

Solstice: Automated Fact-Checking for Medical Documentation

A Multi-Agent System for Evidence Extraction and Verification

1 Why Solstice?

Medical claims appear everywhere—in marketing materials, clinical trials, regulatory documents, and patient information sheets. Verifying these claims traditionally requires expert reviewers to manually search through hundreds of pages of dense scientific literature. This process is time-consuming, expensive, and prone to human error.

Solstice automates this verification process by combining advanced document understanding with intelligent agent orchestration. The system can process a claim like "Vaccine X shows 95% efficacy in adults over 65" and automatically find, extract, and verify supporting evidence from relevant clinical documents.

2 System Overview

3 How It Works

3.1 Step 1: Understanding Document Structure

Medical documents are complex—they mix narrative text with data tables, clinical figures, and regulatory disclaimers. Solstice first "sees" the document using computer vision to identify each element:

This visual understanding is crucial because:

- Key efficacy data often appears in tables
- Safety information may be in figure captions
- Important disclaimers hide in footnotes
- Marketing materials use visual hierarchy to emphasize claims

3.2 Step 2: Intelligent Agent Orchestration

Once the document structure is understood, specialized agents work together to verify claims:

Each agent has a specific role:

- **Evidence Extractor:** Searches documents for passages related to the claim
- **Evidence Verifier:** Confirms quotes are accurate and truly support the claim
- **Completeness Checker:** Identifies missing evidence and triggers additional searches
- **Visual Analyzer:** Examines tables and figures for data supporting or contradicting claims

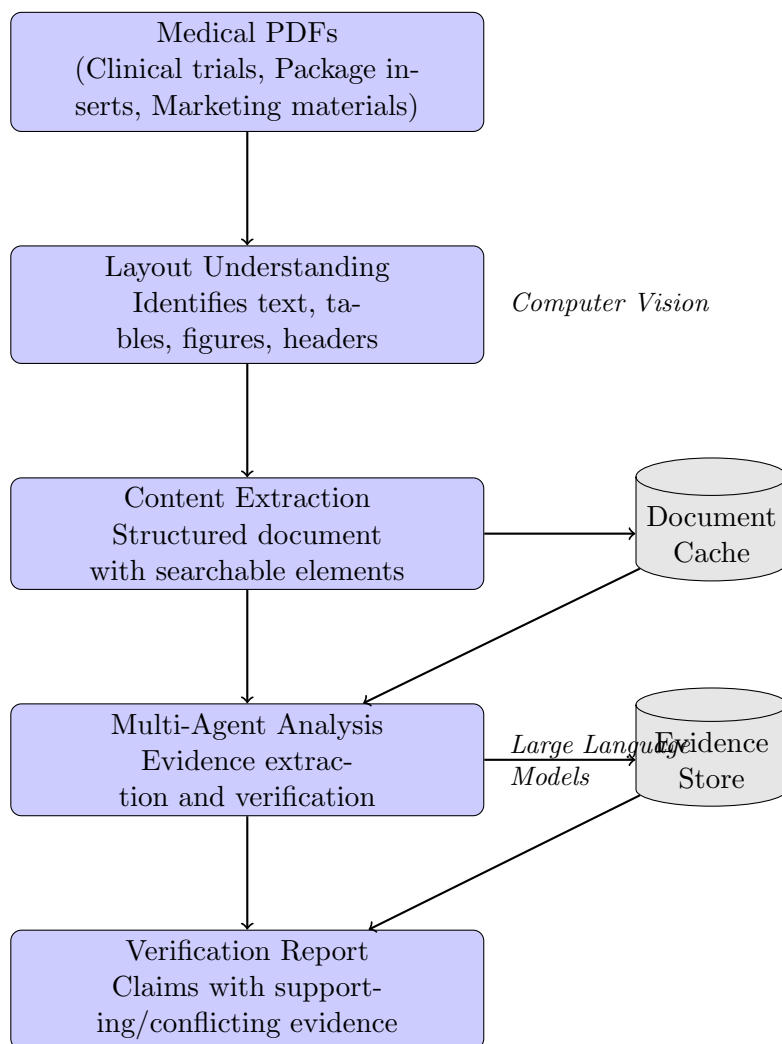


Figure 1: High-level architecture of the Solstice system

Total elements: 15
Reading order: 15 elements

Vaccine 29 (2011) 7733–7739



3. Title: Protective efficacy of a trivalent recombinant hemagglutinin protein vaccine (FluBlok®) against influenza in healthy adults: A randomized, placebo-controlled trial^A

4. Text: John Treanor^{a,*}, Hana El Sahly^b, James King^c, Irene Graham^d, Ruvim Izikson^e, Robert Kohberger^f, Peter Patriarca^g, Manon Cox^e

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6. Figure: ARTICLE INFO

Article history:
Received 20 May 2011
Received in revised form 27 July 2011
Accepted 27 July 2011
Available online 9 August 2011

Keywords:
Influenza vaccine
Baculovirus expression
Recombinant protein
Clinical trials

7. Title: ABSTRACT

8. Text: **Background:** Development of influenza vaccines that do not use embryonated eggs as the substrate for vaccine production is a high priority. We conducted this study to determine the protective efficacy a recombinant, baculovirus-expressed seasonal trivalent influenza virus hemagglutinin (rHA0) vaccine (FluBlok®). **Methods:** Healthy adult subjects at 24 centers across the US were randomly assigned to receive a single injection of saline placebo (2304 subjects), or trivalent FluBlok containing 45 mcg of each rHA0 component (2344 subjects). Serum samples for assessment of immune responses by hemagglutination-inhibition (HAI) were taken from a subset of subjects before and 28 days after immunization. Subjects were followed during the 2007–2008 influenza season and combined nasal and throat swabs for virus isolation were obtained from subjects reporting influenza-like illness. **Results:** Rates of local and systemic side effects were low, and the rates of systemic side effects were similar in the vaccine and placebo groups. HAI antibody responses were seen in 78%, 81%, and 52% of FluBlok recipients to the H1, H3, and B components, respectively. FluBlok was 44.6% (95% CI, 18.8%, 62.6%) effective in preventing culture-confirmed influenza meeting the CDC influenza-like illness case definition despite significant antigenic mismatch between the vaccine antigens and circulating viruses. **Conclusions:** Trivalent rHA0 vaccine was safe, immunogenic and effective in the prevention of culture confirmed influenza illness, including protection against drift variants.

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9. Title: Introduction

10. Text: Though embryonated hen's eggs have been used to generate effective influenza vaccines for many years, this system does have several important drawbacks. Vaccine manufacturing using eggs requires specialized facilities, and the ability to scale up egg production rapidly in response to an emergency is limited. In addition, poultry are potentially vulnerable to the same subtypes of influenza

14. Text: that might also be responsible for pandemic influenza. It is usually necessary to adapt candidate vaccine viruses for high yield growth in eggs, a process that can be time consuming, is not always successful, and which can select receptor variants that may not be optimally representative of circulating influenza strains [1,2].

15. Text: Expression of proteins in insect cells using recombinant baculovirus has emerged as a promising technology for vaccine production. New recombinant baculoviruses can be generated quickly from sequence data, protein expression is very efficient under the control of the baculovirus polyhedrin promoter, and post-translational modifications of the protein are generally similar to other eukaryotic systems. In previous studies, we have evaluated baculovirus-expressed recombinant influenza virus hemagglutinins (rHA0s) as influenza vaccines in humans. Monovalent and bivalent rHA0s have been well tolerated and immunogenic in

11. Text: ^ATrials.gov Identifier: NCT00539981.

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12. Text:

13. Text: X/S – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.vaccine.2011.07.128

Figure 2: Layout detection on a clinical trial paper identifies distinct regions: title, abstract, body text, tables, and figures. Each element is extracted separately for targeted analysis.

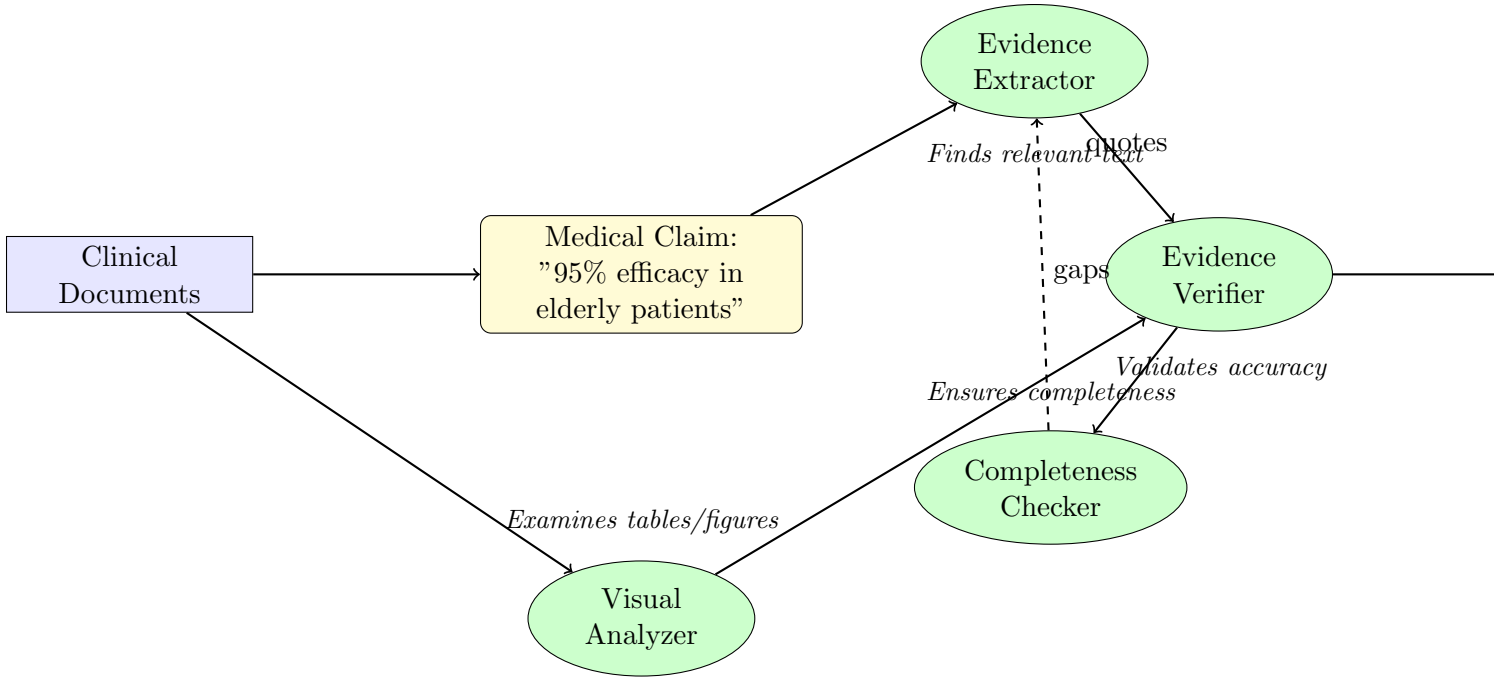


Figure 3: Agents collaborate to thoroughly verify each claim, with feedback loops ensuring comprehensive coverage

3.3 Step 3: Comprehensive Reporting

The system produces detailed reports showing:

- Exact quotes supporting each claim
- Visual evidence from tables and figures
- Conflicting information if found
- Confidence assessment based on evidence strength
- Missing evidence that couldn't be located

4 Real-World Applications

4.1 Clinical Trial Verification

When pharmaceutical companies publish trial results, Solstice can verify that marketing claims accurately reflect the scientific data. The system catches discrepancies like selective reporting or overgeneralization of results.

4.2 Regulatory Compliance

Medical device manufacturers must ensure their promotional materials align with FDA-approved indications. Solstice automatically cross-references marketing claims against regulatory documents.

4.3 Marketing Material Review

Marketing materials require special attention due to their persuasive nature:

2. Separator



Appropriate medical treatment must be immediately available to manage potential anaphylactic reactions following administration of Flublok.

Please see additional Important Safety Information throughout. Before administration, please see full Prescribing Information here.

5

5 Key Innovations

5.1 Multimodal Understanding

Unlike text-only systems, Solstice analyzes tables, graphs, and figures—critical for medical evidence where key data often appears visually.

5.2 Intelligent Orchestration

Agents work together with feedback loops, ensuring thorough verification. If gaps are found, the system automatically searches for additional evidence.

5.3 Traceable Verification

Every claim links back to its source evidence, maintaining transparency and allowing human review of the automated findings.

5.4 Scalable Architecture

The system processes multiple claims in parallel while managing computational resources efficiently.

6 Impact and Benefits

- **Speed:** Reduces verification time from days to minutes
- **Accuracy:** Systematic analysis eliminates human oversight errors
- **Completeness:** Examines entire documents, not just keyword matches
- **Transparency:** Provides traceable evidence for every verification
- **Scalability:** Handles large document sets that would overwhelm human reviewers

7 Future Directions

Solstice continues to evolve with planned enhancements:

- Cross-document reasoning to synthesize evidence from multiple sources
- Temporal analysis to track how claims change over time
- Contradiction detection between related documents
- Integration with regulatory databases for real-time compliance checking

8 Conclusion

Solstice represents a paradigm shift in medical document verification. By combining visual document understanding with intelligent agent orchestration, it transforms a manual, error-prone process into an automated, reliable system. This enables faster drug development, more accurate marketing, and ultimately, better-informed healthcare decisions.