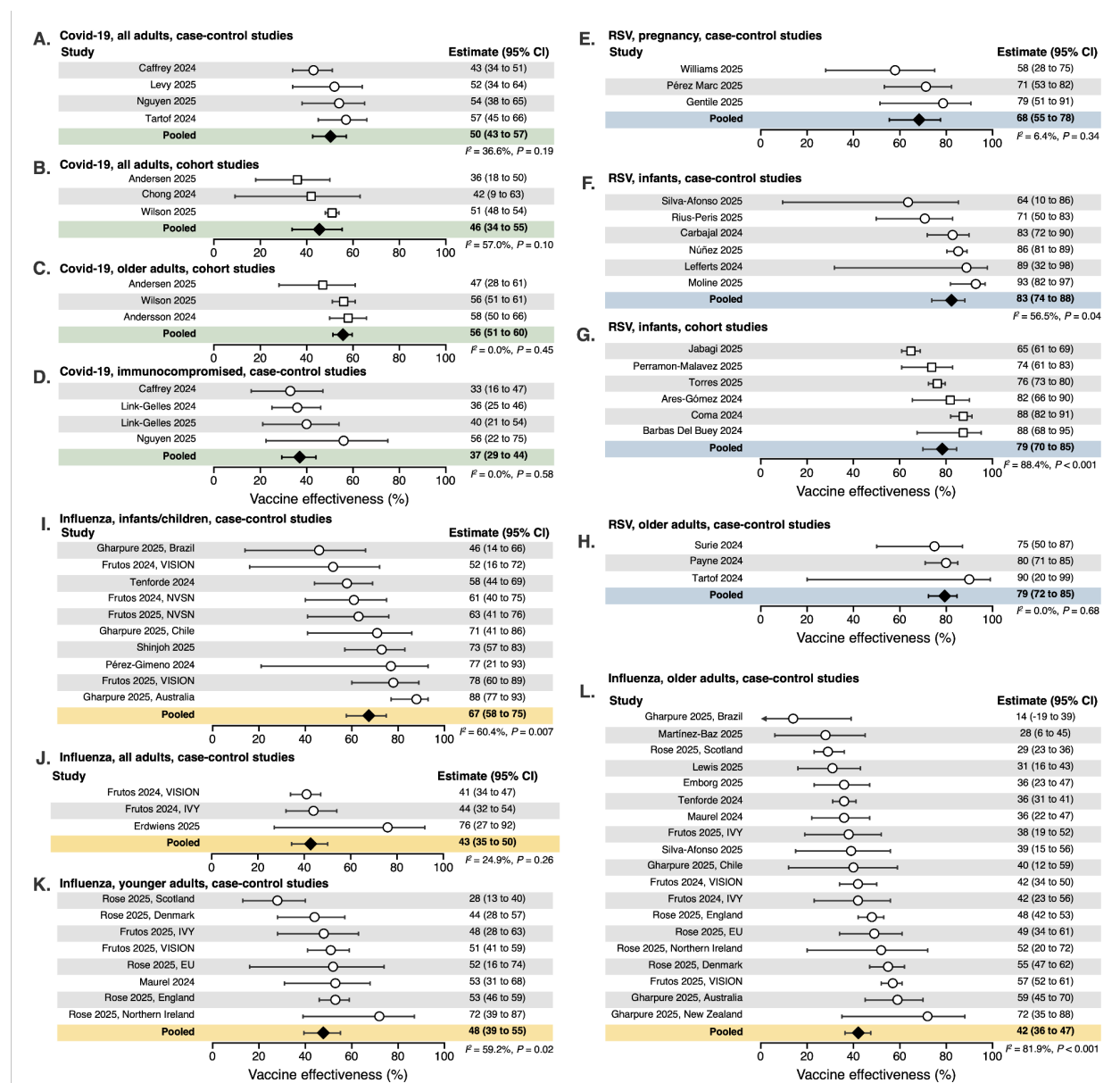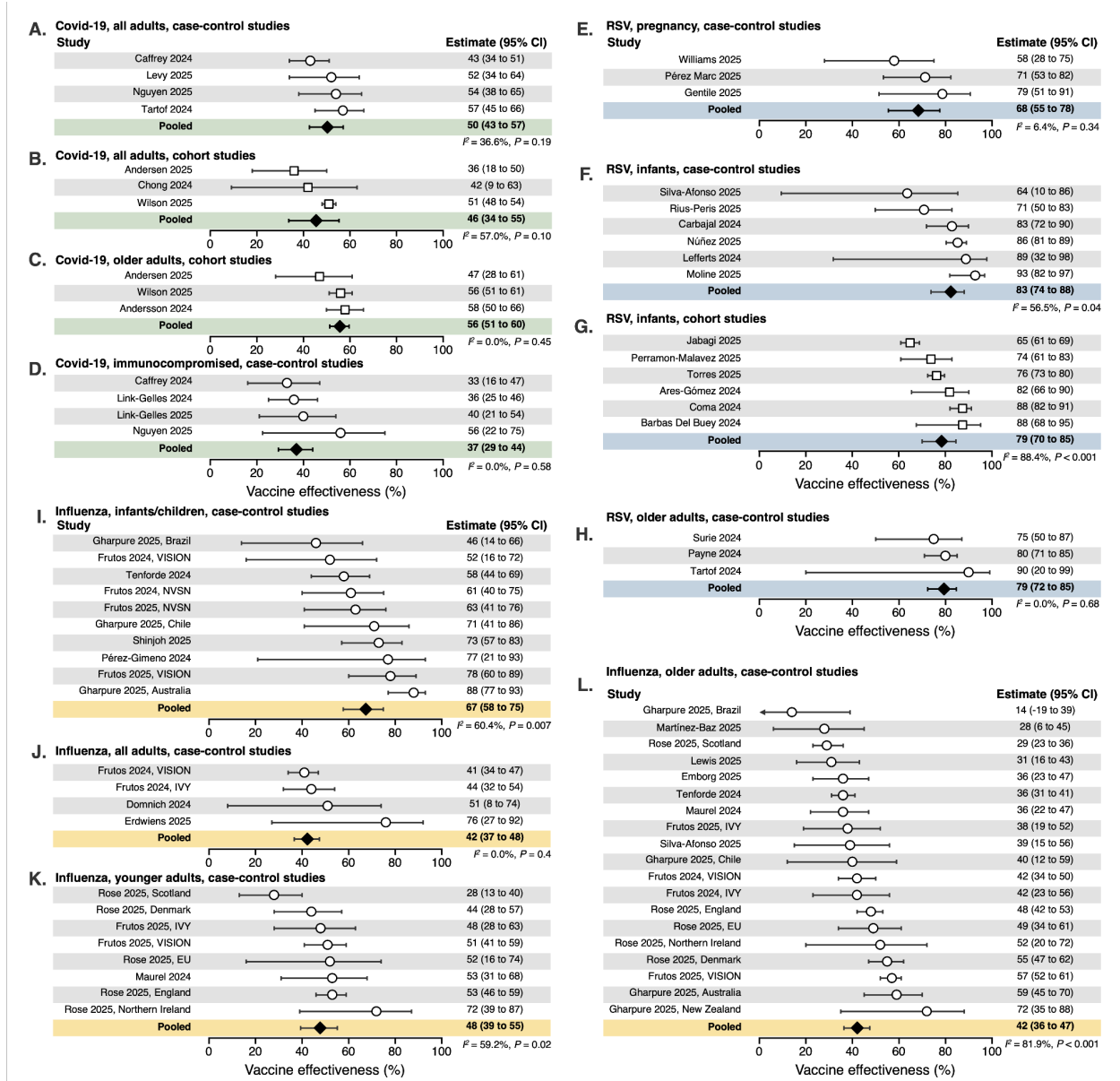# Figure 2. Meta-analysis of vaccine effectiveness against hospitalization

Forest plots demonstrating population-specific vaccine effectiveness against hospitalization for Covid-19 (**A-D**, green), RSV (**E-H**, blue), and influenza (**I-L**, yellow) for case-control (○) and cohort (□) studies. Heterogeneity (I^2 and P value) are displayed in the bottom righthand corner of each forest plot. Arrow indicates lower bound of 95% confidence interval falls below zero. In sensitivity analyses, we excluded studies with moderate and high risk of bias; findings were similar to our primary results (**Figure S4**).

A. Covid-19, all adults, case-control studies

Study	Estimate (95% CI)
Caffrey 2024	43 (34 to 51)
Levy 2025	52 (34 to 64)
Nguyen 2025	54 (38 to 65)
Tartof 2024	57 (45 to 66)
Pooled	**50 (43 to 57)**

$I^2 = 36.6\%$, $P = 0.19$

B. Covid-19, all adults, cohort studies

Andersen 2025	36 (18 to 50)
Chong 2024	42 (9 to 63)
Wilson 2025	51 (48 to 54)
Pooled	**46 (34 to 55)**

$I^2 = 57.0\%$, $P = 0.10$

C. Covid-19, older adults, cohort studies

Andersen 2025	47 (28 to 61)
Wilson 2025	56 (51 to 61)
Andersson 2024	58 (50 to 66)
Pooled	**56 (51 to 60)**

$I^2 = 0.0\%$, $P = 0.45$

D. Covid-19, immunocompromised, case-control studies

Caffrey 2024	33 (16 to 47)
Link-Gelles 2024	36 (25 to 46)
Link-Gelles 2025	40 (21 to 54)
Nguyen 2025	56 (22 to 75)
Pooled	**37 (29 to 44)**

$I^2 = 0.0\%$, $P = 0.58$

Vaccine effectiveness (%)

E. RSV, pregnancy, case-control studies

Study	Estimate (95% CI)
Williams 2025	58 (28 to 75)
Pérez Marc 2025	71 (53 to 82)
Gentile 2025	79 (51 to 91)
Pooled	**68 (55 to 78)**

$I^2 = 6.4\%$, $P = 0.34$

F. RSV, infants, case-control studies

Silva-Afonso 2025	64 (10 to 86)
Rius-Peris 2025	71 (50 to 83)
Carbajal 2024	83 (72 to 90)
Núñez 2025	86 (81 to 89)
Lefferts 2024	89 (32 to 98)
Moline 2025	93 (82 to 97)
Pooled	**83 (74 to 88)**

$I^2 = 56.5\%$, $P = 0.04$

G. RSV, infants, cohort studies

Jabagi 2025	65 (61 to 69)
Perramon-Malavez 2025	74 (61 to 83)
Torres 2025	76 (73 to 80)
Ares-Gómez 2024	82 (66 to 90)
Coma 2024	88 (82 to 91)
Barbas Del Buey 2024	88 (68 to 95)
Pooled	**79 (70 to 85)**

$I^2 = 88.4\%$, $P < 0.001$

Vaccine effectiveness (%)

H. RSV, older adults, case-control studies

Surie 2024	75 (50 to 87)
Payne 2024	80 (71 to 85)
Tartof 2024	90 (20 to 99)
Pooled	**79 (72 to 85)**

$I^2 = 0.0\%$, $P = 0.68$

Vaccine effectiveness (%)

I. Influenza, infants/children, case-control studies

Study	Estimate (95% CI)
Gharpure 2025, Brazil	46 (14 to 66)
Frutos 2024, VISION	52 (16 to 72)
Tenforde 2024	58 (44 to 69)
Frutos 2024, NVSN	61 (40 to 75)
Frutos 2025, NVSN	63 (41 to 76)
Gharpure 2025, Chile	71 (41 to 86)
Shinjoh 2025	73 (57 to 83)
Pérez-Gimeno 2024	77 (21 to 93)
Frutos 2025, VISION	78 (60 to 89)
Gharpure 2025, Australia	88 (77 to 93)
Pooled	**67 (58 to 75)**

$I^2 = 60.4\%$, $P = 0.007$

J. Influenza, all adults, case-control studies

Study	Estimate (95% CI)
Frutos 2024, VISION	41 (34 to 47)
Frutos 2024, IVY	44 (32 to 54)
Erdwiens 2025	76 (27 to 92)
Pooled	**43 (35 to 50)**

$I^2 = 24.9\%$, $P = 0.26$

K. Influenza, younger adults, case-control studies

Rose 2025, Scotland	28 (13 to 40)
Rose 2025, Denmark	44 (28 to 57)
Frutos 2025, IVY	48 (28 to 63)
Frutos 2025, VISION	51 (41 to 59)
Rose 2025, EU	52 (16 to 74)
Maurel 2024	53 (31 to 68)
Rose 2025, England	53 (46 to 59)
Rose 2025, Northern Ireland	72 (39 to 87)
Pooled	**48 (39 to 55)**

$I^2 = 59.2\%$, $P = 0.02$

Vaccine effectiveness (%)

L. Influenza, older adults, case-control studies

Study	Estimate (95% CI)
Gharpure 2025, Brazil	14 (-19 to 39)
Martínez-Baz 2025	28 (6 to 45)
Rose 2025, Scotland	29 (23 to 36)
Lewis 2025	31 (16 to 43)
Emborg 2025	36 (23 to 47)
Tenforde 2024	36 (31 to 41)
Maurel 2024	36 (22 to 47)
Frutos 2025, IVY	38 (19 to 52)
Silva-Afonso 2025	39 (15 to 56)
Gharpure 2025, Chile	40 (12 to 59)
Frutos 2024, VISION	42 (34 to 50)
Frutos 2024, IVY	42 (23 to 56)
Rose 2025, England	48 (42 to 53)
Rose 2025, EU	49 (34 to 61)
Rose 2025, Northern Ireland	52 (20 to 72)
Rose 2025, Denmark	55 (47 to 64)
Frutos 2025, VISION	57 (52 to 61)
Gharpure 2025, Australia	59 (45 to 70)
Gharpure 2025, New Zealand	72 (35 to 88)
Pooled	**42 (36 to 47)**

$I^2 = 81.9\%$, $P < 0.001$

Vaccine effectiveness (%)

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Levy 2025	52 (34 to 64)
Nguyen 2025	54 (38 to 65)
Tartof 2024	57 (45 to 66)
Pooled	**50 (43 to 57)**

$I^2 = 36.6\%$, $P = 0.19$

B. Covid-19, all adults, cohort studies

Andersen 2025	36 (18 to 50)
Chong 2024	42 (9 to 63)
Wilson 2025	51 (48 to 54)
Pooled	**46 (34 to 55)**

$I^2 = 57.0\%$, $P = 0.10$

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Andersen 2025	47 (28 to 61)
Wilson 2025	56 (51 to 60)
Andersson 2024	58 (50 to 66)
Pooled	**56 (51 to 60)**

$I^2 = 0.0\%$, $P = 0.45$

D. Covid-19, immunocompromised, case-control studies

Caffrey 2024	33 (16 to 47)
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Link-Gelles 2025	40 (21 to 54)
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Vaccine effectiveness (%)

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Frutos 2024, VISION	41 (34 to 47)
Frutos 2024, IVY	44 (32 to 54)
Domnich 2024	51 (8 to 74)
Erdwiens 2025	76 (27 to 92)
Pooled	**42 (37 to 48)**

$I^2 = 0.0\%$, $P = 0.4$

K. Influenza, younger adults, case-control studies

Rose 2025, Scotland	28 (13 to 40)
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Rose 2025, England	53 (46 to 59)
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Vaccine effectiveness (%)

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$I^2 = 56.5\%$, $P = 0.04$

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Maurel 2024	36 (22 to 47)
Frutos 2025, IVY	38 (19 to 52)
Silva-Afonso 2025	39 (15 to 56)
Gharpure 2025, Chile	40 (12 to 59)
Frutos 2024, VISION	42 (34 to 50)
Frutos 2024, IVY	42 (23 to 56)
Rose 2025, England	48 (42 to 53)
Rose 2025, EU	49 (34 to 61)
Rose 2025, Northern Ireland	52 (20 to 72)
Rose 2025, Denmark	55 (47 to 62)
Frutos 2025, VISION	57 (52 to 61)
Gharpure 2025, Australia	59 (45 to 70)
Gharpure 2025, New Zealand	72 (35 to 88)
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Vaccine effectiveness (%)

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