

Missed Opportunities?! Gaps in Capturing the Full Value of Vaccination Across Health Economic Studies of COVID-19 Vaccination

Danai Bem,¹ Maria Nassim,² Xuan Wang,³ Nicolas Van de Velde,⁴ Ekkehard Beck,⁴ Clive Pritchard,¹ Keya Joshi^{4,*}

¹ICON plc, Reading, UK; ²ICON plc, Berlin, Germany; ³ICON plc, Stockholm, Sweden; ⁴Moderna, Inc., Cambridge, MA, USA

*Presenting author.

BACKGROUND

- The COVID-19 pandemic has caused an unprecedented global health, economic, and social crisis,¹ disproportionately impacting vulnerable populations, with disruptions in and increased strain on healthcare systems^{1,3}
- Vaccination, currently the most effective public health intervention against COVID-19, resulted in an overall reduction in associated mortality of 57% globally (up to 75% in some countries), with a concomitant reduction in infection-related morbidity^{4,6}
- The impact of COVID-19 vaccination during the pandemic has emphasized the significant health and socioeconomic value of vaccination (VoV) to society, including its impact on macroeconomics, health systems strengthening, and health equity⁷
- As countries adjust to endemic SARS-CoV-2 with regular national immunization programs and reimbursement of COVID-19 vaccination, economic evaluations can broaden our understanding of the economic impact and benefits of vaccination, in turn helping to inform vaccine allocation policies⁸

OBJECTIVES

- To summarize the evidence on published economic models of COVID-19 vaccination to support policy and reimbursement decision-making for COVID-19 vaccination during the transition to the endemic setting and help inform future COVID-19 cost-effectiveness models
- To understand how economic models of COVID-19 vaccination have captured the broad health and socioeconomic VoV

METHODS

Study Design

- A systematic search of MEDLINE, Embase, EconLit, and the International Network of Agencies for Health Technology Assessment was conducted on September 21, 2023 (PROSPERO registration: CRD42023470154), to identify English-language studies on cost-effectiveness outcomes of COVID-19 vaccination published between January 2019 and September 2023
- Studies were included if they met the criteria shown in **Table 1**
- VoV was assessed based on a published VoV framework (**Supplementary Table S1**)^{7,10}

Table 1. Predetermined Eligibility Criteria Regarding the Population, Interventions, Comparators, Outcomes, and Study Design (PICOS)

	Inclusion Criteria	Exclusion Criteria
Population	- General population of all age groups - Targeted population, including but not limited to children, adults, older adults, and health workers	No restriction on population
Interventions	Any COVID-19 vaccine (primary series or boosters) and vaccination strategy	- Models not assessing any COVID-19 vaccines - Models focusing on screening strategies
Comparators	- Any COVID-19 vaccine/ vaccination strategy - No vaccination	Models comparing COVID-19 vaccination with any pharmaceutical treatment
Outcomes	- Total costs/cost benefit - Cost per QALYs, DALYs, or LYs gained - Other effectiveness measure/health outcomes (infections/cases/deaths/hospitalization averted) - Model parameters (clinical, direct and indirect costs, resource use)	Studies not reporting outcomes of interest
Study design	- CEAs - CBAs - CUAs - Dynamic transmission models	- Narrative reviews - Case studies/case series - Letters/editorials/commentaries/news notes - Study protocols - Historical articles - Animal studies - Systematic literature reviews^a
Publication type	Full-text publications and appraisals/assessment reports from HTA agencies	Model studies available only in abstract form
Other limitations	- Geographic location: no restrictions - Time horizon: from 2019 onward - Language: English	

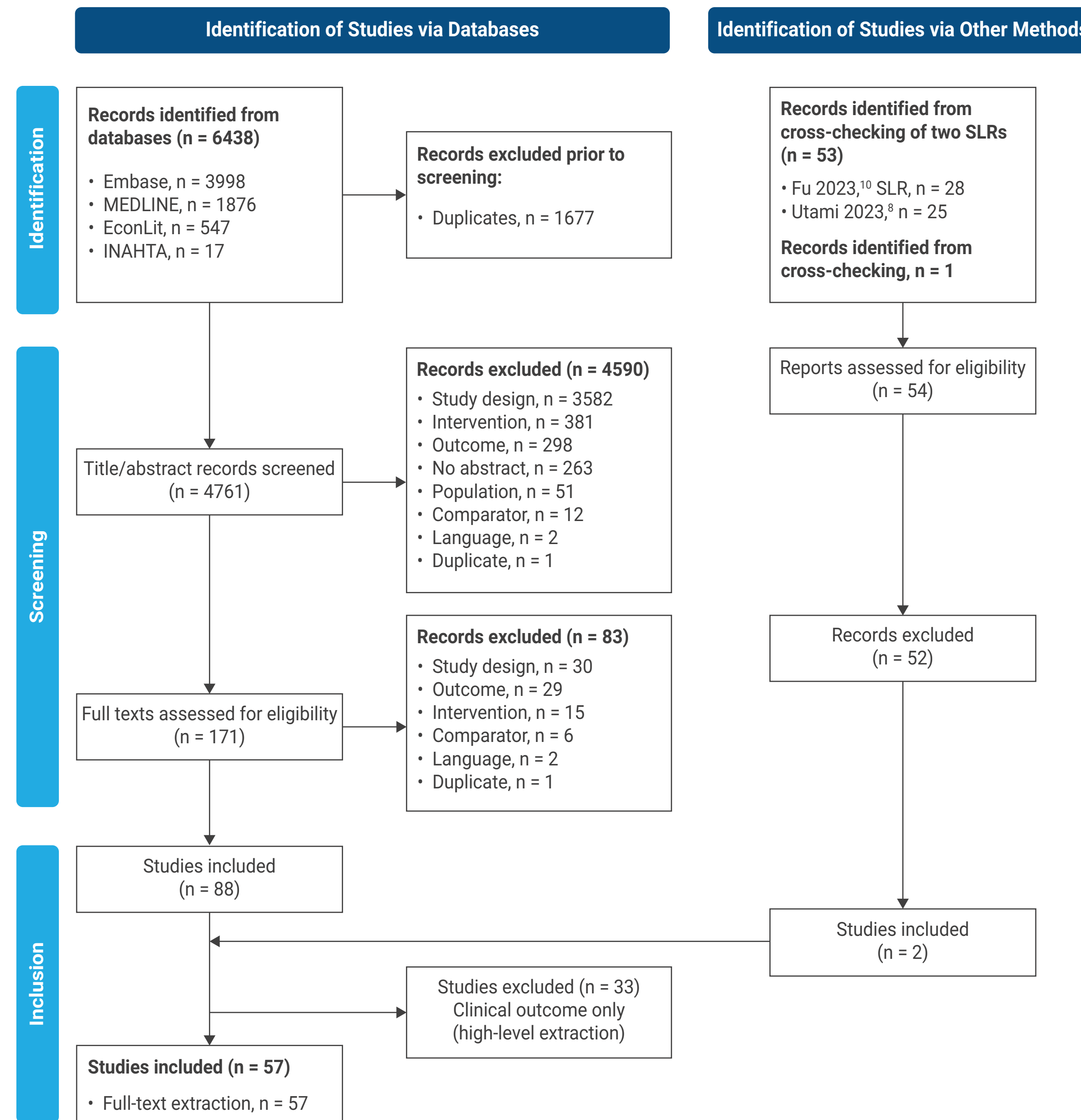
CBA, cost-benefit analysis; CEA, cost-effectiveness analysis; CUA, cost-utility analysis; DALY, disability-adjusted life-year; HTA, Health Technology Assessment; LY, life-year; QALY, quality-adjusted life-year; SLR, systematic literature review.

^aRelevant published SLRs were cross-checked.

RESULTS

- A total of 57 unique studies reporting cost-effectiveness outcomes were included in the review (**Figure 1**)

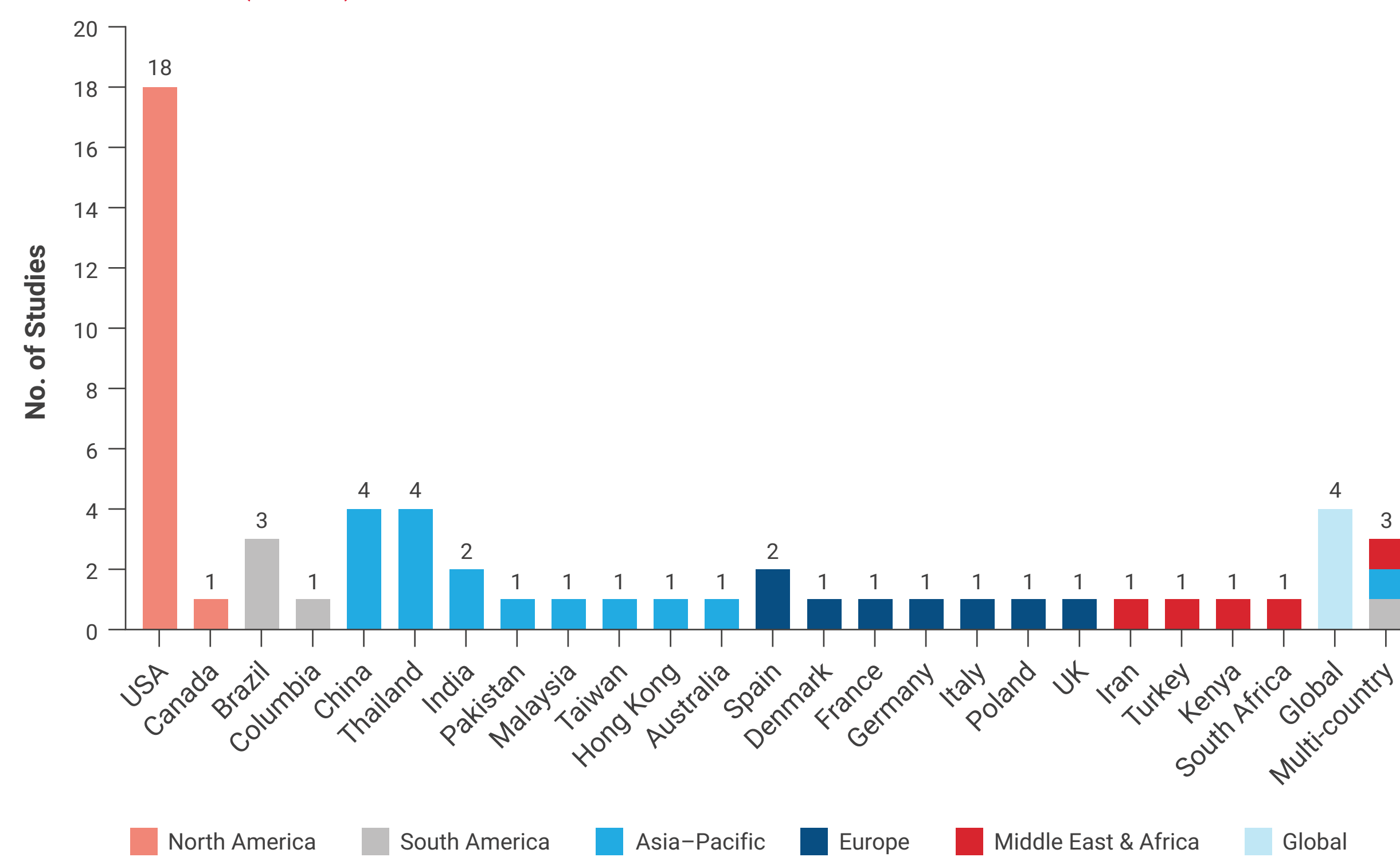
Figure 1. PRISMA Flow Diagram Illustrating the Study Selection Process



INAHTA, International Network of Agencies for Health Technology Assessment; SLR, systematic literature review.

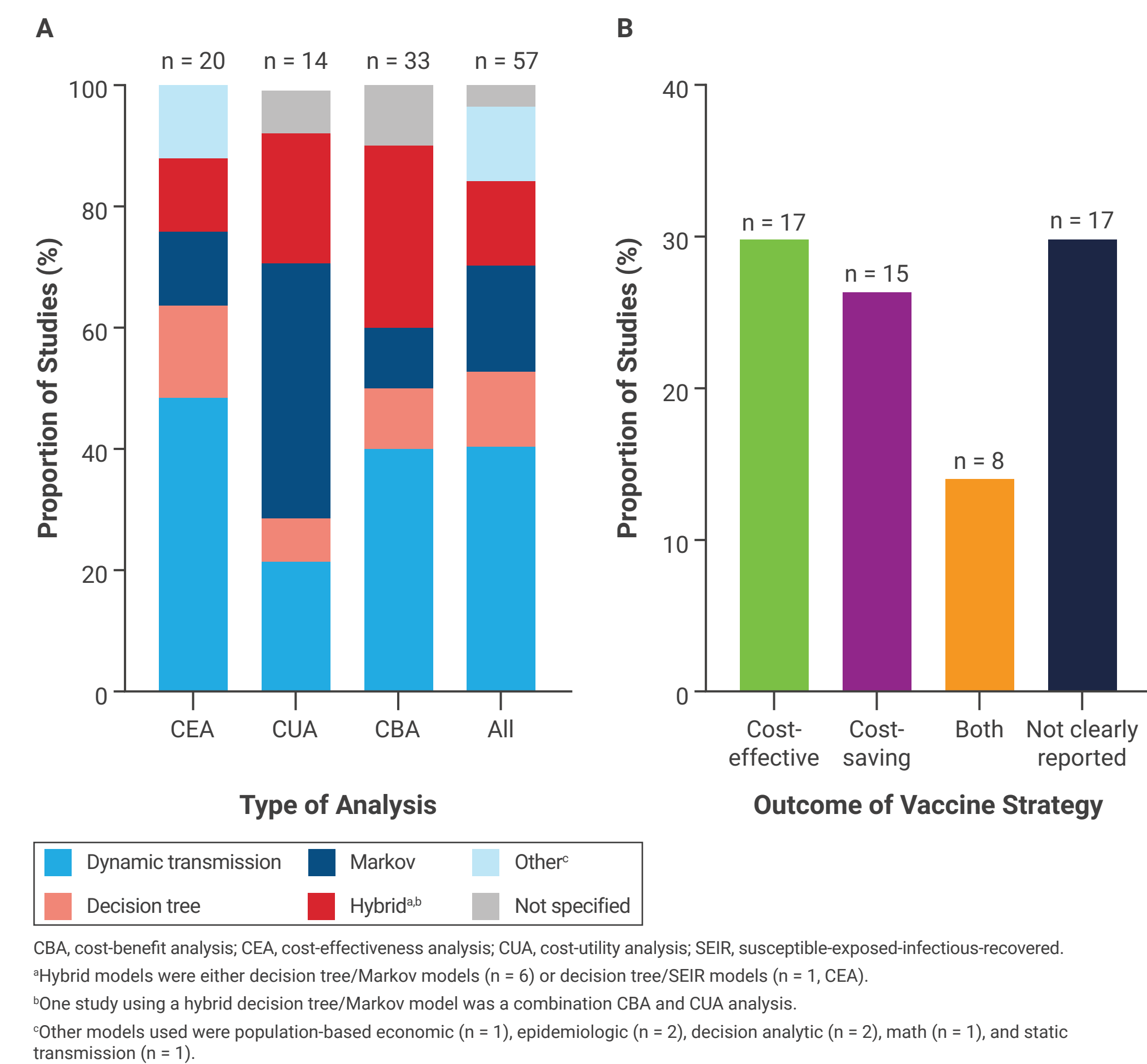
- Cost-effectiveness studies were predominantly from North America (n = 19) and the Asia-Pacific region (n = 16; **Figure 2**)

Figure 2. Distribution of Cost-Effectiveness Studies Across Different Geographical Regions and Countries (n = 57)



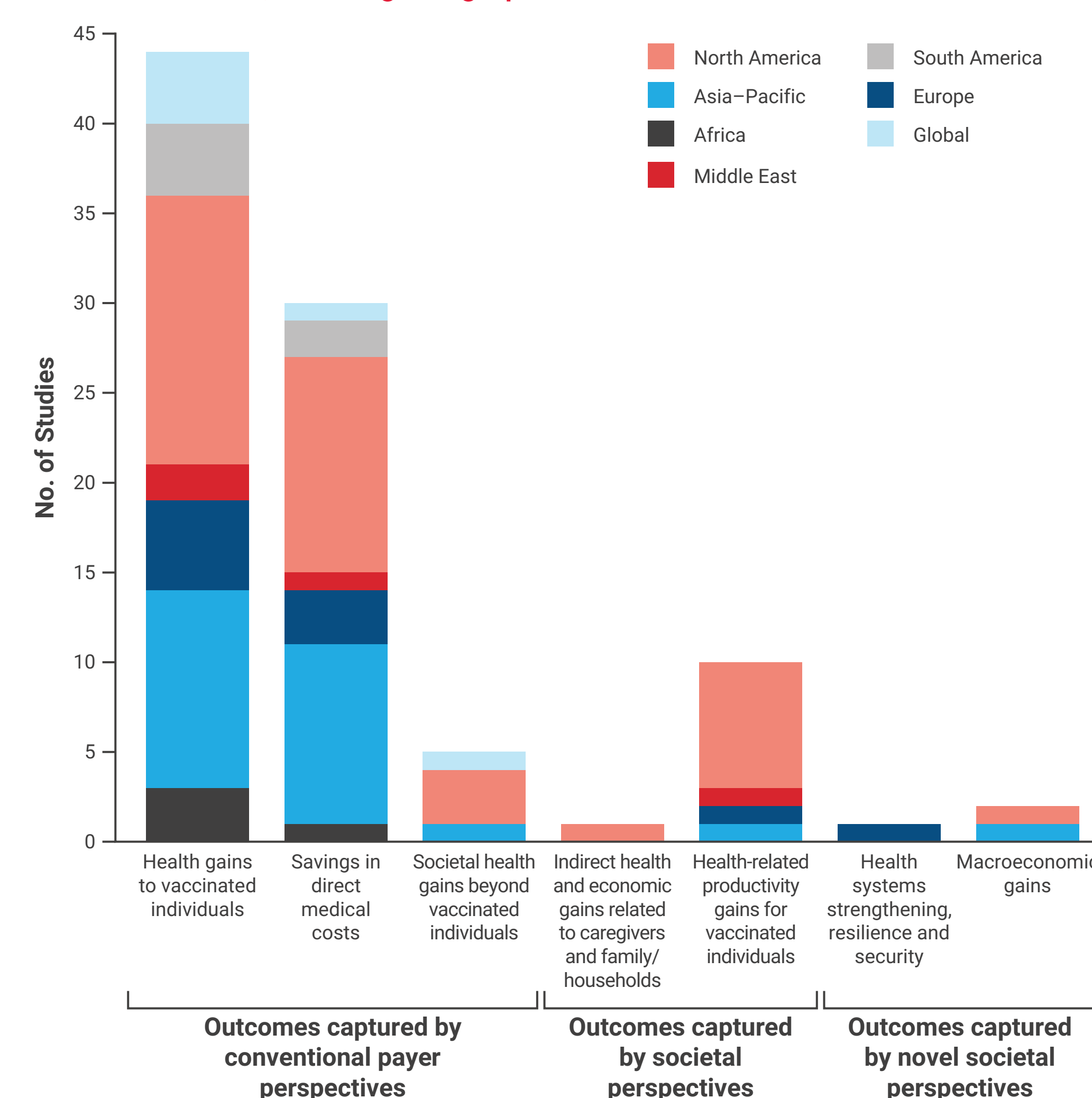
- Of the 57 studies captured by the search, 24 adopted a dynamic transmission model-based approach, 10 used Markov modeling, and 8 were based on decision tree models; the remaining 15 studies adopted various approaches, but predominantly hybrid models (eg, a combination of decision tree and Markov models) (**Figure 3A**)
- The most common type of analysis was cost-effectiveness analysis (n = 34), followed by cost-utility analysis (CUA; n = 13) and cost-benefit analysis (CBA; n = 9); 1 study reported both CUA- and CBA-based outcomes¹¹
- Of the 40 studies (70%) reporting on vaccine cost-effectiveness, COVID-19 vaccination strategies were found to be cost-effective in 17 and cost-saving in 15; 8 studies reported that the vaccine strategies were both cost-effective and cost-saving, depending on the scenario analyzed (**Figure 3B**)
- The overall outcomes of economic analyses were not clearly reported in the remaining 17 studies (30%)

Figure 3. Distribution of (A) Modeling Approaches by Cost-Effectiveness Analysis Type and (B) Outcomes of Vaccine Strategies Across Studies (n = 57)



- Most models used the healthcare system perspective alone (n = 32), followed by the societal perspective (n = 12); 8 models used a combined healthcare system and societal or collective/societal perspective (USA, n = 4; Asia, n = 2; Spain, n = 1; multi-country, n = 1), and 5 studies did not specify the perspective used
- Overall, most studies did not include broader socioeconomic concepts (**Figure 4**)
 - Almost 90% of studies (n = 51) reported outcomes captured by conventional payer perspective concepts (eg, direct medical costs, health gains in vaccinees)
 - Ten studies captured conventional societal perspective concepts (eg, indirect health and economic gains to caregivers and households, productivity in vaccinees)
 - However, only 3 studies considered broader, novel socioeconomic concepts,¹²⁻¹⁴ including macroeconomic gains from resumed social and economic activity due to businesses re-opening, increased employment/earnings, and increased workforce productivity when people no longer work remotely or assist their children with online school

Figure 4. Value of Vaccination: Socioeconomic Concepts Reported in the Included Studies, Showing Geographic Distribution^{a,b}



^aIndividual studies may have reported outcomes in more than 1 sub-category.

^bThe VoV framework comprises 20 concepts^{7,15}; only concepts that are reported in the captured studies are shown.

CONCLUSIONS

- Across the studies included in this analysis, COVID-19 vaccination was either cost-effective or cost-saving, regardless of geographic region or the modeling approach used
- Few studies explored the documented broader impact of vaccination against COVID-19
 - Only 3 studies in the present analysis incorporated broader-value considerations aligned with novel socioeconomic concepts of the VoV framework
 - Most studies reported outcomes only from the healthcare payer or narrower societal perspective
- Limited assessment of the broad health and socioeconomic VoV can result in ineffective policy decisions and restricted access to vaccination, applicable to both COVID-19 vaccination and other vaccination programs
- As the COVID-19 pandemic transitions to an endemic phase, future vaccination economic evaluations, and policy and reimbursement decisions need to capture the broader health and socioeconomic impact of vaccination to learn from the experience and to help ensure a vital economy, resilient healthcare system, and elimination of health disparities

ADDITIONAL INFORMATION

Please scan the QR code for a PDF copy of the poster and access to supplementary materials. Copies of the poster and supplementary materials obtained through the QR code are for personal use only and may not be reproduced without written permission of the authors.



For additional information, please contact Keya Joshi at keya.joshi@modernatx.com.

References

- World Health Organization. Chapter 2. Current context: the COVID-19 pandemic and continuing challenges to global health In: *A Healthy Return. Investment Case for a Sustainably Financed WHO*. WHO; 2022. <https://www.who.int/about/funding/invest-in-who/investment-case-2.0/challenges>
- Haileamlak A. *Ethiop J Health Sci*. 2021;31(6):1073-1074.
- Shadmi E, et al. *Int J Equity Health*. 2020;19(1):104.
- Iacobucci G. *BMJ*. 2024;384:q125.
- World Health Organization. COVID-19 vaccinations have saved more than 1.4 million lives in the WHO European Region, a new study finds. WHO; 2024. <https://www.who.int/europe/news/item/16-01-2024-covid-19-vaccinations-have-saved-more-than-1.4-million-lives-in-the-who-european-region-a-new-study-finds>
- Tu W, et al. *Am J Public Health*. 2022;113(1):96-104.
- Postma M, et al. *Vaccine*. 2022;40(30):3999-4007.
- Utami AM, et al. *J Glob Health*. 2023;13:06001.
- Beck E, et al. *Vaccine*. 2022;40(30):4008-4016.
- Fu Y, et al. *J Evid Based Med*. 2023;16(2):152-165.
- Wang WC, et al. *J Formos Med Assoc*. 2021;120(suppl 1):S95-S105.
- Gandjour A. *Q Rev Econ Finance*. 2022;84:1-8.
- Kirson N, et al. *J Med Econ*. 2022;25(1):119-128.
- Suphanchaimat R, et al. *Int J Environ Res Public Health*. 2021;18(20):10803.

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Disclosures

DB, MN, XW, and CP are employees of ICON plc. NV, EB, and KJ are employees of Moderna, Inc., and hold stock/stock options in the company.