR through effective communication, education and training

Goal 2. Develop new vaccines that contribute to prevention and control of AMR

Objective 4. Bridge the funding gap for R&D of new vaccines with potential for global AMR impact

Objective 5. Develop regulatory and policy mechanisms to accelerate approval and use of new vaccines that can reduce AMR

Goal 3. Expand and share knowledge of vaccine impact on AMR

Objective 6. Improve methodologies and increase collection and analysis of data to assess vaccine impact on AMR, including antimicrobial use

Objective 7. Develop estimates of vaccine value to avert the full public health and socioeconomic burden of AMR
