



## Introduction

- > Health technology assessment (HTA) plays a critical role in evaluating the value of vaccines for reimbursement and policy decision-making.
- > Traditional HTA frameworks may not fully capture the broader value elements unique to vaccines, such as their impact on disease transmission and health system resilience.
- > The STEDI framework—originally developed for antimicrobials—offers a multidimensional perspective, incorporating **Spectrum, Transmission, Enablement, Diversity, and Insurance** value components.
- > This work explores the conceptual transferability and relevance of the STEDI framework to vaccine HTA, aiming to enhance the comprehensiveness of value assessment in this context.

## Methods

We conducted a conceptual analysis comparing each STEDI dimension (Spectrum, Transmission, Enablement, Diversity, Insurance) with established and emerging frameworks for assessing vaccine value in HTA.

- > Reviewed relevant literature, including:
  - Key publications on the STEDI framework and its application in antimicrobial assessment, for example Brassel, 2023<sup>1</sup>
  - Foundational and recent HTA guidelines for vaccines from agencies such as JCVI<sup>2</sup>, CADTH<sup>3</sup>, and WHO<sup>4</sup>
  - Peer-reviewed articles and reviews discussing broader value elements of vaccines, for example Brassel, 2021<sup>5</sup>
  - Reports on the economic, social, and health system impacts of vaccination, for example Hutubessy 2023<sup>6</sup>
- > Evaluated the potential for adapting STEDI components to the unique characteristics of vaccines.

## Results

We mapped each STEDI dimension to analogous or distinct value domains in vaccines (see **Table 1**).

**Table 1. Mapping STEDI dimensions to vaccine domains.**

STEDI Dimension	Definition	Vaccine Value Element	Applicability	Explanation
Spectrum	Breadth of pathogens an antimicrobial acts against.	Population coverage and cross-protection across strains/serotypes.	Strong alignment	Vaccines can provide broad protection across strains, similar to spectrum in antimicrobials.
Transmission	Impact on reducing spread of infection within and between populations.	Direct and indirect (herd) protection reducing disease transmission.	Strong alignment	Vaccines reduce transmission at both individual and population levels, directly comparable.
Enablement	Ability to enable other medical procedures by preventing or managing infection risk.	Enables broader healthcare delivery (e.g., reduces need for antibiotics, supports health system resilience).	Partial overlap	Vaccines indirectly enable other treatments/procedures, though less central than antimicrobials.
Diversity	Availability of multiple treatment options to reduce resistance risk.	Strain diversity coverage; relevance when pathogen evolves (e.g., influenza).	Partial overlap	Vaccines target evolving pathogens, but the diversity concept differs from antimicrobial resistance.
Insurance	Societal value of having antimicrobials as a safeguard against future threats.	Insurance against future outbreaks/pandemics by maintaining preparedness.	Strong alignment	Vaccines act as societal insurance against emerging threats, highly comparable to antimicrobials.

Colour coding: green equates to STEDI domains that map seamlessly from antimicrobials to vaccines; orange equates to domains that require adjusted value domains for vaccine applicability.

After mapping the STEDI component value domains, take-home results from our assessment of their transferability are detailed below.

### Spectrum adapted to vaccines as breadth and durability of protection

- > Operationalize spectrum as antigenic/strain coverage, cross-protection, and durability against antigenic evolution; include platform update latency where relevant.<sup>1,5</sup>
- > Practical metrics to incorporate as part of this domain: number of strains/lineages covered, effectiveness retention against drift, update turnaround time.

### Transmission value is readily quantifiable for vaccines

- > Dynamic transmission models and surveillance data routinely capture indirect effects (herd protection, reduced incidence, hospitalizations), enabling robust estimation of population-level benefits.<sup>5,6</sup>
- > In contrast to antimicrobials, the indirect (transmission) benefits of vaccines—such as herd protection and reduction of disease spread—are typically substantial. Whereas dynamic transmission models are increasingly used to quantify these effects in vaccine HTAs, their inclusion is not yet standard practice across all settings, though there is a strong rationale for broader adoption.

## Results (continued)

### Enablement should be reframed as health system capacity and continuity

- > Rather than enabling specific procedures, vaccination preserves bed capacity and staff time by averting seasonal and outbreak surges, reducing backlogs and service disruptions.<sup>5,6</sup>
- > Practical metrics to incorporate as part of this domain: bed-days averted, peak occupancy avoided, elective throughput preserved, ICU admissions averted, staff absenteeism reductions.

### Diversity encompasses portfolio resilience and antimicrobial resistance (AMR) co-benefits

- > 'Diversity' requires reinterpretation for vaccines as they typically target specific pathogens c.f. broad-spectrum antibiotics; but, instead, can be efficacious for multiple strains/variants.
- > Vaccine portfolios diversified by pathogen, antigen, and platform spread risk of antigenic drift/shift and supply shocks; platform agility (e.g., rapid updates) adds option value.<sup>1</sup>
- > Vaccination can reduce inappropriate antibiotic use, contributing to AMR mitigation.
- > Practical metrics to incorporate as part of this domain: number of distinct platforms/antigens, time-to-update for variants, supply redundancy index, antibiotic prescriptions averted.

### Insurance value is estimable via preparedness scenarios

- > Scenario-based analyses (e.g., variant emergence, pandemic risk, supply disruption) can quantify avoided health and economic losses attributable to vaccination programs and flexible manufacturing.<sup>1,6</sup>
- > Practical metrics to incorporate as part of this domain: expected losses avoided across scenarios, time-to-response, vaccine availability under stress tests, macroeconomic spillovers prevented.

### Operationalisation within HTA to avoid double counting

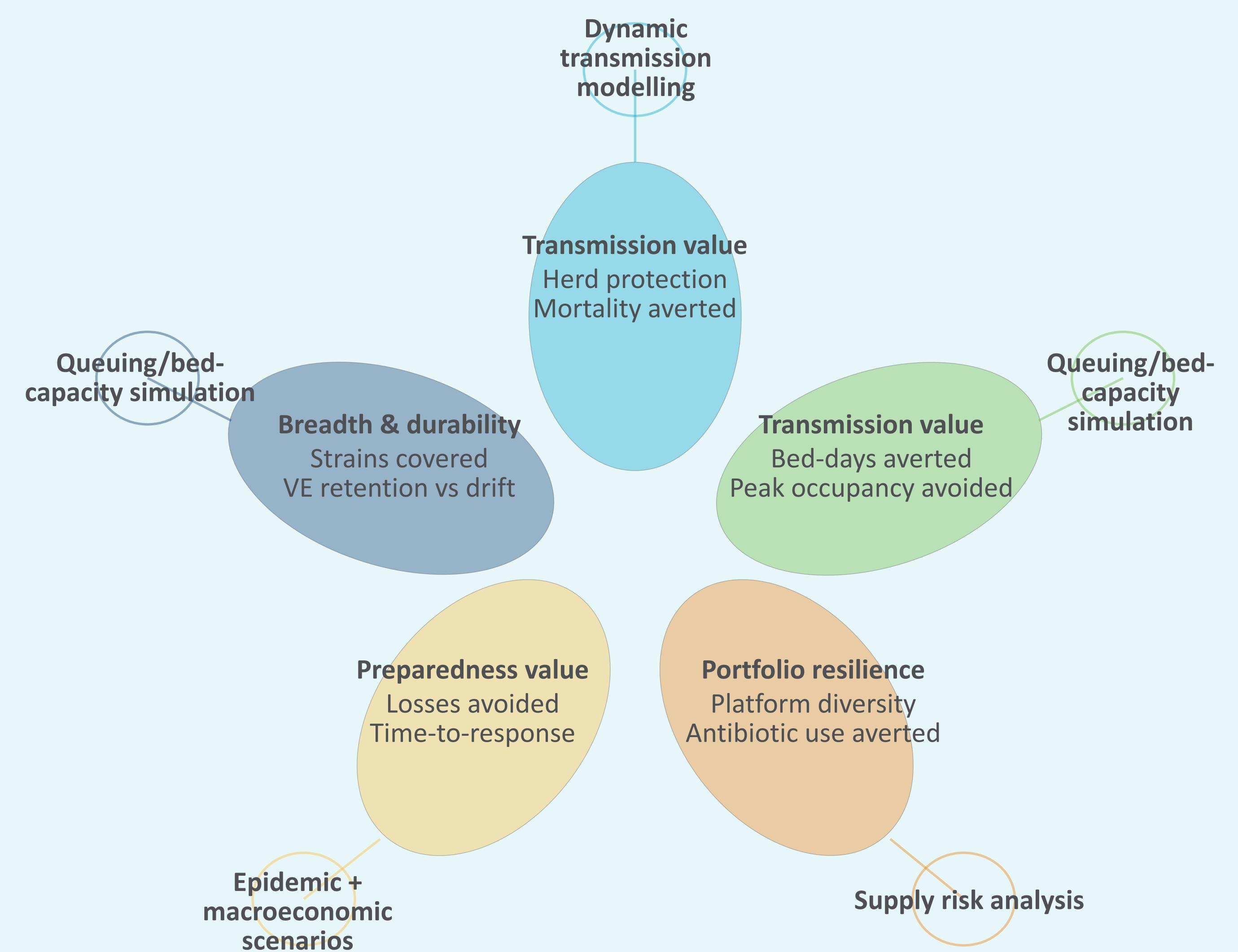
Having outlined and compared the value dimensions using the STEDI framework, we now provide practical recommendations for how these elements can be effectively operationalised in vaccine HTA (see **Figure 1**).

Pre-specify where each value element is quantified:

- > Spectrum (breadth/durability): vaccine effectiveness inputs and sensitivity analyses.
- > Transmission: dynamic transmission module (indirect effects, herd protection).
- > Enablement/capacity: health system capacity module (bed-days, throughput).
- > Diversity: portfolio/platform resilience assessment (risk-spread, supply).
- > Insurance/option value: scenario analysis (preparedness and macro impacts).

Use clear attribution rules (e.g., AMR reductions captured under Diversity, not Transmission) to prevent overlap.

**Figure 1. Adapting STEDI for Vaccine HTA - results operationalization map.**



Infographic links five adapted value elements to the HTA modules where they are quantified. Ring thickness encodes evidence maturity (thick = mature; medium = developing; thin = emerging). VE = vaccine effectiveness.

## Conclusions

STEDI is largely transferable to vaccines when adapted to vaccine-specific attributes (breadth/durability for Spectrum; capacity preservation for Enablement; portfolio/platform resilience for Diversity; preparedness-focused Insurance).

Incorporating these elements into vaccine HTA can broaden value capture without double counting when placement in the model is pre-specified and attribution rules are transparent. By moving beyond the traditional focus on direct health outcomes and costs, this approach enables the recognition of broader benefits—such as reduced transmission, enhanced health system resilience, and preparedness for future threats—that are often overlooked in current HTA frameworks. This more comprehensive assessment can support better-informed policy and funding decisions, ultimately benefiting both healthcare systems and the wider public by ensuring that the full societal value of vaccination is reflected in resource allocation. Priorities for implementation include:

- > Standardize health system capacity metrics (e.g., bed-days averted, peak occupancy avoided) and integrate them into HTA alongside transmission modules.
- > Define preparedness scenarios and valuation methods for Insurance and Diversity (e.g., variant emergence, supply shocks, platform agility).
- > Establish measurable Spectrum indicators (strain coverage, cross-protection, update latency) and embed them in effectiveness and sensitivity analyses.
- > Engage stakeholders early (HTA bodies, clinicians, payers, patients) to agree on definitions, data sources, and reporting standards, enhancing reproducibility and uptake.

## References

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