Use of Agentic AI to Create Health Economic Models

How purpose-built agentic workflows combine deterministic code, AI, and human expertise to produce scientifically defensible health economic models

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DESIGN PHILOSOPHY

How AI Should Be Used for Scientific Work

The sophistication is in knowing where *not* to use AI. Effective agentic systems combine three elements, each applied where it adds the most value, and each addressing a specific gap in general-purpose LLMs.

Deterministic Code

Known functions, structural scaffolding, fixed blueprints.

Markov trace, discounting, ICER calculations are defined, not generated by AI.

Addresses: probabilistic variability and lack of domain constraints

REMOVES ERROR CLASS

AI Where It Adds Value

Evidence synthesis, parameter extraction, result interpretation, QC diagnosis. Tasks where judgment and flexibility matter.

Addresses: tasks requiring judgment that deterministic code cannot handle

CONSTRAINED SURFACE AREA

Human-in-the-Loop

Review specs before building, review flagged concerns, approve the model before finalizing.

Decision authority stays with the expert.

Addresses: accountability gaps, audit trail and oversight obligations

JUDGMENT WHERE IT COUNTS

Constraining where AI operates shrinks the surface area for probabilistic errors

AGENTIC ARCHITECTURE

What Agentic System Design Provides

A monolithic LLM call attempting everything is fragile and produces opaque outputs. Agentic system design partitions work into focused, well-defined tasks: the same underlying models, deployed more effectively.

🎯

Focused Scope, Better Output

Each task gets its own agent with a manageable, targeted context. A parameter extraction agent does not hold code architecture in mind. Each step is tractable, which means each output is better.

FOCUSED CONTEXT PER STEP

✅

Verifiable at Every Step

Discrete steps create natural checkpoints. Every intermediate output can be tested and corrected before the next step begins. A monolithic call gives you a finished artifact with nothing to verify against.

CHECKPOINTS AT EVERY STAGE

🔄

A System That Monitors Itself

QC agents detect errors, coding agents correct them, and QC re-runs. Generation, verification, and correction form a closed loop. This is what makes the system genuinely agentic.

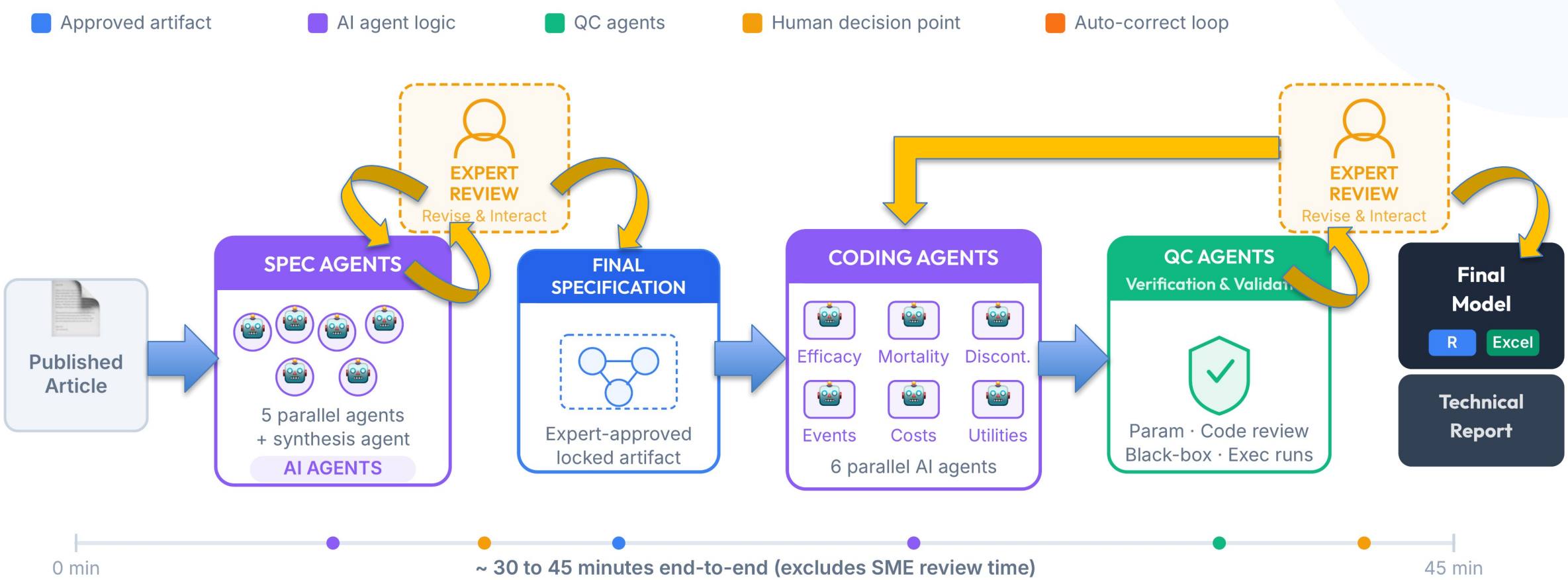
SELF-MONITORING FEEDBACK LOOP

Agentic architecture is the right fit for multi-step scientific work that requires quality control, verification, and auditability.

THE AGENTIC WORKFLOW

From Published Article to Validated Model

Heinz et al. 2022 · JAKi vs dupilumab · Atopic dermatitis · UK NHS perspective

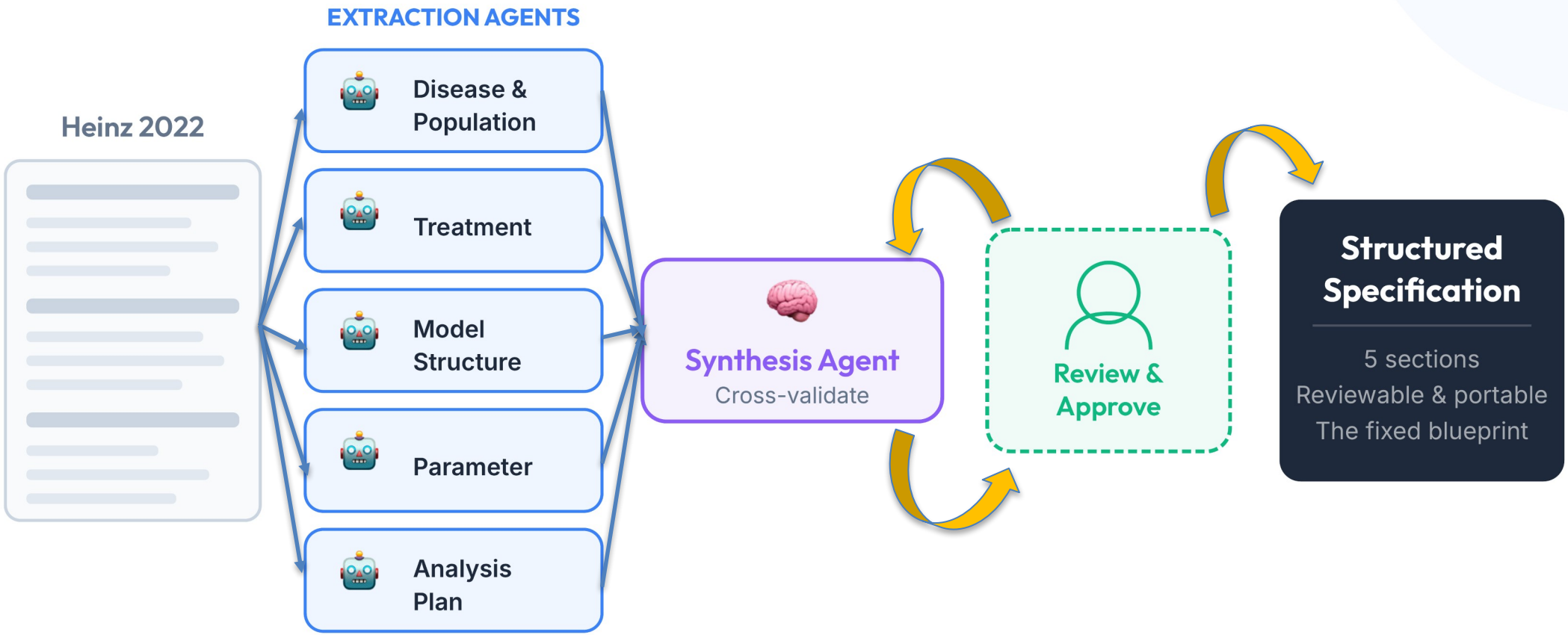


Three feedback loops: expert and specification, QC and coding (automated), expert and final review. The system corrects, the expert controls.

MULTI-AGENT EXTRACTION · SPECIFICATIONS

The Deterministic Blueprint

Same specification, same model. The spec is the fixed point that ensures reproducibility, regardless of how each extraction agent arrived at its output.



Nothing gets built until the blueprint is reviewed and approved by the expert

AGENTIC CODE GENERATION + QUALITY CONTROL

Scaffolding + AI Agents + Human Review

Deterministic Scaffolding

⚙️ **Architecture is locked** by the structural blueprint before any agent writes code

🔧 **Known functions** (Markov trace, discounting, ICER) are deterministic code, not AI-generated

🏗️ **Platform domain knowledge:** tunnel states, time-dependent transitions, therapy sequencing are already defined. Each agent operates within this constrained space.

Each new model builds on the platform. Agents operate within a constrained scope, not a blank canvas.

6 Parallel AI Agents for Coding

🤖 Efficacy	🤖 Mortality	🤖 Discontinuation
🤖 Adverse Events	🤖 Costs	🤖 Utilities

Independent QC Agents: Verification & Validation

📊 Parameter Verification	🔍 Code Validation	🧪 18+ Black-Box Tests

AUDITABILITY

The Paper Trail: From Process to Evidence

The final model code is the primary output. Methodological trust is established through full documentation of every decision, assumption, and data source throughout the agentic process.

📋

Structured Specifications

The complete blueprint: disease, population, structure, parameters, analysis plan. Reviewable and shareable.

🏗️

Structural Blueprint

Health states, transitions, cycle definitions. The architecture of the model, locked before code generation.

💻

R Model Code

Fully transparent, editable R scripts. Runs on any standard R environment. The deliverable.

✅

QC Agent Results

What was tested, what passed, what failed, what was auto-fixed, what was flagged for expert review.

💬

User Interactions

Every user input, modification, and approval decision. How SME judgment was incorporated at each checkpoint.

📖

Technical Report

15-50 page report: methodology, results, schematics, sensitivity analysis interpretation.

> *This documentation package supports HTA submission requirements. It is the traceability that separates "we used AI" from "we used AI defensibly."*

KEY TAKEAWAYS

Key Takeaways

Can it produce a real model?

Yes. Published article to validated, executable R model in under an hour. The same specification can also produce an Excel implementation.

What does the expert actually do?

Review, revise, pressure test. The system is designed for interaction, not just approval. SME time goes to scientific judgment, not mechanical production.

How do you know it's right?

Agentic QC loops: the system verifies its own outputs at every step, corrects what it can, and flags what needs human judgment. Verification agents are independent from generation agents.

Is it reproducible?

Same specification, same model. The specification is the study protocol. It documents every assumption, data source, and methodological choice. Given that protocol, the model is reproducible in the same way traditional research is: a complete, documented methodology another team could follow.

One Blueprint, Two Implementations

The same structured specifications that produced this R model can also produce an Excel implementation. Blueprint portability is the reusability story in action.

R Model ✓

SAME SPECS →

Excel Model