A Quantitative Framework for Evaluating Acquisition Opportunities Under Uncertainty

Applied to Batoclimab (IMVT-1401) as a Case Study in Immunology Portfolio Diversification

Integrating Probability-of-Success (PoS) and Discounted-Cash-Flow (DCF) modeling to strengthen decision quality in Biogen's Immunology strategy.

Hunter Worssam
November 13th, 2025

Agenda

1. **Context & Rationale: Why consider an addition to Biogen's Immunology portfolio?**

2. **Framework Design: How can we bring structure and consistency to external asset evaluation?**

3. **Application: How does the framework perform in practice for Batoclimab (IMVT-1401)?**

4. **Strategic Insights & Recommendations: What are the implications for Biogen's portfolio strategy?**

5. **Conclusion: Turning Uncertainty into Decision Confidence**

A Decision Quality Framework for Evaluating Assets Under Uncertainty

Decision Quality Elements[1]

Identify the Right Problem: Clearly define the decision (acquire, partner, or pass) along with the target indication and timing.

Explore Alternatives: Develop feasible internal and external paths, deal structures, and timing options to ensure true choice.

Reliable Inputs: Base assumptions on therapeutic-area and class priors, analog benchmarks, and structured uncertainty ranges.

Trade-offs: Articulate how ROI, lifecycle, and strategic fit are balanced against Biogen's risk tolerance.

Use Sound Reasoning: Apply transparent probabilistic models (PoS, timelines, rNPV) and pressure-test them through scenarios.

Commit to Action: Predefine decision triggers and monitoring plans for when to revisit or adapt the decision.

Decision Analysis Implementation[8]

Define: Scope the decision, explore alternatives, and establish success metrics (asset rNPV, portfolio Sharpe ratio, etc).

Quantify: Estimate phase-specific PoS using Bayesian or logistic models with TA/MoA covariates, model phase durations via survival analysis, and capture phase and post-approval costs.

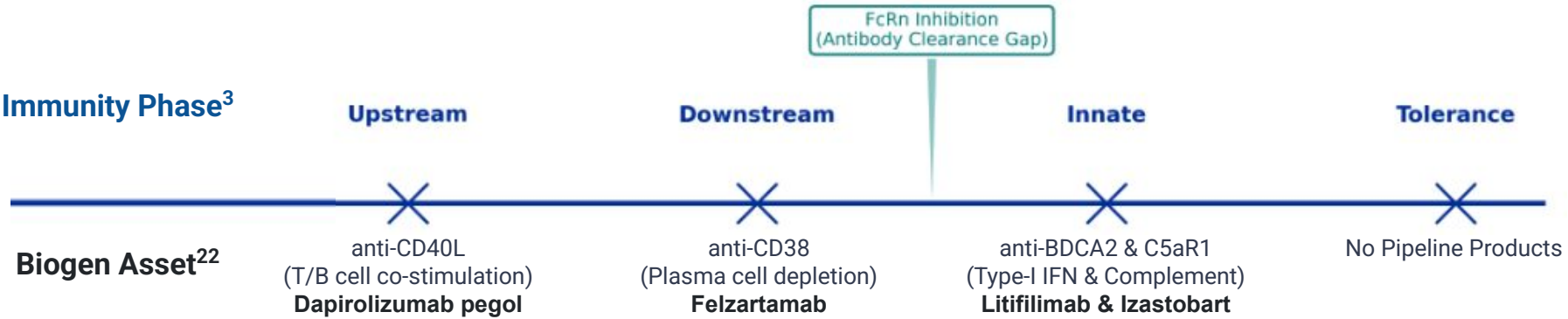
Value: Compute risk-adjusted NPV, perform Monte Carlo simulations to generate a value distribution, conduct sensitivity analysis, and evaluate flexibility using decision trees, regression, or real options.

Decide: Synthesize results into a fair-value band (i.e. P25-P75 rNPV), summarize recommendations and key risks, and specify triggers such as new data that would change the call.

1. Decision Quality elements adapted from Abbas & Howard, Foundations of Decision Analysis *(Pearson, 2015).*

Finding a Gap in Biogen's Immunology Landscape: FcRn Inhibition

DEFINE



Current State

Biogen's immunology portfolio spans three intervention points along the immune cascade:

- **Upstream:** *Block the "go" signal that lets T cells help B cells (anti-CD40L).*
- **Downstream:** *Remove the cells that manufacture autoantibodies (anti-CD38).*
- **Innate:** *Dampen the inflammatory alarms and tissue responses (anti-BDCA2 & C5aR1).*

Strong focus on making fewer antibodies or reducing inflammation, **but no mechanism to clear existing autoantibodies in circulation.**

Opportunity with an FcRn Inhibitor

- **Accelerates IgG clearance**, rapidly and reversibly lowering pathogenic autoantibody levels.
- **Clinically validated** in Myasthenia Gravis, reducing uncertainty in development and valuation.
- **Strategic fit** that complements Biogen's Immunology expertise while diversifying mechanism and risk.

For full references, see slides 14-15

FcRn Inhibition Landscape and Selection of Batoclimab (IMVT-1401)

DEFINE

Mechanism: FcRn inhibitors block IgG recycling, accelerating clearance of pathogenic autoantibodies; a validated approach in antibody-mediated diseases such as Myasthenia Gravis (MG), CIDP, and Graves' disease.

Clinical context: Multiple FcRn assets are in late-stage development:

Asset	Company	Clinical Stage	Indications	Notes
Rozanolixizumab[10]	UCB	Approved (MG)	MG, CIDP	First-in-class FcRn antibody; validated mechanism.
Nipocalimab[23]	Janssen	Phase 3	MG, HDFN, SLE	Broad pipeline; very large sponsor, not partnerable.
Batoclimab[5] (IMVT-1401)	**Immunovant**	**Phase 3 (MG)**	**MG, CIDP, TED, Graves**	**De-risked FcRn antibody with proven IgG reduction and manageable safety.**
IMVT-1402[5] (Next-gen Batoclimab)	Immunovant	Phase 1/2	MG, TED, RA, GD, CIDP	Next-gen FcRn with lower complications; early safety unknown.

Batoclimab was selected for this analysis as it is:

- **Clinically de-risked:** Demonstrated rapid, reversible IgG lowering and consistent efficacy signals across autoimmune programs.
- **Partnerable:** Immunovant retains rights and may pursue co-development, unlike larger pharma-owned FcRn assets.
- **Near-term data visibility:** Phase 3 MG readout expected within 1 year, enabling realistic valuation modeling.
- **Complementary to Biogen's portfolio:** Addresses antibody-clearance gap without overlapping mechanisms.

For full references, see slides 14-15

Key Success Metrics for Evaluating Batoclimab (IMVT-1401)

To evaluate Batoclimab's potential value and strategic fit within Biogen's Immunology portfolio, we apply a balanced scorecard of **quantitative** and **qualitative** success metrics.

Risk-Adjusted Net Present Value[8] (rNPV)

- Calculates expected asset value by weighting future cash flows by phase-specific probabilities of success (PoS).
- Integrates key assumptions like development cost, duration, pricing, market penetration, and discount rate of future cash flows.
- Provides a single decision metric for comparing across internal and external assets.

Fair-Value Band (Monte Carlo Analysis)

- Samples uncertainty distributions for PoS, launch timing, market uptake, and cost assumptions.
- Produces a probabilistic valuation range, showing confidence intervals for decision-making.
- Captures variability and risk tolerance at both the individual asset and portfolio level.

Portfolio Sharpe Ratio (Pre & Post-Addition of Batoclimab, not included in this presentation due to time constraints)

- Quantifies the change in risk-adjusted return of Biogen's immunology portfolio before vs. after adding Batoclimab.
- Incorporates expected rNPV contribution (return) versus added variance (risk) from phase, mechanism, and indication.
- Applies L1-regularization to estimate optimal portfolio weight and implied upper-bound acquisition price within the risk budget.

Strategic Fit Index (Not included in this presentation due to time constraints)

- Assesses how well Batoclimab complements Biogen's current immunology mechanisms.
- Evaluates therapeutic adjacency, modality synergy, and competitive positioning, with lower correlation indicating greater diversification.
- Incorporates expert insight from Biogen scientists, clinicians, and strategists to contextualize the quantitative results above.

For full references, see slides 14-15

Key rNPV Modeling Assumptions - Batoclimab in Myasthenia Gravis

QUANTIFY

Development Timing

- **Phase 3**: Ongoing; initiated June 2022 with top-line readout expected **1H 2026 (**per Immunovant 2025)**.**[5]
- **Regulatory Review:** Benchmarked to FcRn analogs (Vyvgart ~7 mo, Rystiggo ~9 mo, Ultomiris ~18 mo); baseline = **12 mo ± 3 mo.**[9, 10, 11]
- **Commercial Launch Prep:** Benchmarked to Vyvgart/Rystiggo (6-9 mo); baseline = **6 mo** if leveraging Biogen's neurology footprint, **± 3 mo** if not.[9, 10]

Probability of Success (PoS)

- **Post-Phase 3 Approval: 70% (range 60-70%).** Benchmarked to FcRn first-pass approvals and broad neurology data.[13]
- **Regulatory + Launch: 85% (range 80-90%).** Consistent with biologic BLA approval rates and FcRn precedents (no CRLs; standard/priority reviews).[9]
- **Cumulative from today: ~60%.** Product of the two gates (**0.70 × 0.85**), representing a de-risked MoA with realistic execution variability.

Development Costs

- **Phase 3 execution: $45M remaining** (of $150M total). Phase 3 began in 2022 and is in the final 30% of spend, including final data analysis and submission readiness. Total cost benchmarked to FcRn analog trials (Vyvgart, Rystiggo).[9, 10]
- **Regulatory + Launch Prep: $25M** (base $20-30M). Covers BLA filing and market readiness; benefits from Biogen's existing neurology infrastructure.

Market Model (Myasthenia Gravis, US+EU)

- **Treated prevalence: 35-60K patients**. Values are directly from Immunovant 2025 projections and align with historical Vyvgart/Rystiggo decks.[9,10]
- **Annual net price: $200K** (range $180-220K). Analogs ranged from $180k-$195k, but subcutaneous administration could enable higher pricing.[9, 10]
- **Gross-to-Net: 20%** (range 15-25%). Specialty biologic benchmark is 20%, and analogs all clustered around 20%.
- **Peak penetration: 55% by Year 5**. This is consistent with FcRn analog adoption curves, and Immunovant is targeting 50-60% by years 4-5.[19]

Financials

- **COGS: 20% of revenue**. Typical for recombinant monoclonal antibodies & consistent with FcRn analog gross margins (Argenx, UCB).[9, 10]
- **SG&A: 25% of revenue**. Based on specialty biologic launches with existing infrastructure (Vyvgart, Ultomiris).[17, 18]
- **Tax rate: 21%**. Standard U.S. federal corporate rate.
- **WACC: 10%**. Representative biotech cost of capital (8-12 % range per EvaluatePharma/UBS benchmarks).[19]
- **Exclusivity: 10 yrs.** Core patents extend to 2033 with potential extensions through 2043 (per Immunovant 2025).[5]

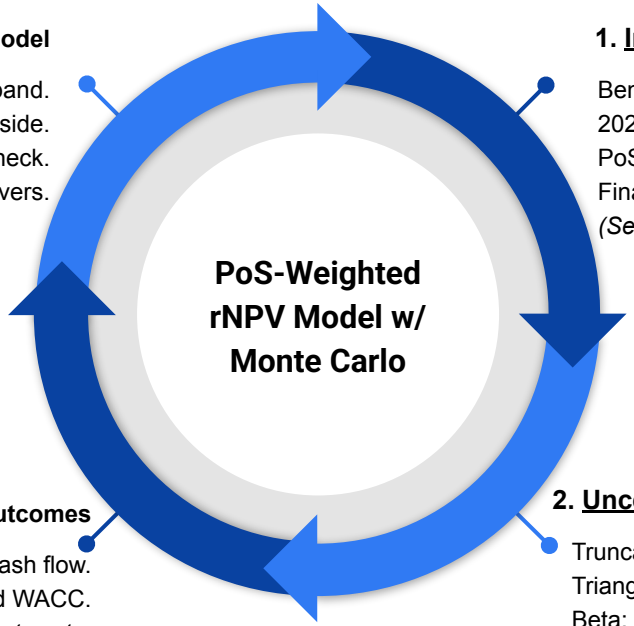
For full references, see slides 14-15

How the Model Works: PoS-Weighted rNPV with Monte Carlo

VALUE

4. Outputs & QA - Derive insights & validate the model

Report P75 - P25 rNPV percentiles & fair-value band.
Prob(rNPV > 0) and Mean(P25) to show downside.
Validate base-case mean ≈ P50 as a model calibration check.
Sensitivity tornado charts to identify top drivers.



1. Inputs & Priors - Anchor model to real-world data

Benchmarks & company data: FcRn analogs & Immunovant 2025 deck.
PoS priors: BIO 2023.
Financials: EvaluatePharma/UBS (WACC, SG&A, COGS).
(See prior slide for full sources.)

3. rNPV Engine - Convert uncertainty into financial outcomes

Convert annual patient adoption to revenue, then to free cash flow.
Weight by cumulative PoS and discount by sampled WACC.
Subtract PV of committed development costs.
Run Monte Carlo simulations to generate the value distribution.

2. Uncertainty Modeling - Depict uncertainty probabilistically

Truncated normal: timings, WACC, and cost bounds.
Triangular: prevalence, peak penetration %, time-to-peak.
Beta: phase-gated PoS (bounded 0-1).
Gaussian copula: Preserves realistic correlations.

A transparent, quantitative framework that translates clinical and commercial uncertainty into investment-grade decision confidence.

Modeled rNPV Distribution and Fair-Value Band for Batoclimab (IMVT-1401)

VALUE

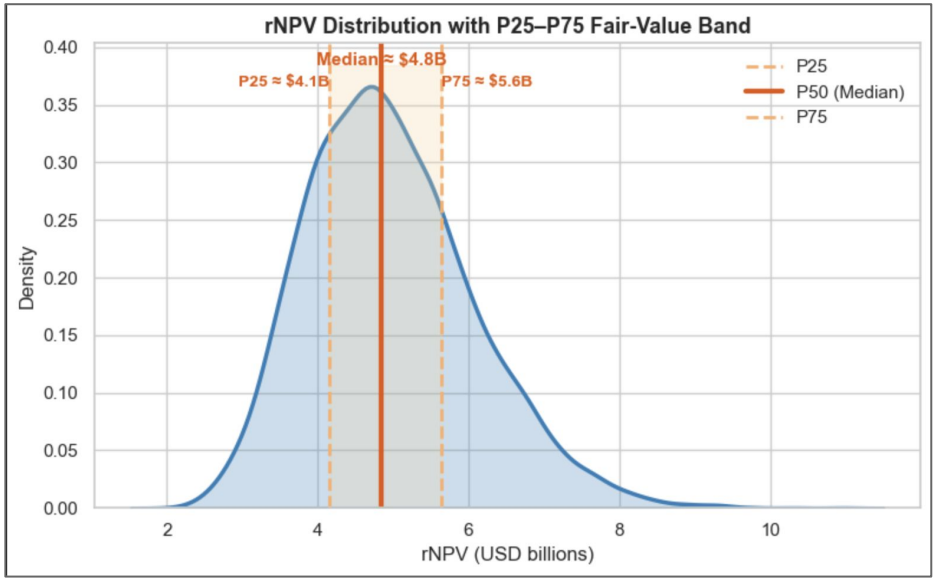


Figure 1. Monte Carlo simulation of Batoclimab's risk-adjusted NPV (10,000 runs) showing a median value of approximately $4.8 billion and a fair-value range (P25-P75) of $4.1-$5.6 billion.

Metric	Value (USD)
P10 rNPV	$3.6B
P25–P75 Range	**$4.1B - $5.6B**
P50 (Median)	$4.8B
Base-Case rNPV	$4.7B
Prob(rNPV > 0)	**100%**
Expected Shortfall (ES25)	$3.6B

Table 1. Summary of key rNPV distribution metrics derived from 10,000 Monte Carlo simulations.

The rNPV distribution is centered near the base case, confirming that the model is well-calibrated and internally consistent.

No negative outcomes were observed, indicating that downside risk is limited and primarily driven by commercial uncertainty rather than clinical or regulatory volatility. This is consistent with a de-risked FcRn class supported by strong analog performance.

Key Value Drivers and Sensitivity Analysis

VALUE

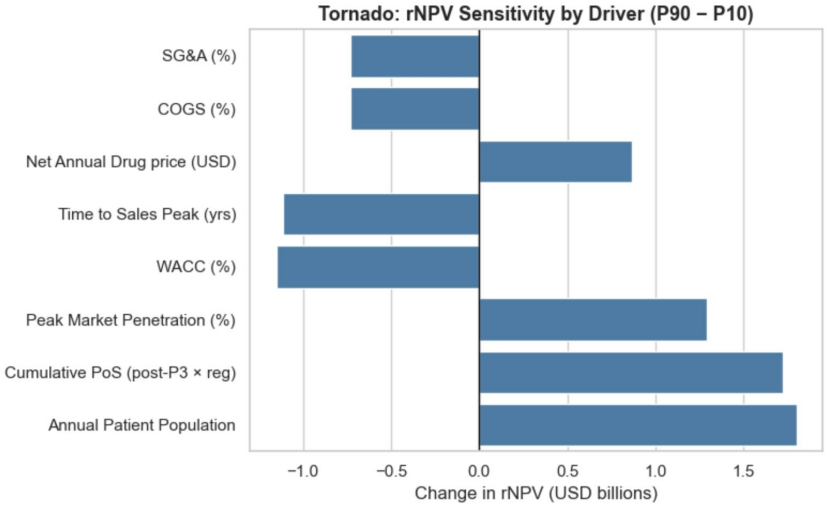


Figure 2. Tornado Plot of rNPV Sensitivity. Monte Carlo-based sensitivity analysis showing the change in rNPV (USD billions) between the 90th and 10th percentile of each input. Batoclimab's valuation is most sensitive to market penetration, treated population, and pricing assumptions, while probability of success and cost parameters exert smaller effects.

Driver	Spearman ρ
Annual Patient Population	0.487
Cumulative PoS	0.440
Time to Peak Sales (yrs)	-0.346
Peak Market Penetration (%)	0.346
WACC (%)	-0.313
Net Annual Drug Price (USD)	0.241
SG&A (%)	-0.208
COGS (%)	-0.189

Table 2. Spearman Rank Correlations of Model Inputs. Rank correlations between each input variable and rNPV confirm directionality of influence. Positive correlations indicate value drivers, while negative correlations reflect risk levers.

rNPV is driven primarily by commercial levers, especially peak market penetration (%) and annual patient population, with WACC (%) next in importance. Clinical PoS has a smaller impact given that the FcRn class is already clinically validated. The practical implication of these findings is to focus diligence on market sizing, payer access, and launch execution. These drivers then inform scenario design and post-deal KPI tracking.

Strategic Recommendation and Portfolio Implications

DECIDE

Batoclimab is a high-confidence, high-value opportunity to diversify and potentially de-risk Biogen's Immunology portfolio.

✅ **Robust intrinsic value:** Median rNPV ≈ **$4.8B***, with a tight fair-value band ($4.1 - $5.6B) and downside risk of $3.6B across 10,000 simulations. Additionally, the current Immunovant market cap is below the modeled median rNPV.

✅ **Mechanistic diversification:** FcRn inhibition uniquely addresses Biogen's antibody-clearance gap, bridging the immune system cascade gap between felzartamab and litifilimab.

✅ **Commercial synergy:** Leverages Biogen's existing neurology and rare-disease footprint, including shared specialists, field force and patient journey mapping models.

✅ **Manageable risk profile:** Remaining uncertainty is predominantly commercial, including factors such as pricing, payer access, and launch execution rather than clinical or regulatory outcomes.

At ~$4.0B, Batoclimab appears capital-efficient versus modeled value and is expected to strengthen the portfolio's risk-adjusted profile; a Sharpe/mean-variance check can confirm the offer cap.

Decision triggers should prompt reassessment if the **MG Phase 3 trial fails to meet its primary endpoint**, if the **gross-to-net discount exceeds 25%** or if the **WACC rises above 12%**.

*Modeled rNPV reflects after-tax cash flows (21% rate) discounted at a variable WACC centered at 10%; U.S. + E.U. Myasthenia Gravis market scope.

Future Directions & Next Steps

1. Portfolio-Level Risk-Return Analysis

- Extend current rNPV model into a portfolio mean-variance framework to estimate Biogen's Immunology and Global Portfolio **Sharpe ratios pre- and post-Batoclimab** addition.
- Use these metrics to derive an **implied upper bound on acquisition price** consistent with the portfolio's target risk tolerance and return objectives.

2. Next-Generation Asset Assessment (IMVT-1402)

- Model IMVT-1402 as a **high-risk, high-reward follow-on opportunity** using early-stage PoS priors.
- Compare capital allocation efficiency between Batoclimab (1401) and 1402 under varying commercial success assumptions.
- Evaluate whether Biogen's internal VC or BD innovation arm could engage via partnership.

3. Refine Uncertainty Calibration

- Incorporate **external market research and analyst forecasts** via NLP to refine priors for market size, adoption, and pricing variability.
- Explore Bayesian updating as new trial and commercial data emerge.

4. Broader Portfolio Integration and Strategic Options

- Assess synergies beyond Immunology (e.g., leveraging neurology field force, payer access infrastructure).
- Model real-option extensions for **new indications** (CIDP, TED, Graves'), including expansion value and staged investment triggers.

Turning Uncertainty into Confident, Data-Driven Decisions

What we did:

- Applied a reusable **Decision Quality (DQ)** framework (Define → Quantify → Value → Decide) to evaluate Batoclimab under real-world uncertainty.
- Developed a transparent, **probability-weighted rNPV model** with Monte Carlo and sensitivity analysis to separate signal from noise.

What it shows:

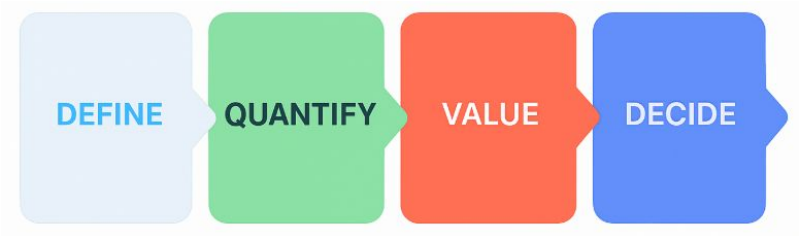
- **High intrinsic value:** rNPV median ≈ **$4.8B** with a **P25–P75** band of **$4.1 - $5.6B**.
- **Strategic fit:** FcRn inhibition fills Biogen's **antibody-clearance gap** while leveraging the neurology footprint.
- **Risk is manageable:** Variability is driven primarily by **commercial factors** rather than clinical or regulatory uncertainty.

What to decide:

- Proceed to **partnership/acquisition diligence**, anchored by the modeled fair-value band.
- Use **decision triggers** to stay disciplined: revisit if **MG Ph3 misses**, **GTN >25%**, or **WACC >12%**.

Why this scales:

- The framework is **reusable**: automate inputs, standardize PoS/financial priors, and rerun for any asset to ensure **consistent, auditable** decisions.



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