13th INTERNATIONAL CONFERENCE TYPHOID & OTHER INVASIVE SALMONELLOSES

December 5-7, 2023 | Kigali, Rwanda

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Efficacy of typhoid vaccines against culture confirmed *Salmonella* Typhi in typhoid endemic countries : A systematic review and meta-analysis

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Open Access Article

Strategies to Improve Coverage of Typhoid Conjugate Vaccine (TCV) Immunization Campaign in Karachi, Pakistan

by Farah Naz Qamar [1,*], Rabab Batool [1], Sonia Qureshi [1], Miqdad Ali [1], Tahira Sadaf [1], Junaid Mehmood [1], Khalid Iqbal [2], Akram Sultan [3], Noah Duff [4] and Mohammad Tahir Yousafzai [1]

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Effectiveness of typhoid conjugate vaccine against culture-confirmed typhoid in a peri-urban setting in Karachi: A case-control study

Rabab Batool [a b], Mohammad Tahir Yousafzai [a c], Sonia Qureshi [a], Miqdad Ali [a], Tahira Sadaf [a], Junaid Mehmood [a], Per Ashorn [b d], Farah Naz Qamar [a]

Article Category: Short Report

Risk Factors Associated with Extensively Drug-Resistant Typhoid in an Outbreak Setting of Lyari Town Karachi, Pakistan

Rabab Batool, Sonia Qureshi, Mohammad Tahir Yousafzai, Momin Kazi, Miqdad Ali, and Farah Naz Qamar

View Less —

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Parental acceptance of typhoid conjugate vaccine for children aged 6 months to 15 years in an outbreak setting of Lyari Town Karachi, Pakistan

Rabab Batool [a,b], Mohammad Tahir Yousafzai [a,c], Sonia Qureshi [a], Sajid Muhammad [a], Ibtisam Qazi [a], Tahira Sadaf [a], Per Ashorn [b], Farah Naz Qamar [a,*]

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PLOS ONE

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RESEARCH ARTICLE

Coverage survey of typhoid conjugate vaccine among children aged 6 months to 15 years in an urban slum settlement of Lyari Town Karachi, Pakistan

Rabab Batool, Sonia Qureshi, Zoya Haq, Mohammad Tahir Yousafzai, Rehana A. Salam, Rafey Ali, Tahira Sadaf, Miqdad Ali, Farah Naz Qamar

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Story of Lyari

Rabab Batool*

13th INTERNATIONAL CONFERENCE TYPHOID & OTHER INVASIVE SALMONELLOSES

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Outline

- Background
- Objectives
- Methods
  - PICOS Framework
  - PRISMA
  - Data Collection
  - RoB
  - Statistical Analysis
- Results
- Conclusion

Background

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A virulent strain

Drug-resistant superbug to blame for deadly typhoid outbreak in Pakistan

Researchers warn of limited treatment options as mutated strain of typhoid is blamed for surge in cases

US issues travel alert for Pakistan over typhoid superbug outbreak

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Background

- Strategic Typhoid Alliance Across Africa and Asia (STRATAA) study reported azithromycin resistance of 21% in Bangladesh and 2.8% in Nepal.[1,2]
- Efficacious and safe typhoid vaccines have existed since the early 1990s but were not introduced into routine immunization.

1. Hooda Y, Sajib MS, Rahman H, Luby SP, Bondy-Denomy J, Santosham M, Andrews JR, Saha SK, Saha S. Molecular mechanism of azithromycin resistance among typhoidal Salmonella strains in Bangladesh identified through passive pediatric surveillance. PLoS neglected tropical diseases. 2019 Nov 15;13(11):e0007868.
2. Saha S, Sajib MS, Garrett D, Qamar FN. Antimicrobial resistance in typhoidal Salmonella: around the world in 3 days. Clinical Infectious Diseases. 2020 Jul 29;71(Supplement_2):S91-5.

Characteristics of the 2 Typhoid Vaccines Recommended by the World Health Organization: Ty21a and Vi Polysaccharide

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	Ty21a Vaccine	**Vi Capsular Polysaccharide Vaccine**
Vaccine type	Live attenuated	Subunit
Composition	Chemically mutated Ty2 strain of S. typhi	Purified Vi capsular polysaccharide of Ty2 S. typhi strain
Immunogenic properties	▪Elicits mucosal IgA and serum IgG antibodies against O, H, and other antigens, as well as cell-mediated responses ▪No booster effect has been shown	▪Elicits serum IgG Vi antibodies ▪T-cell independent (no booster response)
Route of administration	Oral	Parenteral (subcutaneous or intramuscular)
Minimum age vaccine is licensed for use	2 years old for liquid formulation and 5 years old for capsule formulation	2 years old
Formulation	▪Enteric-coated capsules, or ▪Liquid suspension (lyophilized vaccine + buffer mixed with water upon use)	Solution of 25 µg combined with buffer
Number of doses required for complete vaccine regimen	3 to 4	1
Storage requirements	Requires storage at 2º to 8ºC	Requires storage at 2º to 8ºC
Shelf life in higher temperature	14 days at 25 °C	6 months at 37 °C 2 years at 22 °C
Safety/tolerability	High	High
Efficacy at 3 years (95% CI)	51% (36–62%)	55% (30–70%)
Length of protection	At least 5–7 years	At least 3 years

Syed KA, Saluja T, Cho H, Hsiao A, Shaikh H, Wartel TA, Mogasale V, Lynch J, Kim JH, Excler JL, Sahastrabuddhe S. Review on the recent advances on typhoid vaccine development and challenges ahead. Clinical Infectious Diseases. 2020 Jul 29;71(Supplement_2):S141-50.

World Health Organization

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Home / News / Typhoid vaccine prequalified

Typhoid vaccine prequalified

Home 〉 News 〉 New typhoid vaccine offers hope of protection for children

New typhoid vaccine offers hope of protection for children

PUBLISHED
29 SEP 2017

RESEARCH HEALTH SCIENCE

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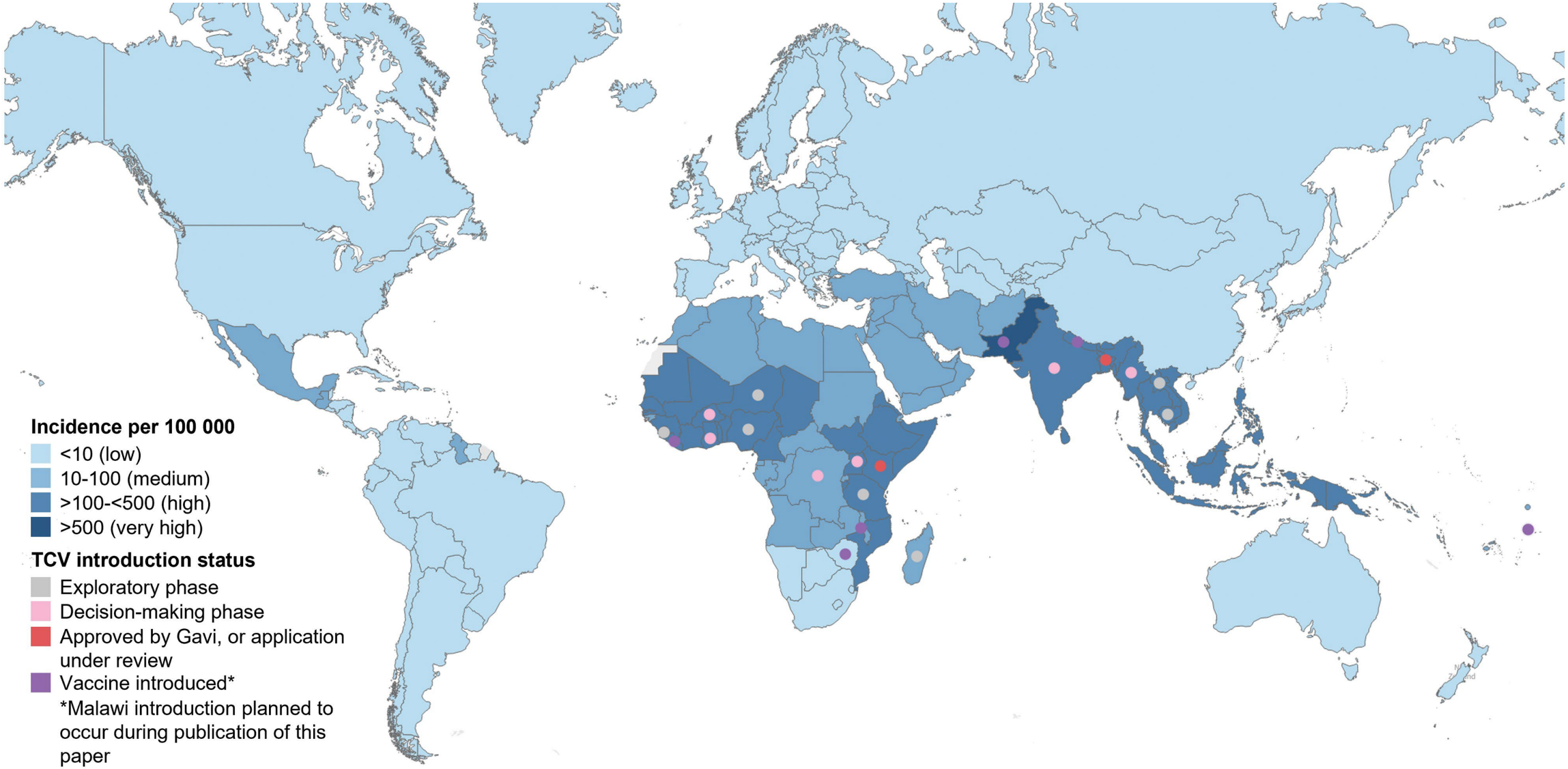
A new typhoid vaccine for both adults and children has been proven by Oxford researchers to be safe and effective in preventing the disease.

Perspective

Extensively Drug-Resistant Typhoid — Are Conjugate Vaccines Arriving Just in Time?

Jason R. Andrews, M.D., Farah N. Qamar, F.C.P.S., Richelle C. Charles, M.D., and Edward T. Ryan, M.D.


Incidence per 100 000
<10 (low)
10-100 (medium)
>100-<500 (high)
>500 (very high)
TCV introduction status
Exploratory phase
Decision-making phase
Approved by Gavi, or application under review
Vaccine introduced*
*Malawi introduction planned to occur during publication of this paper

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Objectives

- To synthesize evidence on the efficacy and safety of typhoid vaccines against culture-confirmed *S.* Typhi.

Methods

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Literature search

- January 1986, and January 2023
- Cochrane (CENTRAL), MEDLINE, and Embase

Search updated on November 2nd, 2023.

PROSPERO protocol ID: CRD42021241043

Description of the PICOS strategy

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Population	All age groups
Intervention	**All typhoid vaccines:** The Live Attenuated Ty21a, Vi capsular polysaccharide, Vi-tetanus toxoid conjugate vaccine, Vi polysaccharide conjugated to recombinant Pseudomonas aeruginosa exotoxin A vaccine (Vi-rEPA)
Comparison	**Control:** Placebo , Typhoid-inactive agents , Vaccines other than Typhoid
Outcome	**Vaccine efficacy:** calculated as (1 – IRR)×100% **Adverse event**s: within 7 days following vaccination.
Study Type	**Included:** Randomized control trials (RCTs) (individually, cluster and quasi-randomized trials) **Excluded:** - Observational studies - Modeling studies, human challenge studies, studies with sample size <30 - Studies in languages other than English - Trials that aimed to assess only the immunogenicity of vaccine, or side effects - Studies older than 1986

The PRISMA flow diagram

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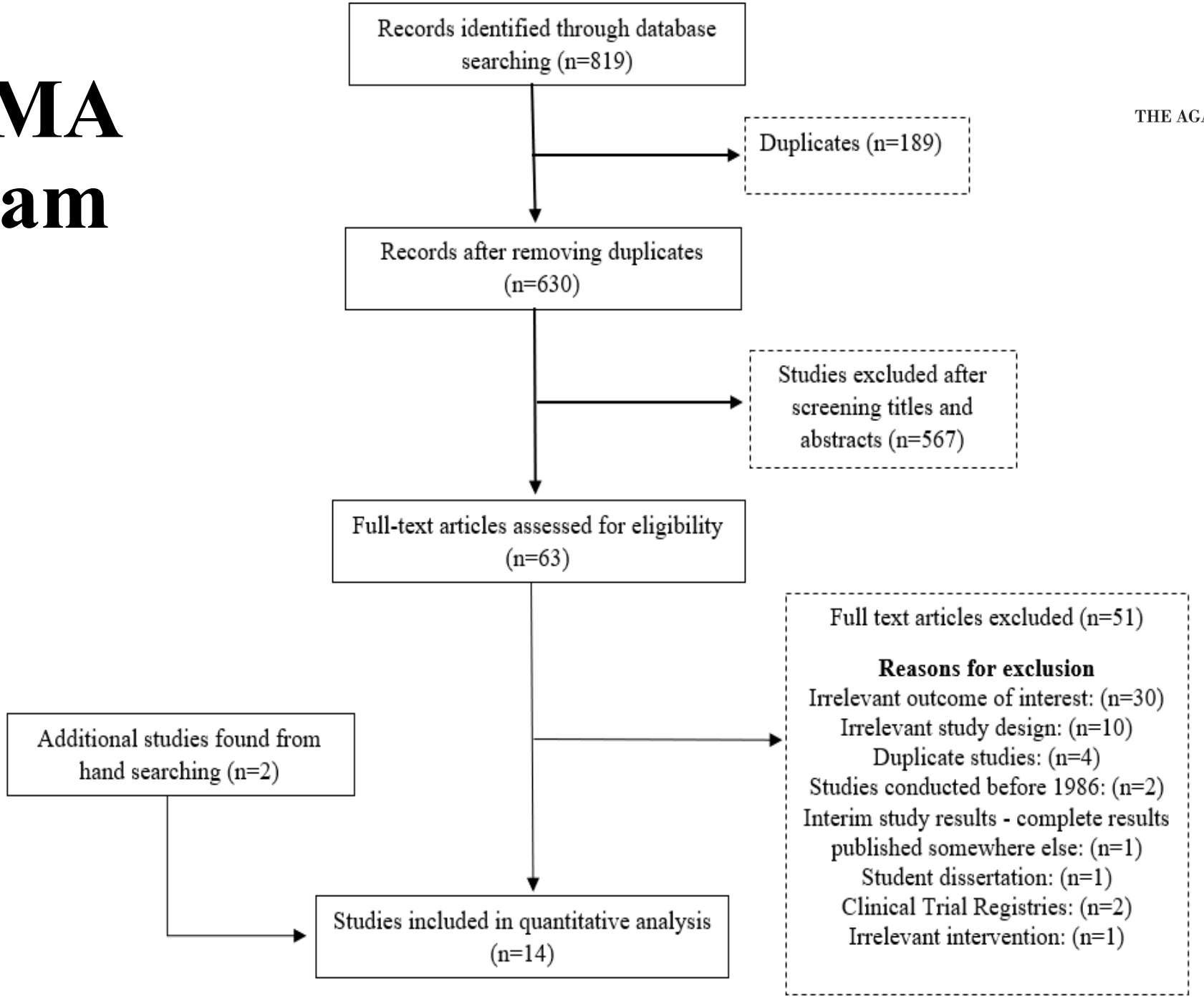

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Data collection

- Covidence Systematic Review Software >> screening

- Data were extracted on:
  - Type of vaccine, number of shots or doses, follow-up duration, nature of vaccine formulation
  - Mode of administration (oral, IM)
  - Type of surveillance method for vaccine efficacy
  - Age of trial participants
  - Outcomes reported (vaccine efficacy and adverse events).

Data collection

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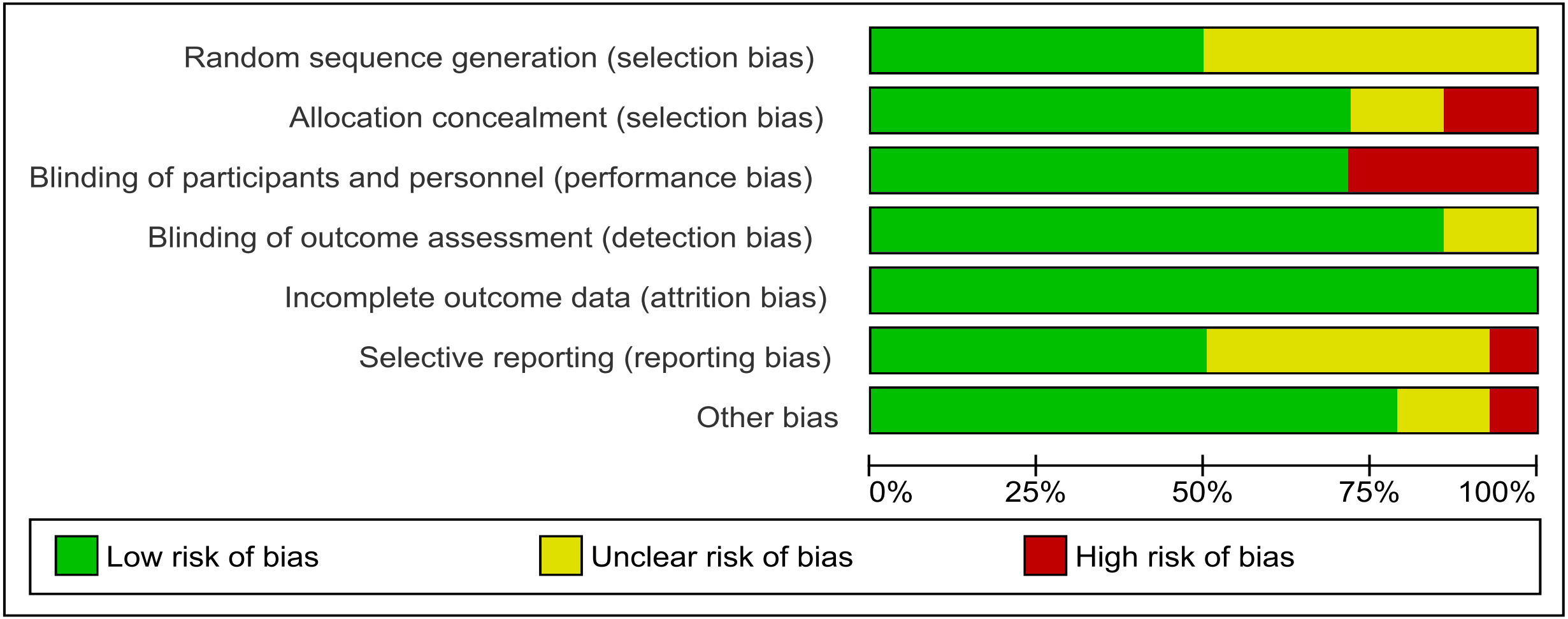
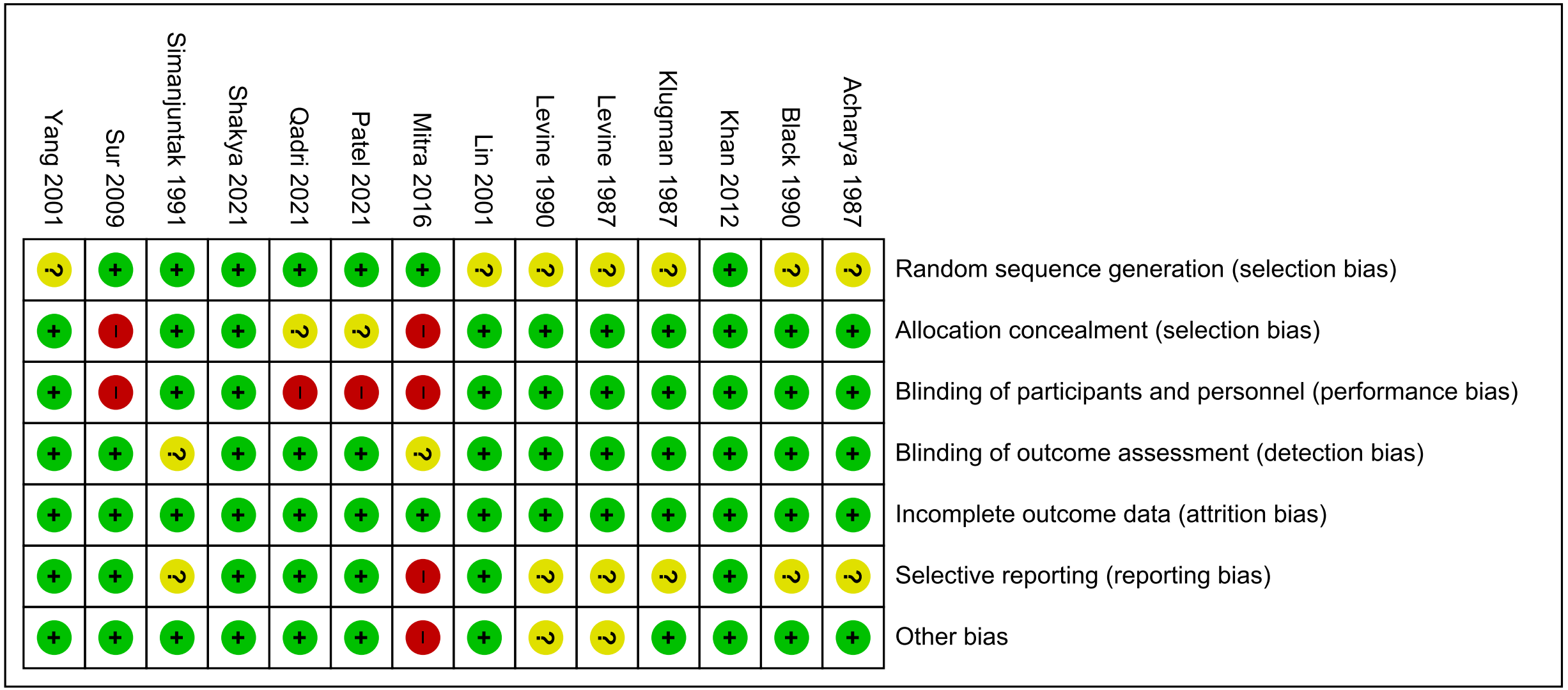
- For cluster-RCTs , effective sample sizes was calculated.
- The estimates from the individually randomized and cluster adjusted RCTs were pooled using GIV method.
- Methodological quality of articles was assessed using RoB 2.0.
- Quality of evidence for outcomes of interest was summarized as per (GRADE) criteria.

GRADEpro GDT

Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies



Risk of bias summary for each risk of bias item for each included study



Statistical analysis

Meta-analysis

- RevMan software (5.4.1).

- Random effects model
  - data were heterogeneous.
- Statistical heterogeneity
  - τ^2, I^2, and the significance of the χ^2 test.
- Publication bias
  - funnel plots by assessing asymmetry.
- Subgroup analysis
  - Age groups

Results

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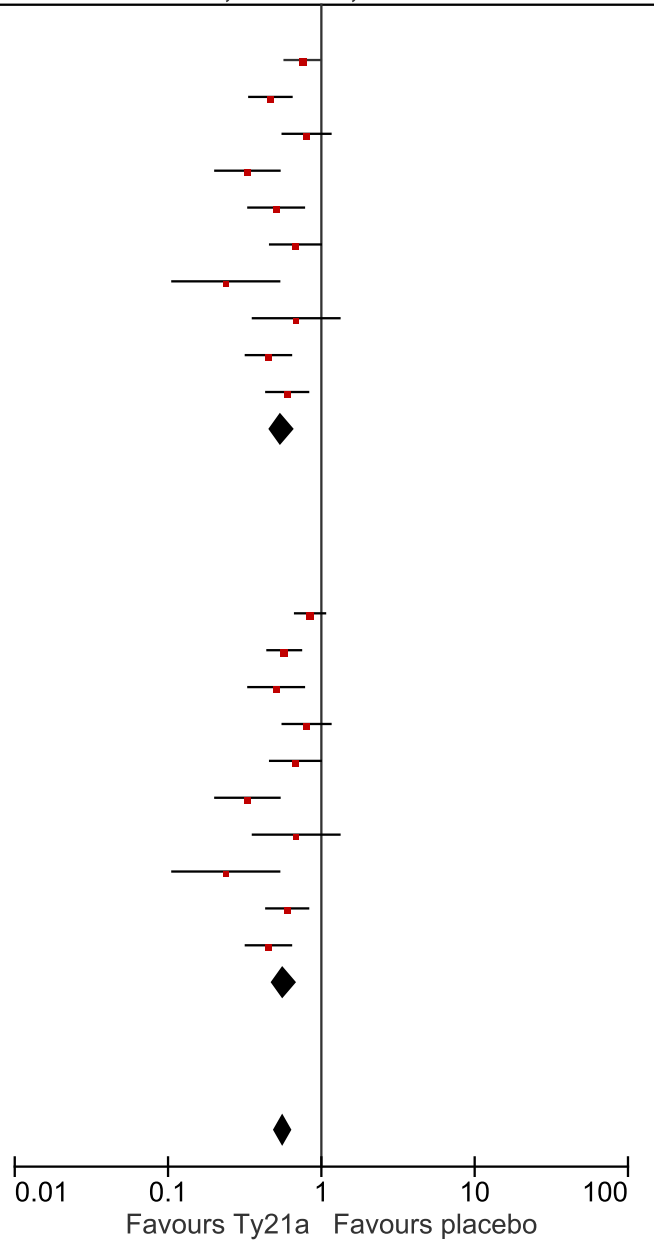
Ty21a versus control

Study or Subgroup	log[Risk Ratio]	SE	Weight	Risk Ratio IV, Random, 95% CI
26.9.5 Cumulative efficacy at 1-3 years				
Black 1990 (1)	-0.2797	0.139	6.6%	0.76 [0.58, 0.99]
Black 1990 (2)	-0.7652	0.1618	6.0%	0.47 [0.34, 0.64]
Levine 1987 (3)	-0.2221	0.1832	5.5%	0.80 [0.56, 1.15]
Levine 1987 (4)	-1.1106	0.246	4.2%	0.33 [0.20, 0.53]
Levine 1987 (5)	-0.679	0.213	4.9%	0.51 [0.33, 0.77]
Levine 1987 (6)	-0.3887	0.1944	5.3%	0.68 [0.46, 0.99]
Levine 1990 (7)	-1.4354	0.4094	2.2%	0.24 [0.11, 0.53]
Levine 1990 (8)	-0.3781	0.3317	2.9%	0.69 [0.36, 1.31]
Simanjuntak 1991 (9)	-0.7949	0.1731	5.7%	0.45 [0.32, 0.63]
Simanjuntak 1991 (10)	-0.5129	0.1603	6.0%	0.60 [0.44, 0.82]
Subtotal (95% CI)			**49.3%**	**0.55 [0.45, 0.67]**
Heterogeneity: Tau² = 0.05; Chi² = 21.98, df = 9 (P = 0.009); I² = 59%				
Test for overall effect: Z = 6.05 (P < 0.00001)				
26.9.8 Cumulative efficacy at 1-5 years				
Black 1990 (11)	-0.1696	0.1148	7.2%	0.84 [0.67, 1.06]
Black 1990 (12)	-0.5575	0.1287	6.8%	0.57 [0.44, 0.74]
Levine 1987 (13)	-0.679	0.213	4.9%	0.51 [0.33, 0.77]
Levine 1987 (14)	-0.2221	0.1832	5.5%	0.80 [0.56, 1.15]
Levine 1987 (15)	-0.3887	0.1944	5.3%	0.68 [0.46, 0.99]
Levine 1987 (16)	-1.1106	0.246	4.2%	0.33 [0.20, 0.53]
Levine 1990 (17)	-0.3781	0.3317	2.9%	0.69 [0.36, 1.31]
Levine 1990 (18)	-1.4354	0.4094	2.2%	0.24 [0.11, 0.53]
Simanjuntak 1991 (19)	-0.5129	0.1603	6.0%	0.60 [0.44, 0.82]
Simanjuntak 1991 (20)	-0.7949	0.1731	5.7%	0.45 [0.32, 0.63]
Subtotal (95% CI)			**50.7%**	**0.57 [0.47, 0.70]**
Heterogeneity: Tau² = 0.06; Chi² = 26.19, df = 9 (P = 0.002); I² = 66%				
Test for overall effect: Z = 5.46 (P < 0.00001)				
Total (95% CI)			**100.0%**	**0.56 [0.49, 0.64]**
Heterogeneity: Tau² = 0.05; Chi² = 48.94, df = 19 (P = 0.0002); I² = 61%				
Test for overall effect: Z = 8.30 (P < 0.00001)				
Test for subgroup differences: Chi² = 0.08, df = 1 (P = 0.78), I² = 0%				

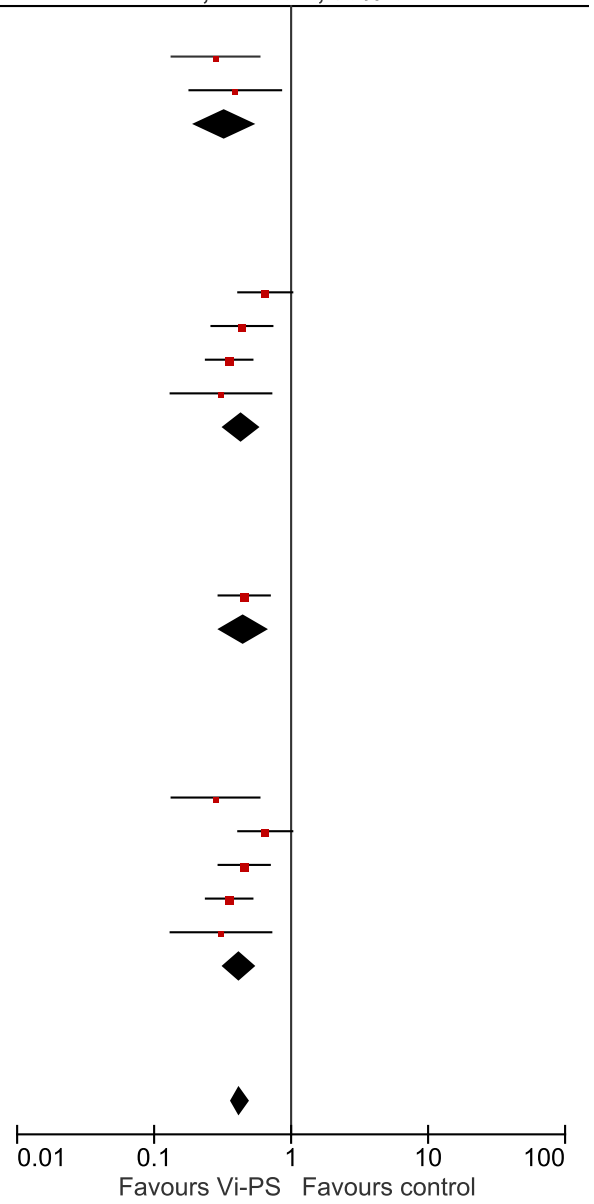


Summary of findings: Ty21a versus control for preventing Typhoid fever

Outcomes	Anticipated absolute effects (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)
	Risk with control	**Risk with vaccine**			
Ty21a versus placebo for blood culture confirmed *S.* Typhi					
Incidence of Typhoid fever at 1 year	54 per 10,000	**32 per 10,000** (25 to 41)	**RR 0.59** (0.46 to 0.76)	129757 (3 RCTs)	⊕⊕⊕⊕ High
Incidence of Typhoid fever at 2 years	99 per 10,000	**50 per 10,000** (39 to 65)	**RR 0.50** (0.39 to 0.65)	129757 (3 RCTs)	⊕⊕⊕◯ Moderate[a]
Incidence of Typhoid fever at 1 to 3 years	116 per 10,000	**64 per 10,000** (52 to 78)	**RR 0.55** (0.45 to 0.67)	247649 (4 RCTs)	⊕⊕⊕◯ Moderate[b]
Incidence of Typhoid fever at 4 years	108 per 10,000	**71 per 10,000** (47 to 108)	**RR 0.66** (0.44 to 1.00)	82544 (1 RCT)	⊕⊕◯◯ Low[c,d]
Incidence of Typhoid fever at 5 years	120 per 10,000	**84 per 10,000** (58 to 123)	**RR 0.70** (0.48 to 1.02)	82544 (1 RCT)	⊕⊕◯◯ Low[e,f]
Cumulative incidence of Typhoid fever at 1 to 5 years	130 per 10,000	**74 per 10,000** (61 to 91)	**RR 0.57** (0.47 to 0.70)	247649 (4 RCTs)	⊕⊕⊕◯ Moderate[g]

Vi-PS versus control

Study or Subgroup	log[Risk Ratio]	SE	Vi-PS Total	Control Total	Weight	Risk Ratio IV, Random, 95% CI
28.6.2 Efficacy at 1 year						
Acharya 1987	-1.2705	0.3765	3457	3450	4.3%	0.28 [0.13, 0.59]
Klugman 1987	-0.9383	0.3927	5692	5692	4.0%	0.39 [0.18, 0.84]
Subtotal (95% CI)			**9149**	**9142**	**8.3%**	**0.33 [0.19, 0.56]**
Heterogeneity: Tau² = 0.00; Chi² = 0.37, df = 1 (P = 0.54); I² = 0%						
Test for overall effect: Z = 4.09 (P < 0.0001)						
28.6.3 Efficacy at 2 years						
Khan 2012	-0.4344	0.2315	13228	13993	10.6%	0.65 [0.41, 1.02]
Klugman 1987	-0.8267	0.261	5692	5692	8.6%	0.44 [0.26, 0.73]
Sur 2009	-1.0414	0.1993	18869	18804	13.7%	0.35 [0.24, 0.52]
Yang 2001	-1.179	0.4316	65287	65984	3.3%	0.31 [0.13, 0.72]
Subtotal (95% CI)			**103076**	**104473**	**36.3%**	**0.44 [0.32, 0.60]**
Heterogeneity: Tau² = 0.04; Chi² = 4.70, df = 3 (P = 0.20); I² = 36%						
Test for overall effect: Z = 5.08 (P < 0.00001)						
28.6.4 Efficacy at 3 years						
Klugman 1987	-0.7885	0.2194	5692	5692	11.7%	0.45 [0.30, 0.70]
Subtotal (95% CI)			**5692**	**5692**	**11.7%**	**0.45 [0.30, 0.70]**
Heterogeneity: Not applicable						
Test for overall effect: Z = 3.59 (P = 0.0003)						
28.6.5 Cumulative efficacy at 1-3 years						
Acharya 1987	-1.2705	0.3765	3457	3450	4.3%	0.28 [0.13, 0.59]
Khan 2012	-0.4344	0.2315	13228	13993	10.6%	0.65 [0.41, 1.02]
Klugman 1987	-0.7885	0.2194	5692	5692	11.7%	0.45 [0.30, 0.70]
Sur 2009	-1.0414	0.1993	18869	18804	13.7%	0.35 [0.24, 0.52]
Yang 2001	-1.179	0.4316	65287	65984	3.3%	0.31 [0.13, 0.72]
Subtotal (95% CI)			**106533**	**107923**	**43.7%**	**0.42 [0.31, 0.56]**
Heterogeneity: Tau² = 0.04; Chi² = 6.05, df = 4 (P = 0.20); I² = 34%						
Test for overall effect: Z = 5.95 (P < 0.00001)						
Total (95% CI)			**224450**	**227230**	**100.0%**	**0.42 [0.36, 0.50]**
Heterogeneity: Tau² = 0.01; Chi² = 12.15, df = 11 (P = 0.35); I² = 9%						
Test for overall effect: Z = 10.69 (P < 0.00001)						
Test for subgroup differences: Chi² = 0.99, df = 3 (P = 0.80), I² = 0%						



Summary of findings: Vi-PS versus control for preventing Typhoid fever

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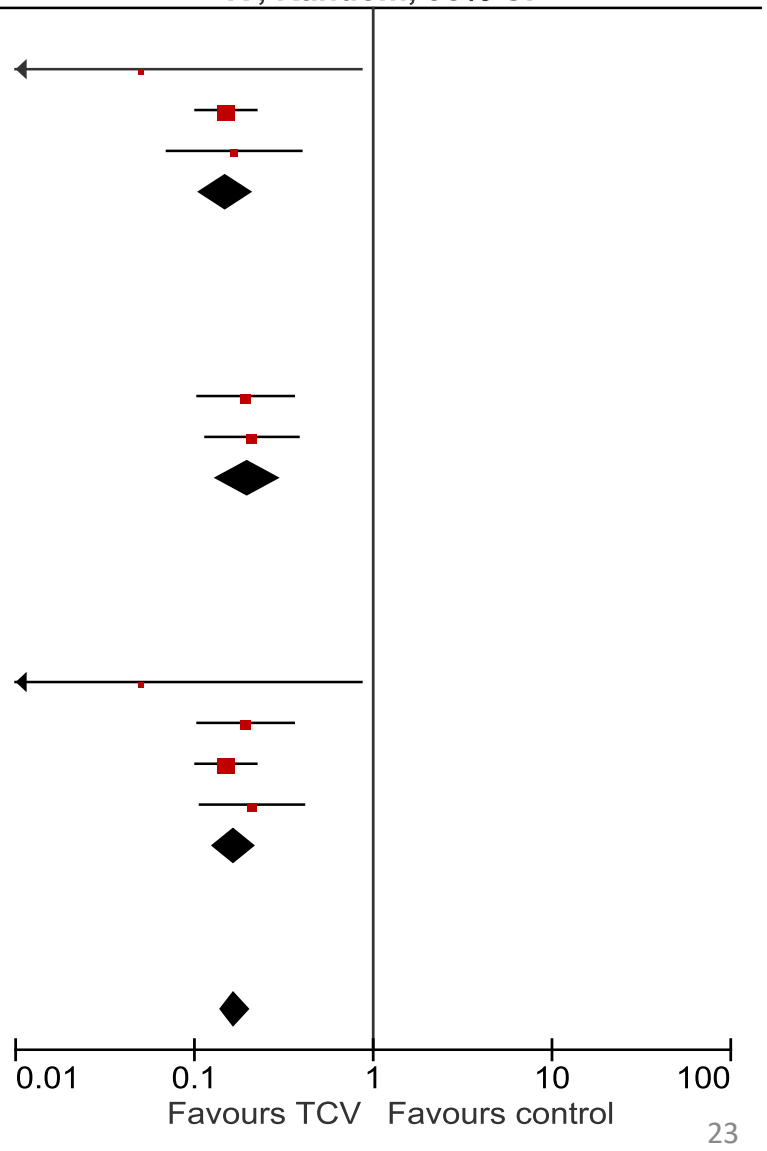
Outcomes	Anticipated absolute effects (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)
	Risk with control	**Risk with vaccine**			
Ty21a versus placebo for blood culture confirmed *S.* Typhi					
Vi-PS versus control for blood culture confirmed *S.* Typhi					
Incidence of Typhoid fever at 1 year	60 per 10,000	**20 per 10,000** (11 to 34)	**RR 0.33** (0.19 to 0.56)	18291 (2 RCTs)	⊕⊕⊕⊕ High
Incidence of Typhoid fever at 2 years	21 per 10,000	**9 per 10,000** (7 to 12)	**RR 0.44** (0.32 to 0.60)	207549 (4 RCTs)	⊕⊕⊕◯ Moderate[h]
Cumulative incidence of Typhoid fever at 1 to 3 years	25 per 10,000	**10 per 10,000** (8 to 14)	**RR 0.42** (0.31 to 0.56)	214456 (5 RCTs)	⊕⊕⊕◯ Moderate[h]

Footnotes

h. High risk of bias was observed in one study (Sur 2009) as the two vaccines (control & typhoid vaccine) were not packaged in an identical fashion therefore allocation concealment and blinding were compromised.

TCV versus control

Study or Subgroup	log[Risk Ratio]	SE	TCV Total	Control Total	Weight	Risk Ratio IV, Random, 95% CI
20.1.2 Efficacy at 1 year						
Mitra 2016	-2.9953	1.45	725	689	0.5%	0.05 [0.00, 0.86]
Qadri 2021	-1.8966	0.1991	30882	30685	26.3%	0.15 [0.10, 0.22]
Shakya 2021	-1.7909	0.4407	10005	10014	5.4%	0.17 [0.07, 0.40]
Subtotal (95% CI)			**41612**	**41388**	**32.1%**	**0.15 [0.11, 0.21]**
Heterogeneity: Tau² = 0.00; Chi² = 0.63, df = 2 (P = 0.73); I² = 0%						
Test for overall effect: Z = 10.53 (P < 0.00001)						
20.1.3 Efficacy at 2 years						
Patel 2021	-1.6428	0.3152	14069	14061	10.5%	0.19 [0.10, 0.36]
Shakya 2021	-1.5613	0.3047	10005	10014	11.2%	0.21 [0.12, 0.38]
Subtotal (95% CI)			**24074**	**24075**	**21.7%**	**0.20 [0.13, 0.31]**
Heterogeneity: Tau² = 0.00; Chi² = 0.03, df = 1 (P = 0.85); I² = 0%						
Test for overall effect: Z = 7.31 (P < 0.00001)						
20.1.4 Cumulative efficacy at 1-2 years						
Mitra 2016	-2.9953	1.45	725	689	0.5%	0.05 [0.00, 0.86]
Patel 2021	-1.6428	0.3152	14069	14061	10.5%	0.19 [0.10, 0.36]
Qadri 2021	-1.8966	0.1991	30882	30685	26.3%	0.15 [0.10, 0.22]
Shakya 2021	-1.5613	0.3407	10005	10014	9.0%	0.21 [0.11, 0.41]
Subtotal (95% CI)			**55681**	**55449**	**46.2%**	**0.17 [0.12, 0.23]**
Heterogeneity: Tau² = 0.00; Chi² = 1.65, df = 3 (P = 0.65); I² = 0%						
Test for overall effect: Z = 11.90 (P < 0.00001)						
Total (95% CI)			**121367**	**120912**	**100.0%**	**0.17 [0.14, 0.21]**
Heterogeneity: Tau² = 0.00; Chi² = 3.40, df = 8 (P = 0.91); I² = 0%						
Test for overall effect: Z = 17.46 (P < 0.00001)						
Test for subgroup differences: Chi² = 1.09, df = 2 (P = 0.58), I² = 0%						



Summary of findings: TCV versus control for preventing Typhoid fever

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Outcomes	Anticipated absolute effects (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)
	Risk with control	**Risk with vaccine**			
TCV versus control for blood culture confirmed S. Typhi					
Incidence of Typhoid fever at 1 year	57 per 10,000	**9 per 10,000** (6 to 12)	**RR 0.15** (0.11 to 0.21)	83000 (3 RCTs)	⊕⊕⊕◯ Moderate[i]
Incidence of Typhoid fever at 2 years	52 per 10,000	**10 per 10,000** (7 to 16)	**RR 0.20** (0.13 to 0.31)	48149 (2 RCTs)	⊕⊕⊕◯ Moderate[i]
Cumulative incidence of Typhoid fever at 1 to 2 years	59 per 10,000	**10 per 10,000** (8 to 13)	**RR 0.17** (0.13 to 0.23)	111130 (4 RCTs)	⊕⊕⊕◯ Moderate[i]

Footnotes

i. High risk of bias was observed in one study (Mitra 2016) in multiple domains including allocation concealment, blinding selective reporting and other biases (analysis not adjusted for clustering, results might have been affected due to seasonal variations and baseline differences were observed between demographics of vaccines versus control group. High risk of bias in blinding was observed in two studies (Patel 2021, Qadri 2021).

Subgroup Analysis

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Results

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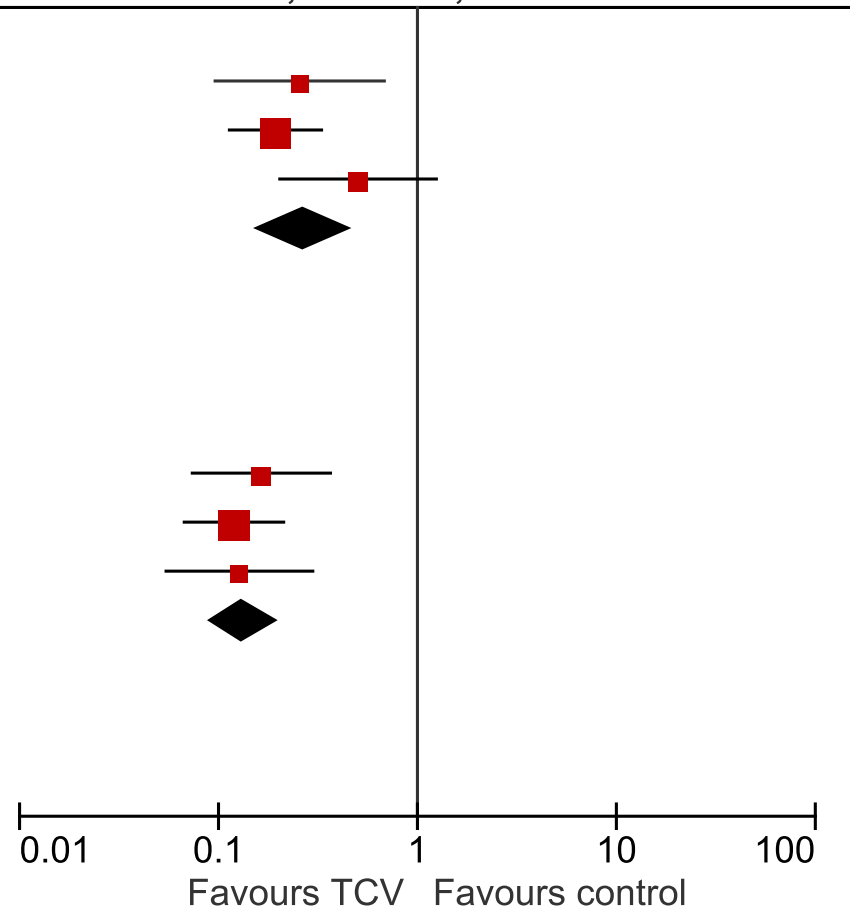
Study or Subgroup	log[Risk Ratio]	SE	TCV Total	Control Total	Weight	Risk Ratio IV, Random, 95% CI
19.1.1 Efficacy of TCV < 5 Years						
Patel 2021	-1.3627	0.4996	5058	5179	24.1%	0.26 [0.10, 0.68]
Qadri 2021	-1.6432	0.2721	8973	9217	49.0%	0.19 [0.11, 0.33]
Shakya 2021	-0.6872	0.4623	3661	3683	26.9%	0.50 [0.20, 1.24]
Subtotal (95% CI)			**17692**	**18079**	**100.0%**	**0.27 [0.15, 0.47]**
Heterogeneity: Tau² = 0.10; Chi² = 3.18, df = 2 (P = 0.20); I² = 37%						
Test for overall effect: Z = 4.57 (P < 0.00001)						
19.1.2 Efficacy of TCV > 5 years						
Patel 2021	-1.8062	0.408	9011	8882	26.2%	0.16 [0.07, 0.37]
Qadri 2021	-2.1238	0.2936	21375	21037	50.6%	0.12 [0.07, 0.21]
Shakya 2021	-2.0604	0.4332	6344	6331	23.2%	0.13 [0.05, 0.30]
Subtotal (95% CI)			**36730**	**36250**	**100.0%**	**0.13 [0.09, 0.20]**
Heterogeneity: Tau² = 0.00; Chi² = 0.41, df = 2 (P = 0.82); I² = 0%						
Test for overall effect: Z = 9.70 (P < 0.00001)						



Test for subgroup differences: Chi² = 3.94, df = 1 (P = 0.05), I² = 74.6%

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Summary of findings: TCV versus control for preventing Typhoid fever in different age groups

Outcomes	**Anticipated absolute effects** (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)
	Risk with control	**Risk with vaccine**			
TCV versus control for blood culture confirmed *S.* Typhi in different age groups					
Incidence of Typhoid fever - children <5 years	7 per 1,000	**2 per 1,000** (1 to 3)	**RR 0.27** (0.15 to 0.47)	35771 (3 RCTs)	⊕⊕⊕◯ Moderate[d]
Incidence of Typhoid fever - children ≥5 years	5 per 1,000	**1 per 1,000** (0 to 1)	**RR 0.13** (0.09 to 0.20)	72980 (3 RCTs)	⊕⊕⊕◯ Moderate[d]

Footnotes:

d. High risk of bias due to lack of blinding in two studies (Patel 2021, Qadri 2021)

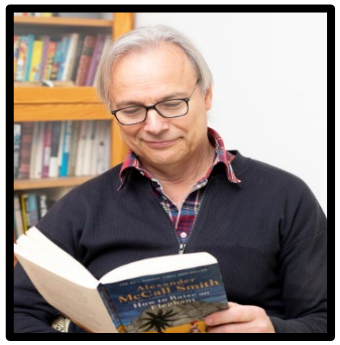
Conclusions

- The data from included trials provide promising results regarding the efficacy of TCV in typhoid endemic countries.
- The efficacy of TCV is found to be higher than that of the previously licensed vaccines.
- The longer-term efficacy of TCV and the need for booster dose for younger children must be assessed.

Acknowledgments

13th INTERNATIONAL CONFERENCE TYPHOID & OTHER INVASIVE SALMONELLOSES

December 5-7, 2023 | Kigali, Rwanda



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THANK YOU