From Information Retrieval (IR) to Argument Retrieval (AR) for Legal Cases: Report on a Baseline Study

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Summary

- Commercial legal information retrieval (IR) system users often want argument retrieval (AR), retrieving:
  - ❑ not just sentences with highlighted terms, but
  - ❑ arguments and argument-related information.
- We conducted baseline study of how two legal IR systems
  - ❑ responded to standard queries
  - ❑ using a corpus of argument-annotated legal cases.
- We identify ways in which IR systems do not meet the need for AR,
  - ❑ illustrate how additional argument-relevant information could address some inadequacies, and
  - ❑ briefly describe how to develop an AR system to retrieve argument-related information from legal decisions.

Vaccine/Injury Project (V/IP) Corpus*

- Legal decisions: does claim comply with National Vaccine Injury Compensation Program?

- Claimant compensated IFF vaccine <u>caused</u> the injury.
  - *Althen v. Secr. of Health and Human Services*, 418 F.3d 1274 (Fed.Cir. 2005):
  - the petitioner must establish, by a preponderance of the evidence, that:
    1. a "medical theory causally connects" the type of vaccine with the type of injury;
    2. there was a "logical sequence of cause and effect" between the particular vaccination and the particular injury; and
    3. a "proximate temporal relationship" existed between the vaccination and the injury.

- Court of Federal Claims "Special Masters":
  - decide which evidence is relevant to which issues of fact,
  - evaluate plausibility of evidence in the legal record,
  - organize evidence and draw reasonable inferences, and
  - make findings of fact.

- Corpus = all decisions in 2-years applying *Althen* test of causation-in-fact
  - 35 decision texts, 15-40 pages per decision

Default Logic Framework (DLF)
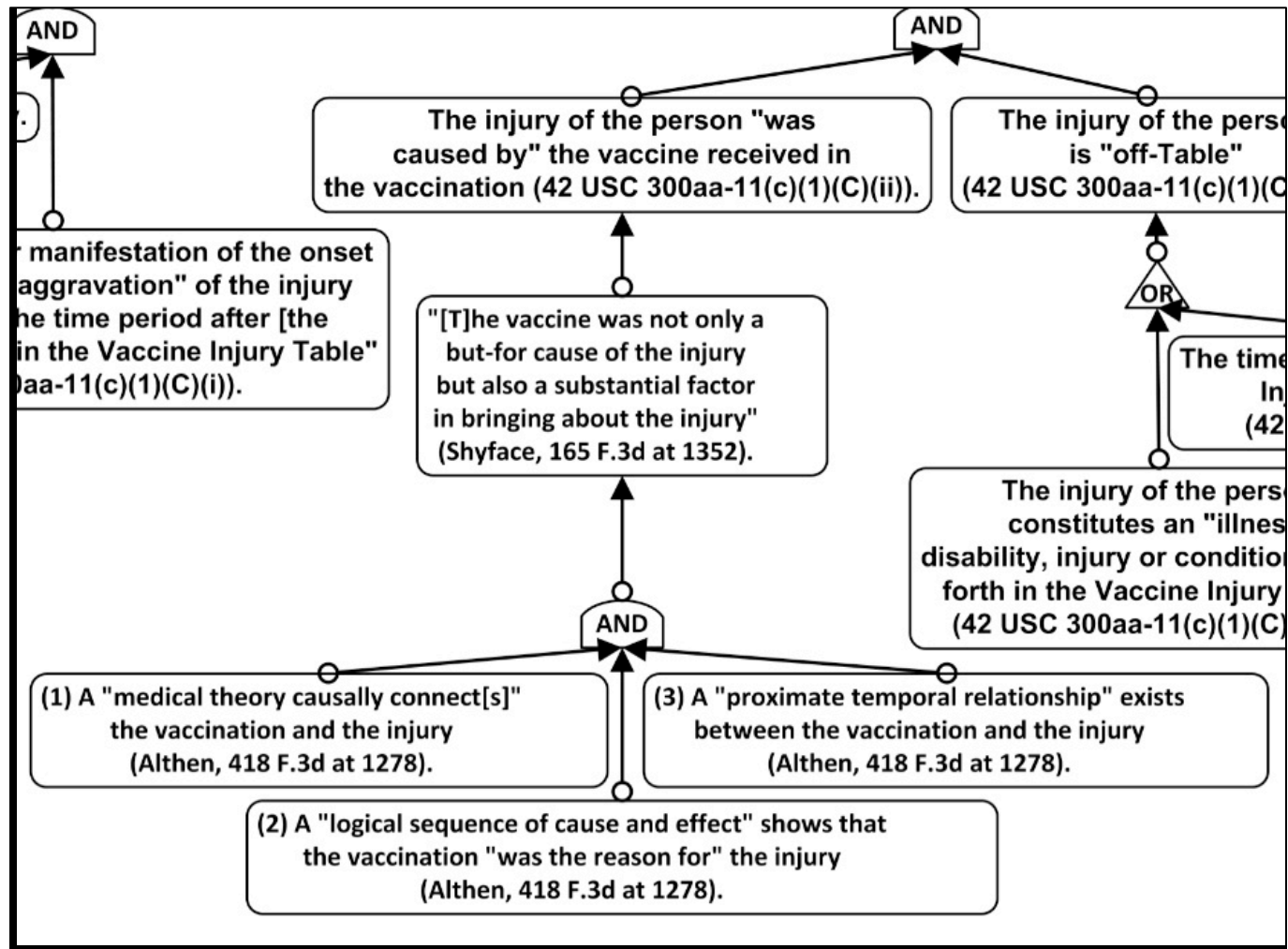
Partial Rule Tree for Vaccine Decisions, Showing Three Causation Conditions of *Althen*

1. DLF Annotations

Ms. Cusati has provided more than preponderant evidence that Eric's intractable seizure disorder led to Eric's death…. Dr. Kinsbourne and Dr. Kohrman agree that MMR vaccine causes fever…. Dr. Kinsbourne and Dr. Kohrman agree that fever causes seizures…. Dr. Kinsbourne and Dr. Kohrman agree that a child who suffers a complex febrile seizure has a greater chance of developing epilepsy…. As such, Dr. Kohrman's reports and testimony, and the medical literature, do not assist the special master in evaluating Ms. Cusati's "legal cause" claim.

AND [1 of 3] : (1) A "medical theory causally connect[s]" the vaccination on November 5, 1996 and an intractable seizure disorder and death (Althen, 418 F.3d at 1278).

"MMR vaccine causes fever" and "fever causes seizures." [C:12; S: Special Master; M: "Ms. Cusati has provided more than preponderant evidence"; NLS: Ms. Cusati has provided more than preponderant evidence that MMR vaccine causes fever. Ms. Cusati has provided more than preponderant evidence that fever causes seizures.]

EVIDENCE FACTORS

FACTOR [1 of 4] : "MMR vaccine causes fever." [C: 11; S: Special Master; B: Drs. Kinsbourne and Kohrman testimony; NLS: Dr. Kinsbourne and Dr. Kohrman agree that MMR vaccine causes fever.]

FACTOR [2 of 4] : "[F]ever causes seizures." [C: 11; S: Special Master; B: Drs. Kinsbourne and Kohrman testimony; NLS: Dr. Kinsbourne and Dr. Kohrman agree that fever causes seizures.]

FACTOR [3 of 4] : "[A] child who suffers a complex febrile seizure has a greater chance of developing epilepsy." [C: 11; S: Special Master; B: Dr. Kinsbourne and Kohrman testimony; NLS: Dr. Kinsbourne and Dr. Kohrman agree that a child who suffers a complex febrile seizure has a greater chance of developing epilepsy.]

FACTOR [4 of 4] : "[T]he medical literature ... do[es] not assist the special master in evaluating Ms. Cusati's 'legal cause' claim." [C: 13; S: Special Master; NLS: As such, Dr. Kohrman's reports and testimony, and the medical literature, do not assist the special master in evaluating Ms. Cusati's "legal cause" claim.]

Very Plausible

2. Presuppositional Concepts: Entities, Events & Relations

Semantic Relations	Meaning (objects or event referents)
1. Covered-vaccine	a vaccine covered by the VICP
2. Specific-date	a specific month, day, year
3. Specific-vaccination	a vaccination with a Covered-vaccine on a Specific-date
4. Generic-injury	a type of injury, adverse condition or disease
5. Injury-onset	a symptom, sign or test result associated with the onset of a Generic-injury
6. Onset-timing	time interval between Specific-vaccination and the earliest Injury-onset
C1. Medical-theory-assertion	assertion that a medical theory causally connects vaccination with a Covered-vaccine with the occurrence of a Generic-injury
C2. Causal-chain-assertion	assertion that a Specific-vaccination caused an instance of a Generic-injury

Noun Phrases: 1-6; Causal Assertions: C1-C2

Baseline Study

- Ten cases in V/IP Corpus involving the first *Althen* condition:
  - five for petitioner (*Cusati, Casey, Werderitsh, Stewart, Roper*)
  - five for government (*Walton, Thomas, Meyers, Sawyer, Wolfe*).
- Each case used as a "source case" to construct a standard search query based on its facts by:
  - substituting values from each "source" case for Covered-vaccine, Generic-injury, and Onset-timing into two templates:
  - Q1. <Covered-vaccine> can cause <Generic-injury>
  - Q2. <Covered-vaccine> can cause <Generic-injury> <Onset-timing>
  - For example:
    - *Casey* Q1: "Varicella vaccine can cause encephalomyeloneuritis".
    - *Casey* Q2: "Varicella vaccine can cause encephalomyeloneuritis within four weeks".

Westlaw Next Results List & Case Reports: *Casey* Q2

List of 60 results for Varicella vaccine can cause encephalomyeloneuritis within four weeks

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1. Doe/17 v. Secretary of Health and Human Services

United States Court of Federal Claims. | December 16, 2008 | 84 Fed.Cl. 691 | 2008 WL 5330496

> HEALTH - **Vaccines**. Special Master in **Vaccine** reasonably found lack of credibility as to claimant, given evidentiary contradictions.

... Petitioner's theory of causation posited that she had a pre-existing condition of CVID, which was significantly aggravated by her **varicella vaccinations**, as evidenced, in part, by the onset of diarrhea and other flu-like symptoms approximately two **weeks** after receiving the second **varicella vaccination** on June **4**, 2001....

...Special Master did not act arbitrarily and capriciously, in "off-table" **Vaccine** Act case in which claimant alleged aggravation of preexisting condition after receiving **varicella vaccine**, by relying on claimant's Social Security disability records preceding **vaccinations**; records showed that claimant had suffered from chronic irritable bowel syndrome (IBS) before receiving **vaccinations**, which was contrary to her representations in **Vaccine** Act claim, and undermined her theory of causation and her credibility. National Childhood **Vaccine**...

...Claimant in "off-table" **Vaccine** Act case must present: (1) medical theory causally connecting **vaccination** and injury; (2) logical sequence of **cause** and effect showing that **vaccination** was reason for injury; and (3) showing of proximate temporal relationship between **vaccination** and injury. National Childhood **Vaccine** Injury Act, 42 U.S.C.A. §§300aa–11(c)(1)(C)(ii), 300aa–13(a)(1)(A)....

... At a scheduled interview twenty-**four weeks** after receiving the second **vaccination** there were no adverse effects of the **vaccine** recorded....

2. Stapleford ex rel. Stapleford v. Secretary of Dept. of Health and Human Services

United States Court of Federal Claims. | October 05, 2009 | 89 Fed.Cl. 456 | 2009 WL 3380616 | 03-234V

> HEALTH - **Vaccines**. Child's seizures and developmental delays were not caused by **varicella** immunization.

... Having concluded that the **varicella vaccine** could not have caused Devon's injury, the Special Master held that the **varicella vaccine** did not **cause** Devon's injury in this case....

Lexis Advance Results List & Case Reports: *Casey* Q2

1. Results List for: Varicella vaccine can cause encephalomyeloneuritis within four weeks

    Content Type: Cases

    Terms: Varicella vaccine can cause encephalomyeloneuritis within four weeks

    Search Type: Natural Language

6,484,948 for **Varicella vaccine can cause encephalomyeloneuritis...**

	Document Title	Jurisdiction	Court	Date
1.	**Casey v. Sec'y of HHS, 2005 U.S. Claims LEXIS 391**	U.S. Federal	Court of Federal Claims	December 12, 2005
	In sum, petitioner was vaccinated against **varicella** on June 9, 1995. The attenuated virus in the **varicellavaccine** both directly attacked petitioner's nervous system and **caused** an immune-mediated inflammatory response in her nervous system. As a result, **withinfourweeks** of her **varicella** vaccination, petitioner began to experience the onset of symptoms of her **encephalomyeloneuritis**. One such symptom was cerebellitis, a condition particularly associated with a natural **varicella** infection, which ...			
	Overview: Petitioner was able to prove by a preponderance of evidence that a varicella vaccine was the cause in fact of her neurological injuries, rendering her entitled to compensation pursuant to he National Childhood Vaccine Injury Act, 42 U.S.C.S. §§ 300aa-1 to 300aa-34.			
2.	**Coppola v. Sec'y of HHS, 2012 U.S. Claims LEXIS 321**	U.S. Federal	Court of Federal Claims	March 07, 2012
	After the hearing, Petitioner identified as the primary issue whether the **varicellavaccinecancause** SIRS 72 hours after its administration in a 56-year old man. Pet'r's Post-Hr'g Br. at 2. Petitioner stated that ″ [t]he only peer-reviewed literature available on the subject simply states that adverse reactions to the **varicellavaccine** have not been reported **within** seventy-two hours in petitioner's age group.″ Id .			
	Overview: In action under Vaccine Act, petitioner had not established prima facie case of causation because, inter alia, there was no reliable theory explaining how varicella vaccination could have caused symptoms of which petitioner complained, and there was not preponderant evidence of a logical sequence of cause and effect between vaccination and illness.			
3.	**Tompkins v. Sec'y of the HHS, 2013 U.S. Claims LEXIS 842**	U.S. Federal	Court of Federal Claims	June 21, 2013
	This news release, coupled with Dr. Pike's assertions and VAERS research, does not constitute preponderant evidence that the meningococcal **vaccinecancause** GBS, particularly in light of the absence in the ensuing seven years of any case reports, studies, or other evidence suggesting that the spike in cases was more than coincidence. Furthermore, a 2008 study based on a mass meningococcal vaccination campaign in Canada showed no increased risk of GBS **within** eight **weeks** of vaccination. Haber ...			
	Overview: Petition for compensation under National Vaccine Injury Compensation Program was dismissed because decedent's respiratory infection, which began two weeks before onset of Guillain-Barré syndrome (GBS) symptoms, was well-recognized cause of GBS, occurred at appropriate temporal interval before onset of symptoms, and was most likely cause for GBS.			

Results of Baseline Study

1. Case Name (date); Winner of claim [*Althen* 1 issue] in Report	2. Vaccine; Alleged Injury; Time-to-Onset	3. Total # cases returned, by query	4. % vaccine comp. cases in top-*10*, by query	5. Source case in top-*10*, by query (Y/N)? (rank)	6. % cases in top-10 whose Case Report has all 3 Q1 [4 Q2] items	7. Source Case Report has all 3 Q1 [4 Q2] items (Y/N)?
Cusati (9/22/05) Pet. [Pet.]	MMR; Intractable seizure disorder and death; After about four days	**Q1WN**: 75	100	YES(2)	30	YES
		Q1LA: 5,648,600	100	YES(1)	70	YES
		Q2WN: 67	100	YES(4)	10	YES
		Q2LA: 7,280,942	100	YES(2)	20	YES
Roper (12/9/05) Pet. [Pet.]	Tetanus; Chronic gastroparesis; Within four days	**Q1WN**: 75	100	NO(21)	0	YES
		Q1LA: 5,463,833	100	YES(1)	10	YES
		Q2WN: 70	100	NO(11)	0	YES
		Q2LA: 6,935,432	100	YES(1)	10	YES
Casey (12/12/05) Pet. [Pet.]	Varicella; Encephalo-myeloneuritis; Within four weeks	**Q1WN**: 56	100	YES(3)	10	YES
		Q1LA: 5,455,390	90	YES(1)	10	YES
		Q2WN: 60	100	YES(4)	10	YES
		Q2LA: 6,484,948	100	YES(1)	10	YES
Werderitsh (5/26/06) Pet. [Pet.]	Hepatitis B; Multiple sclerosis or MS; After a few days to four weeks	**Q1WN**: 73	90	YES(1)	50	YES
		Q1LA: 399,644	100	NO(na)	100	NO
		Q2WN: 41	90	YES(1)	50	YES
		Q2LA: 11	100	NO(na)	100	NO
Stewart (3/19/07) Pet. [Pet.]	Hepatitis A; Cerebellar ataxia; On about the fourth day	**Q1WN**: 61	100	YES(7)	10	YES
		Q1LA: 9,437,542	100	YES(1)	10	YES
		Q2WN: 49	100	YES(8)	10	YES
		Q2LA: 9,639,992	100	YES(1)	10	YES

Results of Baseline Study (cont.)

1. Case Name (date); Winner of claim [*Althen* 1 issue] in Report	2. Vaccine; Alleged Injury; Time-to-Onset	3. Total # cases returned, by query	4. % vaccine comp. cases in top-*10*, by query	5. Source case in top-*10*, by query (Y/N)? (rank)	6. % cases in top-10 whose Case Report has all 3 Q1 [4 Q2] items	7. Source Case Report has all 3 Q1 [4 Q2] items (Y/N)?
Meyers (5/22/06) Govt. [Govt.]	DTaP; Diabetes; At any time	**Q1WN**: 69	100	YES(8)	10	YES
		Q1LA: 5,458,103	100	YES(2)	10	YES
		Q2WN: 69	100	YES(8)	0	NO
		Q2LA: 6,600,933	100	YES(3)	10	YES
Sawyer (6/22/06) Govt. [Govt.]	Tetanus; Hand, wrist and arm injuries; At any time	**Q1WN**: 52	100	NO(22)	0	YES
		Q1LA: 5,926,913	100	YES(8)	20	YES
		Q2WN: 52	100	NO(22)	0	NO
		Q2LA: 6,782,277	100	YES(2)	10	YES
Wolfe (11/9/06) Govt. [Govt.]	Hepatitis B; Intractable seizure disorder; After about one day	**Q1WN**: 74	100	NO(18)	30	YES
		Q1LA: 6,785,674	100	YES(5)	50	YES
		Q2WN: 75	100	NO (26)	10	NO
		Q2LA: 7,896,179	100	NO (33)	20	NO
Thomas (1/23/07) Govt. [Govt.]	DPT; Acute encephalopathy and death; Within several weeks	**Q1WN**: 107	100	NO (89)	90	YES
		Q1LA: 5,610,041	100	NO (12)	80	YES
		Q2WN: 58	100	NO (56)	60	NO
		Q2LA: 6,548,798	100	YES(7)	30	NO
Walton (4/30/07) Govt. [Govt.]	MMR; Myocarditis; After over three weeks	**Q1WN**: 70	90	NO (20)	0	YES
		Q1LA: 5,456,593	90	YES (1)	10	YES
		Q2WN: 73	100	NO (19)	0	YES
		Q2LA: 6,981,746	100	YES (1)	10	YES

Results: *Rank-Ordered Lists of Cases Retrieved*

- Goal: searches should return most relevant cases at top of rank-ordered results list.

  - For all 40 queries, % of returned cases in top-10 cases that were federal vaccine compensation cases always at least 90% (Col.4). ✔

- Goal: source case, whose facts formed basis for the query, should be among highly relevant cases.

  - LA: source case in top-10 cases of Results List 75% of time (Col. 5) , ✔

    - in top-2 cases 60% of time.

    - For 2 queries, LA returned source case but not in the top-10 cases.

  - WN: returned source case in top-10 50% of time (Col. 5), ✔ –

    - in top-2 15% of time.

    - For remaining 10 queries, WN returned source case, but not in top-10 cases.

Results: *Results-List Case Reports*

- For all 40 queries' Results Lists:
  - we determined if Case Reports for source case and top-10 cases
  - included all elements sought by query (Col. 6 & 7).
- Goal: Source's Case Report should be Q1- and Q2-complete:
  - Q1-complete: three elements:
    1. a particular vaccine,
    2. a particular alleged injury,
    3. an indication that the vaccine caused the injury.
  - Q2-complete adds:
    4. an indication of time-to-onset between the vaccination and the manifestation of the injury.
- Goal: Top-10 cases should include some Q1- and Q2-complete Case Reports.

Results: *Results-List Case Reports* (cont.)

Policies for determining if Case Report is Q1- and Q2-complete:

Report should include:

1. vaccine by:
   - ❑ name (e.g., measles-mumps-rubella),
   - ❑ well-known initials (e.g., MMR), or
   - ❑ alternative name (e.g., commercial brand name);
2. injury by name (e.g., myocarditis) or alternative names;
3. for Q2, some specific time period;
4. Regarding causation, report should include assertion or direct implication,
   - ❑ for Q1, that the vaccine can[not] cause the injury.
   - ❑ for Q2, that the vaccine can[not] cause the injury in the specific time period.

Results: *Results-List Case Reports* (cont.)

For 40 queries:

- Re source case:
  - On 4 occasions, WN's Case Report for source case was not Q2-complete even though the query was based on its facts (Col. 7). ✔ –
    - For LA, this occurred twice. ✔ –
    - WN reported *Roper* source case at rank Q1(21) and Q2(11) even though it was only case re gastroparesis in the WN Results List for Q1 or Q2.

- Re top-10 cases:
  - LA always returned at least one case in top-10 whose Case Report was "Q1-complete"or "Q2-complete" (Col. 6). ✔
  - WN did not find any Q1-complete cases in top-10 for 3 queries or any Q2-complete cases in the top-10 for 4 queries. ✔ –

Results: *Case Report Decision Abstracts*

- **Goal:** Case Reports for Top-10 cases should make clear which side won:

  1. ultimate claim for vaccine compensation (i.e., petitioner or the government); and

  2. causation sub-issue under *Althen* Condition 1.

- For all 40 queries, information about winners much less frequent in Case Reports in WN than in LA.

  - ❏ WN reported ultimate-claim outcomes about 29% of the time and causation sub-issue outcomes about 47% of the time. ✔ –

  - ❏ LA reported ultimate-claim outcomes about 88% of the time and causation sub-issue outcomes about 93% of the time. ✔

From IR Systems to AR Systems

Baseline study shows:

- Legal IR systems return relevant cases with natural language queries and probabilistic criteria.

- Ways IR systems' performance is not ideal for AR –
  - retrieval precision (e.g., source cases not ranked highly in Results Lists)
  - Case Reports do not focus on retrieved case features relevant to query.
  - Decision Abstracts do not make clear who won what claims or issues.

- Hypothesis: AR tasks possible if system can:
  - identify / use semantic, presuppositional and DLF information relevant to legal argument (i.e., semantic and pragmatic legal information).

If AR can identify presuppositional info re vaccines:
(i.e., Covered-vaccine, Specific-vaccination)

1. Address some co-reference problems. Cases refer to vaccines ito:

   - generic names ("varicella")

   - popular names ("Chickenpox")

   - commercial brand names ("VARIVAX")

   - in composite vaccines (Quadrigen vaccine combines DPT and polio vaccines)

     - In *Thomas* queries ("DPT vaccine can cause acute encephalopathy and death"), cases involving assertions re Quadrigen-caused injuries may be relevant.

If AR can identify presuppositional info re temporal relations: (i.e., Specific-vaccination, Injury-onset, Onset-timing)

2. Perform simple temporal reasoning.

- In *Wolfe* Q2 queries, neither WN nor LA ranked source case in top-10 cases.
    - Query: "Hepatitis B vaccine can cause intractable seizure disorder after about **one day**"
    - *Wolfe* does not mention "one day" or "day", but
        - mentions "12 hours" in the following sentence:
        - "The temporal relationship between the immunization and the chain of seizure activity which followed, starting within the 12 hours after the immunization, compel [sic] one to conclude that there is a causal relationship between the two."
- In *Walton* Q2, following seem to have misled LA:
    - Query: "MMR vaccine can cause myocarditis **after** over **three weeks**"
    - Cases IR returned:
        - "**three** test cases", "all **three** special masters", "**three** theories",
        - "several **weeks** of evidentiary hearings",
        - "**after** the vaccine (i.e., no time specified)", "**after** the designation of this case", "**after** determining the evidence".

If AR system can identify presuppositional info re injuries:

(i.e., Generic-injury, Injury-onset)

3. Filter sentences / cases not relevant to reasoning about injuries.

    ❑ *Sawyer* queries sought cases involving injuries to the **arm** that might have been caused by the tetanus vaccine.

    ❑ Query: "Tetanus can cause hand, wrist and arm injuries at any time"

    ❑ Cases IR returned:

    ▪ *Garcia* involved vaccinations "in the right and left **arms**";

    ▪ *Pociask* involved a vaccinee with a chronic **arm** problem; and

    ▪ *Hargrove* decision referred to "the site that the antigen was introduced [the **arm**]."

Use logical structure & pragmatic legal context

4. to focus AR on key sentences:

   ❑ Often, few sentences in lengthy opinion capture significant reasoning.

   ❑ User argument goals makes some sentences more relevant than others.

      ▪ For example, purpose behind queries like Q1 or Q2 is fact-oriented.

      ▪ In *Casey* search, Case Reports for cases WN ranked higher than source case contained re-statements of *Althen* rule.

         ❑ They contain search terms, but no info about specific vaccinations, injuries, or durations.

▪ AR could distinguish sentences that re-state the law from those that apply the law to facts using:

   ❑ DLF (Default Logic Framework) rule tree showing *Althen* rule

   ❑ presence / absence of presuppositional entities/events (e.g., Covered-vaccine, Generic-injury, and Onset-timing)

   ❑ citation text analyzer identifying appellate courts (rule-setters)

Use logical structure & pragmatic legal context...

... so that AR can

5.   rank cases more effectively and improve precision.

   ❑   Some knowledge of pragmatic legal context (e.g., which presuppositional info fulfilled or not) may improve precision where

   ❑   source case is only Q1- or Q2-complete case returned, but source is still not ranked at top of Results List (i.e., *Roper*, *Casey*, *Stewart*, *Meyers*, and *Walton,* Table 2, Col. 5).

6.   generate more informative summary of case decisions.

   ❑   determine issues addressed from DLF structure & presuppositional info,

   ❑   conclusion reached (the finding of fact) on each decided issue (i.e., which party won or lost).

Challenges: Attributing (Embedded) Assertions:

- "Attribution problem": determining participant to whom AR system should attribute the assertion.
  - Sentence that expresses causal assertion may be:
    - recounting of allegations in the case,
    - entry in a medical record,
    - testimony of an expert witness,
    - finding of the factfinder.
  - E.g., in *Walton* Q2 search, LA ranked source case first:
    - Sentence recounted causal testimony of witness.
    - But, Special Master discounted testimony, held against petitioner.
- Analyze "Dr. Smith testified that the vaccine can cause the injury":
  a) embedded assertion ("the vaccine can cause the injury") and
 b) the person to whom the assertion should be attributed (e.g., Dr. Smith).

Challenges: presuppositional info phrased differently:

- **If user's goal seeks arguments relevant to proving or disproving *Althen* Condition 1, then**
  - assertions about general causation (Medical-theory-assertions) and specific causation (Specific-causation-assertions) are important.

- **Presents lexical challenges:**
  - recognizing alternative ways to express causal relations, such as "results in" and "brings about".

- **Pragmatic challenges:**
  - recognizing successful / unsuccessful ways of reasoning to causal conclusions.

Argument Retrieval Pipeline
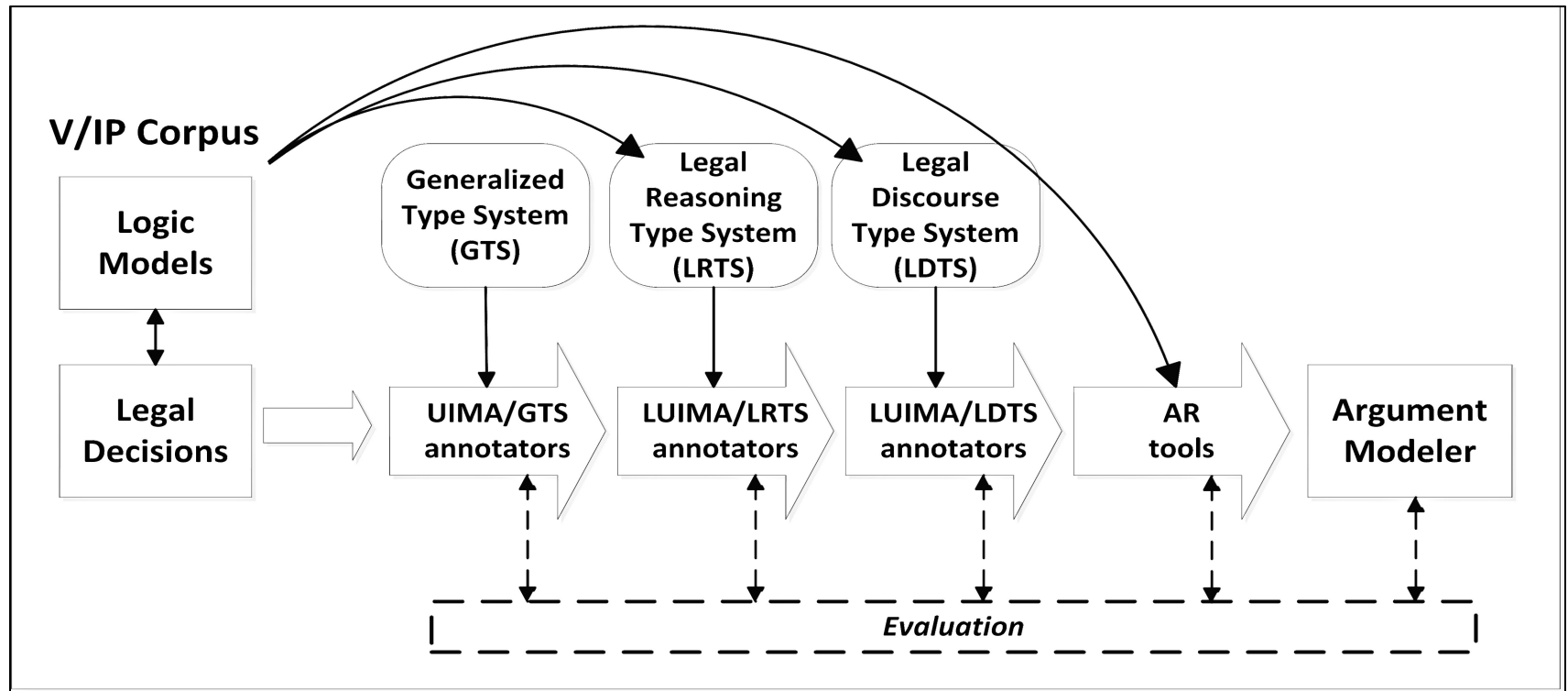
Integrated pipeline of open-source UIMA software components that:

1. takes full-text legal decisions re scientific evidence of causation,

2. extracts syntactic and argument-related semantic and pragmatic (contextual/discourse) information, and

3. uses it to improve IR precision, report extracted arguments, and suggest new evidence and arguments.

References: re automatic semantic processing of case decision texts for legal IR:

- SPIRE retrieved cases and highlighted passages relevant to bankruptcy law factors (Daniels, Rissland 1997).

- SMILE+IBP classified case texts in terms of factors and predicted outcomes (Ashley, Brüninghaus 2009).

- Assigned rhetorical roles to case sentences based on 200 manually annotated Indian decisions (Saravanan, Ravindran 2010).

- Categorized legal cases by Westlaw categories (e.g., bankruptcy, banking) (Thompson 2001) or general topics (e.g., exceptional services pension, retirement) (Gonçalves, Quaresma 2005).

- Extracted treatment history (e.g., ''affirmed'', ''reversed in part'', or ''overruled'') (Jackson, et al. 2003).

- Classified sentences as argumentative based on manually classified sentences from court reports and generated argument tree structures (Mochales, Moens 2011).

- Determined role of sentence in legal case (e.g., as describing the applicable law or the facts) (Hachey, Grover 2006).

- Extracted from criminal cases, offenses raised and legal principles applied to generate summaries (Uyttendaele 1998).

- Extracted holdings of legal cases (McCarty 2007).

Conclusions

- **Baseline study suggests:**
  - current legal IR systems are effective at returning relevant cases, but
  - do not support AR.

- **Module added to full-text legal IR system could:**
  - extract semantic / pragmatic legal information from top n cases returned and
  - analyze them to improve retrieval precision and
  - construct better Case Reports and Decision Abstracts.

- **Future work:**
  - Using V/IP corpus as training data and test bed,
  - program could learn to extract semantic / pragmatic legal information from new case texts with UIMA-based multi-level annotation approach
  - similar to DeepQA architecture of IBM Watson question-answering system (Ashley & Walker, ICAIL 2013).