

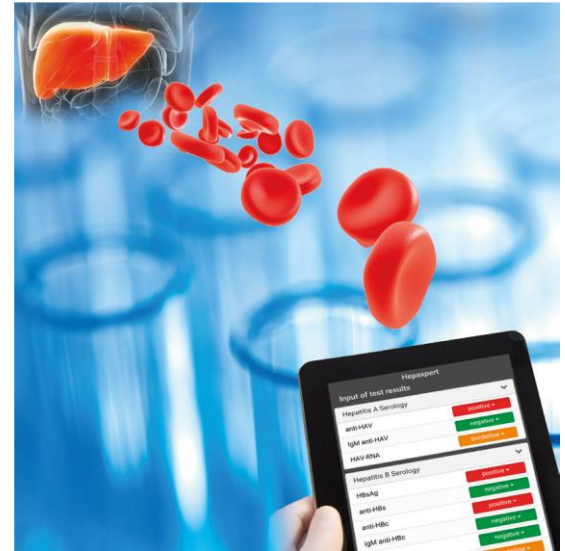
## Arden Syntax in clinical decision support

*Educational material, part 5*

Medexter Healthcare GmbH  
Borschkegasse 7/5  
A-1090 Vienna

[www.medexter.com](http://www.medexter.com)

[www.meduniwien.ac.at/kpa](http://www.meduniwien.ac.at/kpa) (academic)



Better care, patient safety, and quality assurance by Medexter, Vienna, Austria

# The start

---

# ... with Ledley & Lusted (1959)

3 July 1959, Volume 130, Number 3366

## SCIENCE

### Reasoning Foundations of Medical Diagnosis

Symbolic logic, probability, and value theory aid our understanding of how physicians reason.

Robert S. Ledley and Lee B. Lusted

The purpose of this article is to analyze the complicated reasoning processes inherent in medical diagnosis. The importance of this problem has received recent emphasis by the increasing interest in the use of electronic computers as an aid to medical diagnostic processes (1, 2). Before computers can be used effectively for such purposes, however, we need to know more about how the physician makes a medical diagnosis.

If a physician is asked, "How do you make a medical diagnosis?" his explanation of the process might be as follows. "First, I obtain the case facts from the patient's history, physical examination,

fitted into a definite disease category, or that it may be one of several possible diseases, or else that its exact nature cannot be determined." This, obviously, is a greatly simplified explanation of the process of diagnosis, for the physician might also comment that after seeing a patient he often has a "feeling about the case." This "feeling," although hard to explain, may be a summation of his impressions concerning the way the data seem to fit together, the patient's reliability, general appearance, facial expression, and so forth; and the physician might add that such thoughts do influence the considered diagnoses. No one

ance are the ones who do remember and consider the most possibilities."

Computers are especially suited to help the physician collect and process clinical information and remind him of diagnoses which he may have overlooked. In many cases computers may be as simple as a set of hand-sorted cards, whereas in other cases the use of a large-scale digital electronic computer may be indicated. There are other ways in which computers may serve the physician, and some of these are suggested in this paper. For example, medical students might find the computer an important aid in learning the methods of differential diagnosis. But to use the computer thus we must understand how the physician makes a medical diagnosis. This, then, brings us to the subject of our investigation: the reasoning foundations of medical diagnosis and treatment.

Medical diagnosis involves processes that can be systematically analyzed, as well as those characterized as "intangible." For instance, the reasoning foundations of medical diagnostic procedures are precisely analyzable and can be separated from certain considered intangible judgments and value decisions. Such a separation has several important advantages. First, systematization of the reasoning processes enables the physician to define more clearly the intangibles involved and therefore enables him to concentrate full attention on the more

### Symbolic logic

If a patient has disease 2,  
he must have symptom 1

$$D(2) \Rightarrow S(1)$$

If a patient has disease 1 and not disease 2,  
then he cannot have symptom 3

$$D(1) \cdot \neg D(2) \Rightarrow \neg S(3)$$

If a patient has either or both of the symptoms,  
then he must have one or both of the diseases

$$S(1) + S(2) \Rightarrow D(1) + D(2)$$

### The early Vienna approaches (1968 & 69) to computer diagnostics

- support of differential diagnosis
- rare as well as frequent diseases
- possible, not probable diagnoses
- confirmed and excluded diagnoses as well as diagnostic hypotheses
- explanatory system



# CADIAG-I—Three-valued & predicate logic, consistency checking, HIS integration (1976)

obligatory excluding: $S \rightarrow \neg D$ or $\neg(S \wedge D)$				facultative and proving: $S \rightarrow D$			
S/D	0	1	2	S/D	0	1	2
0	1	1	1	0	1	1	1
1	1	0	2	1	0	1	2
2	1	2	2	2	2	1	2

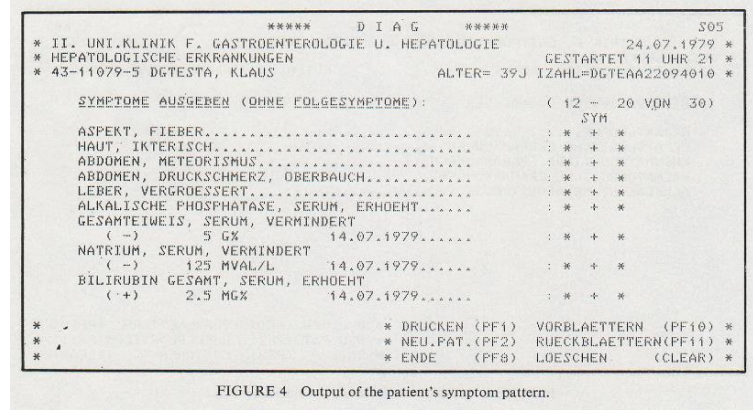
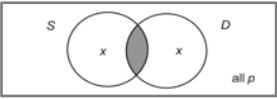
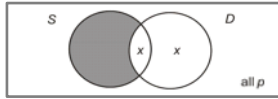


FIGURE 4 Output of the patient's symptom pattern.

<p>Relation EX (excluding)</p> <ol style="list-style-type: none"> <li>all <math>p</math> with <math>S</math> exclude <math>D</math></li> <li>there is at least <i>one</i> <math>p</math> with <math>S</math> and not <math>D</math></li> <li>there is at least <i>one</i> <math>p</math> with <math>D</math> and not <math>S</math></li> </ol>  <p><math>S \text{ EX } D \hat{=} \forall p[S(p) \rightarrow \neg D(p)] \wedge \exists p[S(p) \wedge \neg D(p)] \wedge \exists p[D(p) \wedge \neg S(p)]</math></p>	<p>Relation FC (facultative occuring and confirming):</p> <ol style="list-style-type: none"> <li>all <math>p</math> with <math>S</math> have <math>D</math></li> <li>not all <math>p</math> with <math>D</math> have <math>S</math></li> <li>there is at least <i>one</i> <math>p</math> with <math>S</math></li> </ol>  <p><math>S \text{ FC } D \hat{=} \forall p[S(p) \rightarrow D(p)] \wedge \exists p[D(p) \wedge \neg S(p)] \wedge \exists p[S(p)]</math></p>
--	---

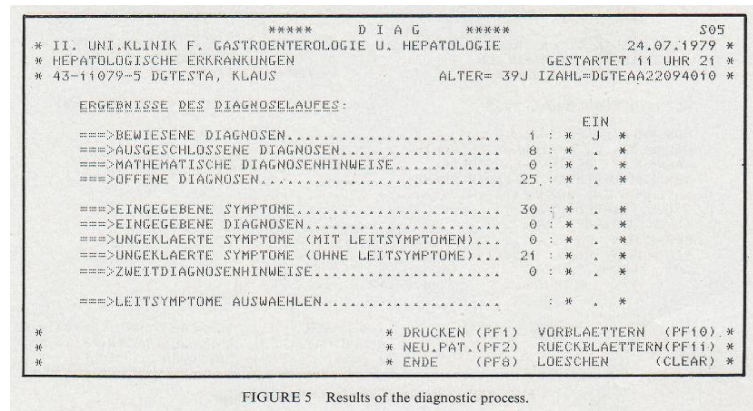
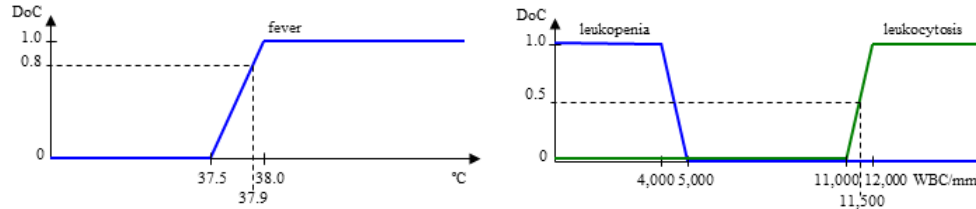


FIGURE 5 Results of the diagnostic process.

# CADIAG-II—Fuzzy sets and fuzzy logic—rheumatology, hepatology, gastroenterology (1977)

## Fuzzy sets and patient data

- Fuzzy relation: after assignment of fuzzy truth values through fuzzy sets and data-to-symbol conversion rules, e.g.,

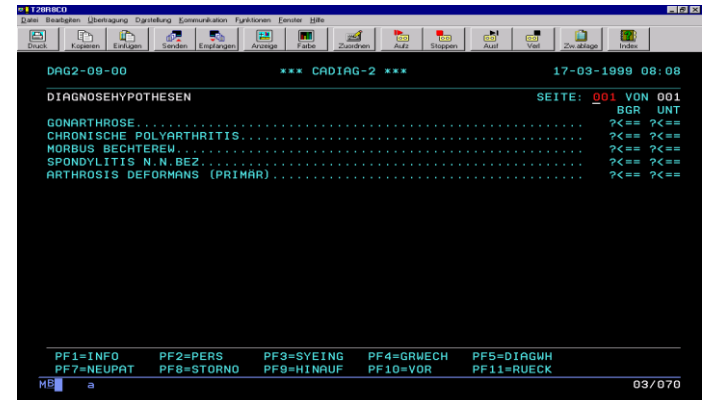
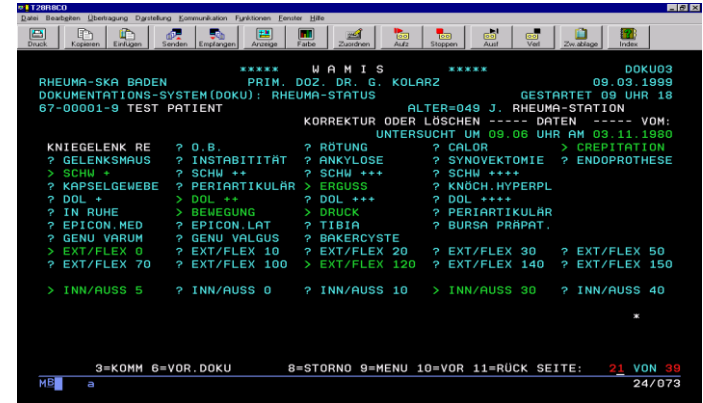


## Fuzzy relationships and medical knowledge

- Two fuzzy relations: (1) frequency of occurrence (2) strength of confirmation

## Compositional rules of fuzzy inference

- Several max-min compositions



# Fuzzy sets: A seminal invention—by Lotfi A. Zadeh (1965)

INFORMATION AND CONTROL 8, 338-353 (1965)

## Fuzzy Sets\*

L. A. ZADEH

*Department of Electrical Engineering and Electronics Research Laboratory,  
University of California, Berkeley, California*

A fuzzy set is a class of objects with a continuum of grades of membership. Such a set is characterized by a membership (characteristic) function which assigns to each object a grade of membership ranging between zero and one. The notions of inclusion, union, intersection, complement, relation, convexity, etc., are extended to such sets, and various properties of these notions in the context of fuzzy sets are established. In particular, a separation theorem for convex fuzzy sets is proved without requiring that the fuzzy sets be disjoint.

### I. INTRODUCTION

More often than not, the classes of objects encountered in the real physical world do not have precisely defined criteria of membership. For example, the class of animals clearly includes dogs, horses, birds, etc. as its members, and clearly excludes such objects as rocks, fluids, plants, etc. However, such objects as starfish, bacteria, etc. have an ambiguous status with respect to the class of animals. The same kind of ambiguity arises in the case of a number such as 10 in relation to the "class" of all real numbers which are much greater than 1.

Clearly, the "class of all real numbers which are much greater than 1," or "the class of beautiful women," or "the class of tall men," do not constitute classes or sets in the usual mathematical sense of these terms. Yet, the fact remains that such imprecisely defined "classes" play an important role in human thinking, particularly in the domains of pattern

## Fuzzy sets—Generalization of classical set theory

- Degrees of membership  $\in [0,1]$  into a fuzzy set, e.g.,
  - light red ball into the fuzzy set "red balls"
  - 37.9°C body temperature into the fuzzy set "fever"
- A whole new branch of **fuzzy mathematics** was born including fuzzy logic, and an ideal field of **fuzzy applications in clinical medicine** was opened
- Formalizes linguistic and propositional uncertainty, up to fuzzy clustering, fuzzy probabilities, and many more

## Vienna clinical fuzzy-based systems

- CADIAG-II, MedFrame, FuzzyKBWean, FuzzyARDS, FuzzyToxopert, Moni

## And some non-fuzzy clinical systems

- Hexapert, Thyrexpert, Rheumexpert

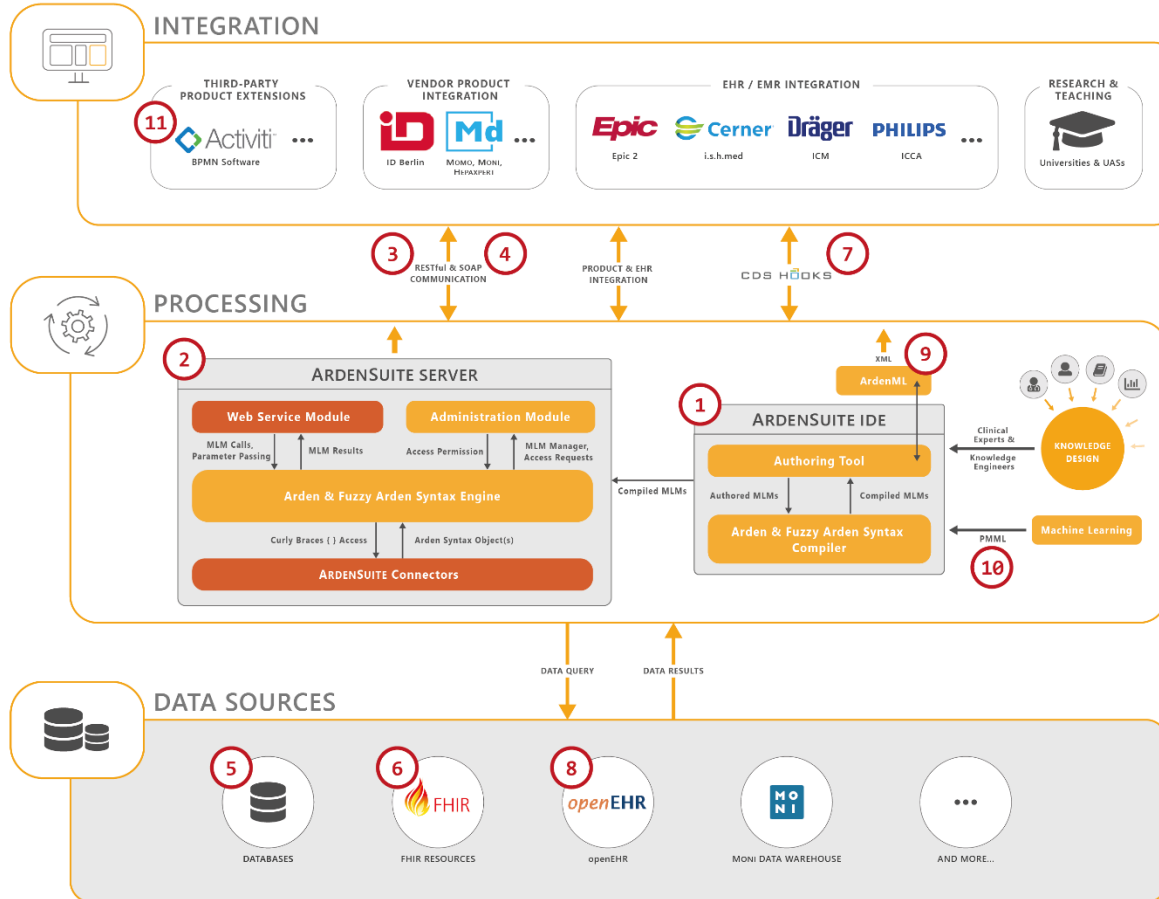


some unification needed

# The ArdenSuite

---





AVAILABLE FOR:



# EHR Applications

---

# SOP checking in melanoma patients receiving chemotherapy

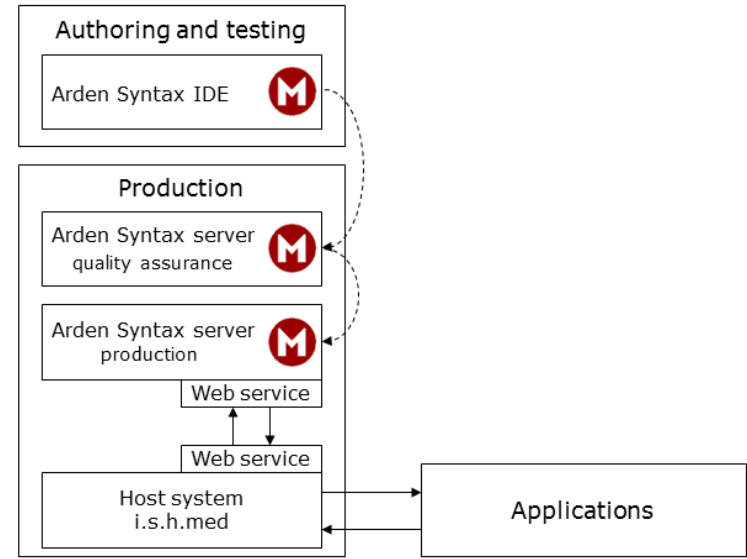
Fall/Aufenthalt Patient: PatNr.: ██████████ Dok.OE: Station 17H  
Druckadressaten Fall: Gesamter Patient  
Dokumentstatus  
Externe Ärzte Bewegung: Gesamter Patient  
Kontakt Daten

Schema:   - in klinischer Validierung

**Prä-Chemotherapie Checkliste**

Text	Bemerkung	14.04.2011	04.04.2011	31.03.2011
• Verabreichungen			3	
▼ Labor		14.04.2011	04.04.2011	31.03.2011
▼ Blutbild				
• Erythrozyten	> 4.0 T/l	4.1	4	4
• Hämoglobin	> 12.0 g/dl	12.3	12	12
• Leukozyten	> 3.0 G/l	3	3	3
• Thrombozyten	> 100 G/l	105	100	100
▼ Metaboliten				
• Creatinin	< 1.2 mg/dl	1.3	1.2	1.2
▼ Entzündungsparameter				
• CRP	< 1 mg/dl	1	1	1
▼ Allgemeinzustand				
• ECOG State		1	1	1
▼ Wissensbasiertes System		<input type="button" value="Prüfen"/>	<input type="button" value="Prüfen"/>	<input type="button" value="Prüfen"/>
• Empfehlung			akzeptiert	akzeptiert
• Status			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
• Erklärung			<input type="button" value="i"/>	<input type="button" value="i"/>
▼ Sonstiges				
• Bemerkung		<input type="text"/>	<input type="text"/>	<input type="text"/>
• Freigabe				
• Storno				

 - MLMs



## University of Colorado Health—with Epic EHR

Arden - Cardiac ICU (7 Patients)

Room/Bed ▲	Patient Name/Age/%	Readmit Score	Service	Braden Score	CHADS	Acuity
		37	Cardiology Heart Failure	21	1.05	
		21	Cardiology Heart Failure	17	10	
		10	Cardiology 3	22	0.56	
		18	Cardiology 2	19	21.16	
		5	Cardiology 3	17	0.99	
		9	Cardiology 2	20	10	

### Heart failure readmission risk score

Input:

- vital signs
- lab data
- demographics
- ATD info
- ICD codes

© 2014 Epic Systems Corporation. Used with permission.

Example of e-mail from HFRRS MLM to HF nurse practitioners:

Message: [REDACTED] | [REDACTED] | Heart Failure Readmission Risk Score = 21 - scores > 20 indicate the patient is at risk for readmission. | Service: Hospitalist-HMS1 | Provider: [REDACTED] | MD [REDACTED]

- patient follow-up and authorization of additional inpatient services (e.g., occupational and physical therapy)

# Intensive care application

---

## Use Case: Hypoglycemia at intensive care units

- Hypoglycemia may seriously harm.
- If patient is unconscious, it is difficult to notice.
- The PDMS (patient data management system) should actively notify the physician:

*If glucose is less than 50mg/dl, then send an SMS message to the physician.*



```
DATA:
LET glucose BE READ {...glucose...};
LET physician_DECT BE DESTINATION {sms:26789};

LOGIC:
IF LATEST glucose IS LESS THAN 50 THEN
    CONCLUDE true;
ENDIF;

ACTION:
WRITE „Warning...” AT physician_DECT;
```



**CONCLUDE TRUE**  
→ Do something

**Monitoring**

Glucose  
 Kalium  
 MONI

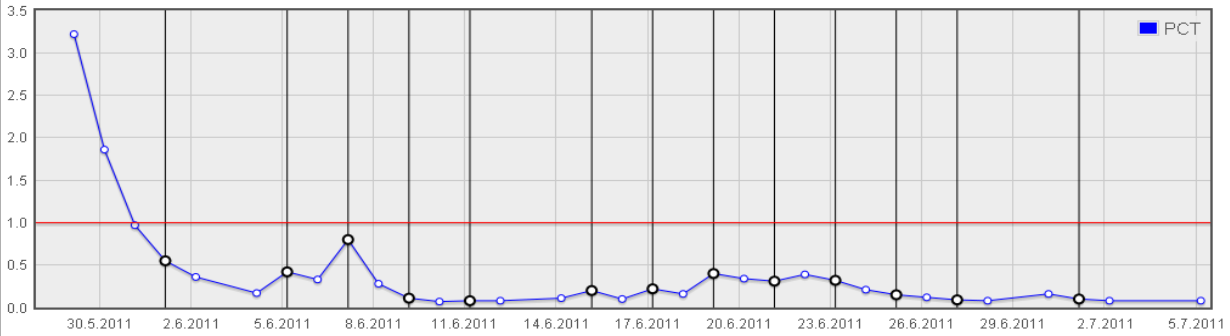
PCT-Studie

**Antwort von Medexter-Engine**

**Aktuell ist keine Procalcitoninmessung erforderlich.**

Patient hat 33 Procalcitoninwerte.  
 Die letzte Procalcitoninmessung erfolgte am 05.07.2011 um 06:00 Uhr und ergab den Wert 0.08.  
 Die letzte Procalcitoninmessung liegt also 7 hours 28 minutes 34. seconds zurück.

Es wurden 13 vermeidbare Messungen gefunden: (4, 7, 9, 11, 13, 16, 18, 20, 22, 24, 26, 28, 31)  
 Das Einsparpotential liegt bei 182 Euro



Regression über alle Werte: -0.03  
 Regression über die letzten beiden Werte: 0  
 Trend: Veränderung pro Stunde: 0

#	Wert	Zeitstempel
1.	3.22	29.05.2011 um 06:00 Uhr
2.	1.86	30.05.2011 um 06:00 Uhr
3.	0.97	31.05.2011 um 06:00 Uhr
4.	0.55	01.06.2011 um 06:00 Uhr
5.	0.36	02.06.2011 um 06:00 Uhr
6.	0.17	04.06.2011 um 06:00 Uhr
7.	0.42	05.06.2011 um 06:00 Uhr
8.	0.33	06.06.2011 um 06:00 Uhr
9.	0.08	07.06.2011 um 06:00 Uhr

from Stefan Kraus, Erlangen, Germany

# cAlerts—Context-sensitive, laboratory-data-based clinical alerts

---



# Clinical alerts at Demo EMR

- iann, Max
- leinhard
- etmar
- tefanie
- Anita
- Karin
- Dominik
- bert
- tein, Lisa
- Renate
- thomas
- arl
- , Martin
- .aura
- ranz
- , Johannes
- Simon
- er, Sonja
- sabeth
- ranz
- abin
- , Markus



## Mustermann, Max

Sex: male NINO: 1234100866  
Age: 48 Case Number: 468895  
Date of Birth: 08-10-1966 Hospital Admittance: 04-15-2015

- Documents
- Vital Signs
- Laboratory
- Diagnoses
- Radiology
- Images
- References
- Outside Records

	04-18-2015 13:02	04-17-2015 12:52	04-16-2015 11:29	04-15-2015 13:37
<b>HEMATOLOGICAL PROFILE</b>				
Leukocytes	19,4 /nl	20,1 /nl	17,5 /nl	17,1 /nl
Hemoglobin	-	-	-	-
...				
<b>BIOCHEMICAL PROFILE</b>				
<b>Electrolytes</b>				
Potassium	-	-	-	-
...				
<b>Inflammation markers</b>				
C-reactive protein	169 mg/l	105 mg/l	98 mg/l	80 mg/l
...				
<b>Kidney function</b>				
Blood urea nitrogen	-	-	-	-
Serum creatinine	-	-	-	-
Urea	-	-	-	-
...				
<b>Enzymes</b>				

### Clinical Alerts

GENERATED	MESSAGES
04-18-2015 13:02	Further increase of CRP +
04-18-2015 13:02	Persistent leukocytosis -
Persistent leukocytosis (19,4 /nl, 04-18-2015 13:02) compared to previous findings:	
04-17-2015 12:52	Leukocytes 20,1 /nl 04-17-2015 12:52 CRP 105 mg/l
04-16-2015 11:29	Leukocytes 17,5 /nl 04-16-2015 11:29 CRP 98 mg/l
04-15-2015 13:37	Leukocytes 17,1 /nl 04-15-2015 13:37 CRP 80 mg/l
04-17-2015 12:52	Further increase of leukocytes +
04-15-2015 13:37	Leukocyte value indicates leukocytosis -
Leukocyte value indicates leukocytosis: 17,1 /nl (04-15-2015 13:37). Consider CRP.	
04-15-2015 13:37	Moderately increased CRP +

## Context-specific alerts: C-reactive protein

Rule ID	Message	Context	Rule
CRP_slight	Slightly increased CRP	Previous value in the normal range or no previous value	$20 \text{ mg/l} \leq \text{CRP} < 50 \text{ mg/l}$
CRP_mod	Moderately increased CRP	Previous value in the normal range or no previous value	$50 \text{ mg/l} \leq \text{CRP} < 100 \text{ mg/l}$
CRP_sign	Significantly increased CRP	Previous value in the normal range or no previous value	$\text{CRP} \geq 100 \text{ mg/l}$
CRP_cont	Further increase of CRP	Patient has no leukemia <b>and</b> 4 <sup>th</sup> + day of infection <b>and</b> value available between 12 and 36 hours prior to the current value	$\text{CRP} \geq 20 \text{ mg/l}$ <b>and</b> $\frac{\text{CRP} - \text{yesterday's CRP}}{\text{yesterday's CRP}} \geq 0.20$

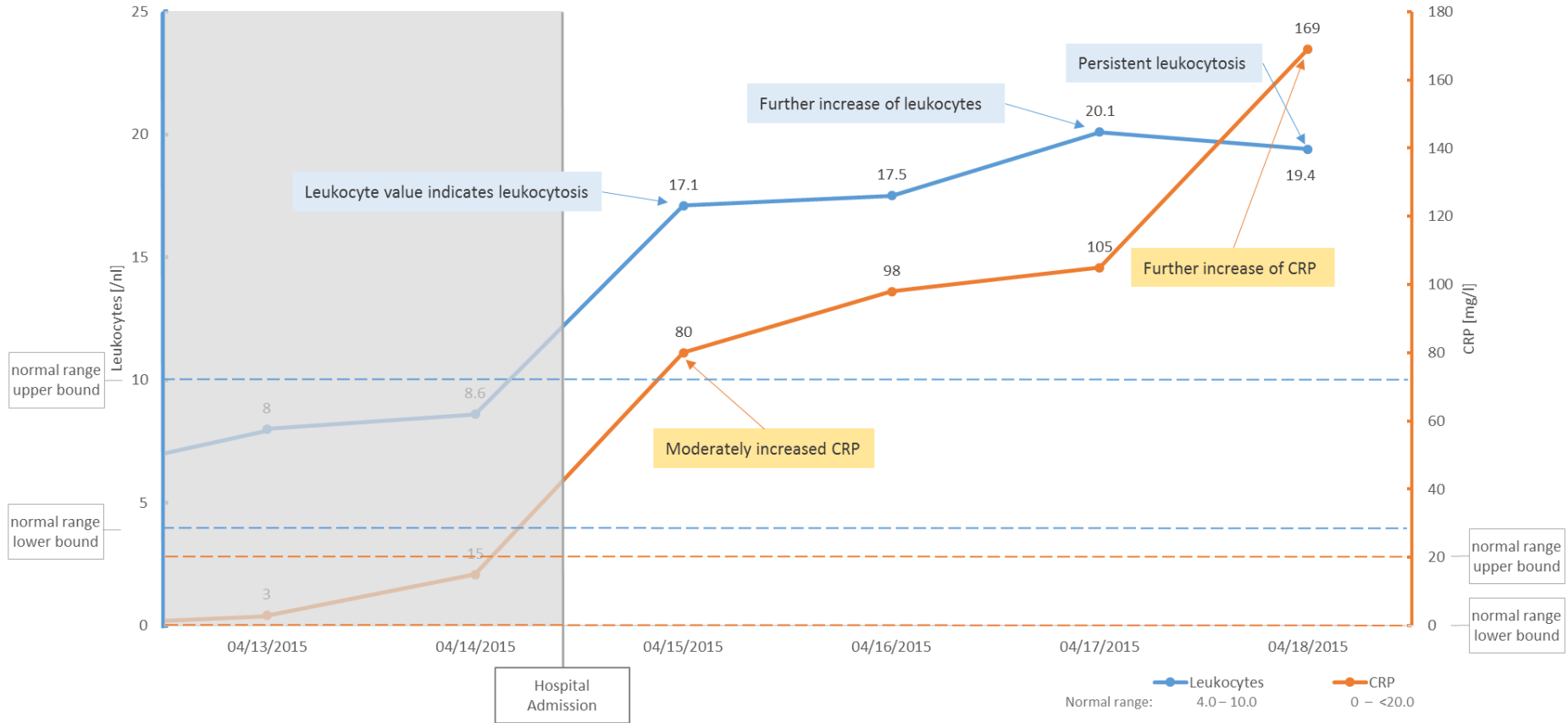
*Note: CRP, C-reactive protein concentration in mg/l*

## Context-specific alerts: Leukocyte count

Rule ID	Message	Context	Rule
<b>Lpen</b>	Leukocyte value indicates leukopenia	-	$0.5 \text{ G/l} < \text{leukocyte count} \leq 3 \text{ G/l}$
<b>Lcyt_leuk</b>	Leukocyte value indicates leukocytosis. Admission diagnosis: leukemia	Leukemia	Leukocyte count $\geq 12 \text{ G/l}$
<b>Lcyt_sinc</b>	Significant increase of leukocytes		$\frac{\text{Leukocyte count} - \text{previous leukocyte count}}{\text{previous leukocyte count}} \geq 0.4$
<b>Lcyt_sdec</b>	Significant decrease of leukocytes		$\frac{\text{Leukocyte count} - \text{previous leukocyte count}}{\text{previous leukocyte count}} \leq -0.4$
<b>Lcyt_inc</b>	Increase of leukocytes compared to previous finding	No leukemia <b>and</b> no previous infection <b>and</b> previous value in the normal range.	Leukocyte count $\geq 12 \text{ G/l}$
<b>Lcyt_pers</b>	Persistent leukocytosis	No leukemia <b>and</b> 4 <sup>th</sup> + day of infection <b>and</b> value available between 12 and 36 hours prior to the current value.	Leukocyte count $\geq 12 \text{ G/l}$ <b>and</b> $\frac{\text{Leukocyte count} - \text{yesterday's leukocyte count}}{\text{yesterday's leukocyte count}} \geq -0.10$

Note: Leukocyte count expressed in grams (G) per liter

# Inflammation monitoring and alerts



# Hepaxpert—Interpretation of hepatitis serology test results

---

# Automated interpretation of hepatitis A, B, and C serology test results

19:16 Mon 25, Mar Hepaxpert

**Hepatitis A Serology**

anti-HAV **POSITIVE** NEGATIVE BORDERLINE NOT TESTED

IgM anti-HAV **POSITIVE** NEGATIVE BORDERLINE NOT TESTED

HAV-RNA **POSITIVE** NEGATIVE BORDERLINE NOT TESTED

**Hepatitis B Serology**

HBsAg **POSITIVE** NEGATIVE BORDERLINE NOT TESTED

anti-HBs **POSITIVE** NEGATIVE BORDERLINE NOT TESTED

anti-HBc **POSITIVE** NEGATIVE BORDERLINE NOT TESTED

IgM anti-HBc **POSITIVE** NEGATIVE BORDERLINE NOT TESTED

HBeAg **POSITIVE** NEGATIVE BORDERLINE NOT TESTED

anti-HBe **POSITIVE** NEGATIVE BORDERLINE NOT TESTED

anti-HBs titre  
Enter value between 0 and 99,999 in U/I value in U/I

**Interpretation**

19:17 Mon 25, Mar Results

**Disclaimer of Liability**

**Hepatitis A Serology**

anti-HAV IgM anti-HAV HAV-RNA

Positive results for total anti-HAV antibodies in combination with negative results for IgM anti-HAV antibodies indicate immunity to the hepatitis virus A and exclude the possibility of a recent hepatitis A. This immunity may either have been acquired naturally through an earlier infection or it may have been induced by active vaccination or passively acquired immunization.

**Hepatitis B Serology**

HBsAg anti-HBs anti-HBc IgM anti-HBc HBeAg anti-HBe anti-HBs titre

The simultaneous occurrence of HBeAg-antigen and anti-HBs antibodies is a rare event in the natural course of a hepatitis B virus infection. This constellation of findings may be attributed to one of the following causes: (a) circulating HBsAg-anti-HBs immune complexes, (b) hepatitis B virus infection coinciding with a hepatitis B vaccination or injection of HB-hyperimmune globulin, or (c) reinfection with a hepatitis virus B with a different HBsAg subtype. Blood and secretions (saliva, sperm, breast milk) of such patients are to be regarded as infectious.

In order to obtain conclusive information on the ambiguous negative or positive result, it is recommended to have new material sent in for testing and/or to consult with the head of the laboratory.

**Hepatitis C Serology**

anti-HCV HCV-RNA

The findings obtained give no indication of a present or earlier hepatitis C virus infection, but these cannot be definitely excluded. In rare cases despite negative HCV antibodies HCV-RNA may be detected in the serum. Nevertheless, in practice anti-HCV-negative blood (also without information about HCV-RNA) is considered to be not infectious with regard to hepatitis C.

**Back** **New Input**

**Hepaxpert**

HBsAg **POS** **NEG** BDL N/A

anti-HBs **POS** **NEG** BDL N/A

anti-HBc **POS** **NEG** BDL N/A

IgM anti-HBc **POS** **NEG** BDL N/A

HBeAg **POS** **NEG** BDL N/A

anti-HBe **POS** **NEG** BDL N/A

anti-HBs titre 120

**INTERPRETATION**

**Results**

**Hepatitis B Serology**

HBsAg anti-HBs anti-HBc

IgM anti-HBc HBeAg anti-HBe

anti-HBs titre: 120 U/I

This constellation of findings (positive anti-HBs antibodies, with negative IgM anti-HBc antibodies) indicates the presence of immunity to the hepatitis virus B. This immunity may either have been acquired naturally upon restitution following a hepatitis B virus infection or it may have been induced by active or passive immunization.

Vaccination Recommendation: If an indication for a hepatitis B vaccination exists, the primary course of immunization has been completed, the last partial vaccination was given at least 1

**BACK** **NEW INPUT**

- includes frequent, rare, as well as inconsistent combinations
- complete coverage of the problem domains
- e.g., hepatitis B serology: about 150 rules in 3 layers for 61,440 possible combinations

# Integration of Hepaxpert into a LIS

## PROTEINDIAGNOSTIK

CRP 61.5 \*\*\* 0.8 - 5.0 mg/l

## HORMONE

TSH 3.00 *Schilddrüsendiagnostik* 0.2 - 3.5 mU/l

## INFEKTIONSSEROLOGIE

HIV-Antikörper Negativ Negativ

## HEPATITIS-SEROLOGIE

Anti-HAV-IgM	Negativ	Negativ
Anti-HAV	<b>Positiv</b> *	Negativ
HBsAG	Negativ	
Anti-HBs	Negativ	
Anti-HBs (quant.)	1.42	U/l
Anti-HBc	Negativ	
Anti-HCV	Negativ	Negativ

test results



### Medizin. Kommentar/Interpretation:

#### HEPATITIS-SEROLOGIE:

Positive Gesamtkörper (Anti-HAV) bei negativen IgM-anti-HAV Antikörpern beweisen Immunität gegen das Hepatitis-A-Virus und schließen eine rezente Hepatitis A aus. Diese Immunität kann entweder durch eine frühere Infektion natürlich erworben oder aber durch aktive Impfung oder passive Immunisierung induziert sein.

Anti-HBs Titer: 1 Units/Liter

Eine bestehende oder frühere Hepatitis-B-Virusinfektion kann (mit Ausnahme des Inkubationsstadiums) ausgeschlossen werden. Es besteht keine Immunität gegen das Hepatitis-B-Virus. Das Blut kann hinsichtlich Hepatitis B als nicht infektiös angesehen werden. **Impfpfehlung:** Die Indikation zur Hepatitis-B-Impfung vorausgesetzt, soll in diesem Fall bei einem Ungeimpften die Grundimmunisierung (entsprechend dem Schema des jeweiligen Impfstoffes) durchgeführt und - zur Abschätzung der Immunantwort - 1-2 Monate nach der letzten Teilimpfung der Anti-HBs Titer bestimmt werden. Bei einem Geimpften mit abgeschlossener Grundimmunisierung soll unverzüglich eine Booster Injektion gegeben und - falls der Verdacht eines slow responders/E besteht - eine Titerkontrolle 2 Monate nach dem Booster erhoben werden.

interpretation



# Hepatitis serology interpretation integrated into an EHR

The screenshot shows a software interface for an EHR. The top bar includes a menu (Datei, Bearbeiten, Fenster, Extra, ?), a navigation pane, and system information (10.11.2005 13:26:54, DEMO -05.03.29.4410, IM/ST1, FLEMING). The left sidebar contains a tree view with categories like 'Station', 'Funktionsbereich', 'OP-Bereich', and 'Expertensystem'. The 'Expertensystem' section is expanded, showing 'Hepaxpert III' selected. The main window displays a table of test results for Hep. A, Hep. B, and Hep. C. Below the table, there is a section for 'Ergebnisse' (Results) with detailed text for Hepatitis A, B, and C.

	Hep. A	Hep. B	Hep. C
Anti-HAVA	Negativ	Anti-HBs	Positiv
IgM anti-HAV	Positiv	Anti-HBs Titr	50
HAV	Grenzwertig	HBsAg	Positiv
		Anti-HBc	Negativ
		IgM_anti_HB	Negativ
		HbeAg	Positiv
		Anti_HBe	Nicht gemessen
		Anti_HCV	Positiv
		HCV_RNA	Grenzwertig

**Ergebnisse**

**Hepatitis A** Der Befund enthält Widersprüche, da definitionsgemäß bei Vorliegen von IgM-anti-HAV-Antikörpern auch die Gesamtkörper Anti-HAV positiv sein müßten.  
Rücksprache mit dem Laborleiter wird empfohlen. Zur Kontrolle des nicht eindeutig negativen oder positiven Befundes wird neuerliche Materialeinsendung empfohlen.

**Hepatitis B** Das gleichzeitige Auftreten von HBe-Antigen und Anti-HBs-Antikörpern ist im natürlichen Verlauf einer Hepatitis-B-Virusinfektion ein seltenes Ereignis. Diese Befundkonstellation ist entweder auf (a) zirkulierende HBsAg-Anti-HBs-Immunkomplexe, (b) auf eine Koinzidenz einer Hepatitis-B-Virusinfektion mit einer Hepatitis-B-Impfung oder Injektion von HB-Hyperimmunglobulin oder (c) eine Reinfektion mit einem Hepatitis-B-Virus mit unterschiedlichem HBsAg-Subtypus zurückzuführen. Blut und Sekrete (Speichel, Sperma, Muttermilch) solcher Patienten sind als infektiös anzusehen.

**Hepatitis C** Es besteht eine rezente oder chronisch persistierende oder eine früher abgelaufene Hepatitis-C-Virusinfektion. Die Bestimmung von HCV-RNA bringt zusätzliche Information. Das Blut solcher Personen ist hinsichtlich Hepatitis C als infektiös anzusehen.  
Zur Kontrolle des nicht eindeutig negativen oder positiven Befundes wird neuerliche Materialeinsendung empfohlen.



# Hepaxpert

## Hepatitis A serology

anti-HAV	IgM anti-HAV	HAV-RNA
positive	not tested	not tested

Antibodies to the hepatitis virus A may occur in three different situations: (a) in the case of a recent hepatitis A virus infection (acute icteric or anicteric hepatitis A, subclinical disease, or stage of convalescence from hepatitis A), (b) in the case of immunity after an earlier hepatitis A virus infection, or (c) after active vaccination or in the case of passively acquired immunity through injection of gamma globulin.

# ChatGPT

KP anti-HAV pos



Anti-HAV (IgM) positive means that a person has been recently infected with the Hepatitis A virus (HAV) and their immune system has produced antibodies to fight the infection. IgM antibodies are the first antibodies to appear after an acute infection and can be detected in the blood within a few days to a few weeks after the initial infection. The presence of anti-HAV (IgM) antibodies indicates an acute or recent infection with HAV. It's important to follow up with a healthcare provider for proper diagnosis and treatment.

KP IgG anti-HAV pos



The presence of IgG anti-HAV antibodies in the blood indicates previous exposure to the Hepatitis A virus (HAV) or vaccination against HAV. IgG antibodies usually appear later than IgM antibodies and persist in the blood for a long time, sometimes for life, providing immunity to HAV.

Detection of IgG anti-HAV antibodies can indicate either a previous infection with HAV, vaccination against HAV, or passive immunity acquired through the transfer of maternal antibodies during pregnancy. It's important to note that the presence of IgG antibodies doesn't necessarily mean that a person is currently infected with HAV.

# Hepaxpert

# ChatGPT

## Rule for interpreting “inconsistent findings”

### RULE 3:

#### IF

HBsAg	anti-HBs	anti-HBc	IgM anti-HBc	HBeAg	anti-HBe
+ •	+ - ± •	- ±	+	+ - ± •	- ± •
- ±	+ - ± •	- ±	+	- ± •	- ± •

#### THEN

The findings are **inconsistent** as, by definition, if IgM anti-HBc antibodies are present, testing for total anti-HBc antibodies would have to be positive as well. It is recommended to have new material sent in for testing and/or to consult with the head of the laboratory.



IgM anti-HBc pos and IgG anti-HBc neg



The presence of IgM anti-HBc antibodies and the absence of IgG anti-HBc antibodies in the blood indicates an acute or recent Hepatitis B virus (HBV) infection. IgM anti-HBc antibodies are the first antibodies to appear after an acute infection and can be detected in the blood within a few weeks after the initial infection, while IgG anti-HBc antibodies are produced during or after an HBV infection and persist in the blood for a longer period, sometimes for life.

It's important to follow up with a healthcare provider for further testing and treatment if you test positive for IgM anti-HBc antibodies, as acute HBV infection can lead to serious complications if left untreated.

# Hepaxpert

## One of the rules to interpret “clinically relevant findings” (rule premises form equivalent classes)

### RULE 103:

#### IF one of the following 100 combinations

HBsAg	anti-HBs	anti-HBc	IgM anti-HBc	HBeAg	anti-HBe
+	• +	- ±	- ± •	+	- ± •
+	• +	+ •	+ - ± •	+	+ - ± •

### THEN

The simultaneous occurrence of HBe-antigen and anti-HBs antibodies is a **rare event** in the natural course of a hepatitis B virus infection. This constellation of findings may be attributed to one of the following causes: (a) circulating HBsAg-anti-HBs immune complexes, (b) hepatitis B virus infection coinciding with a hepatitis B vaccination or injection of HB-hyperimmune globulin, or (c) reinfection with a hepatitis virus B with a different HBsAg subtype. Blood and secretions (saliva, sperm, breast milk) of such patients are to be regarded as infectious.

# ChatGPT



HBeAg pos and IgG anti-HBs pos



HBeAg (Hepatitis B e antigen) positive and IgG anti-HBs (Hepatitis B surface antibody) positive results indicate different stages of Hepatitis B virus (HBV) infection.

- HBeAg positive: It indicates an active HBV infection, in which the virus is actively replicating in the liver and the infected person is highly infectious. This test result suggests that the person is in the acute phase or the highly infectious chronic phase of HBV infection.
- IgG anti-HBs positive: It indicates that the person has developed immunity against the Hepatitis B virus, either through vaccination or previous infection with HBV. This test result suggests that the person is protected against HBV infection.

It's important to follow up with a healthcare provider for further evaluation and monitoring if you have HBeAg positive results, as this may require antiviral treatment to prevent further liver damage. The presence of IgG anti-HBs antibodies indicates immunity to HBV, which provides protection against future HBV infection.

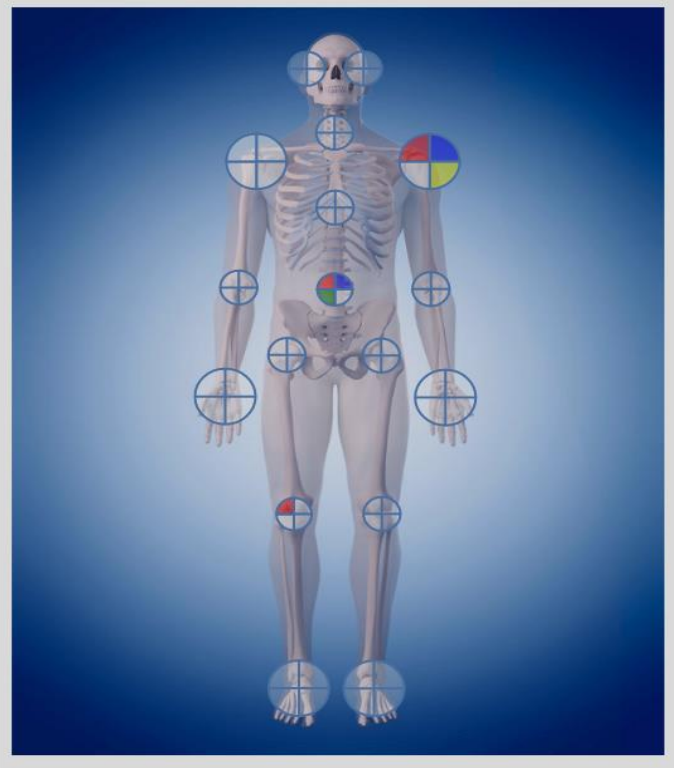
# Rheumexpert— Interpretive tool for rheumatology

---

- Start
- Patientenübersicht
- Untersuchung
- Anamnese
- Status
- Labor/Röntgen
- Diagnosevorschlag
- Report
- Einstellungen

# Untersuchung 3 - Simpson, Homer Jay (12.05.1956)

- Anamnese
- Status Gelenke
- Status Wirbelsäule
- Status (Matrix)
- Labor/Röntgen
- Diagnosevorschlag



Akromioklavikular links

- Druckschmerz
- Bewegungsschmerz
- periartikulärer Schmerz
- Schwellung, knöchern
- Schwellung, weich
- Schwellung, Erguß
- Rötung
- Bewegungseinschränkung

Abbrechen Ok

## Untersuchung 3 - Simpson, Homer Jay (12.05.1956)

Anamnese Status Gelenke Status Wirbelsäule Status (Matrix) Labor/Röntgen Diagnosevorschlag

## → Verdacht auf entzündliche Gelenkerkrankung

Differentialdiagnostisch kommt in Frage:

- Verdacht auf chronische Polyarthritis
- Verdacht auf reaktive Arthritis
- Verdacht auf Arthropathia psoriatica

Bitte weisen Sie Ihren Patienten zur weiteren Abklärung einer Spezialambulanz oder einem Rheumatologen zu.

Mit etwas geringerer Wahrscheinlichkeit kommt auch folgende Krankheitsgruppe in Frage:

- Verdacht auf metabolische Gelenkerkrankung

## Folgende Krankheitsgruppen sind weitestgehend ausgeschlossen:

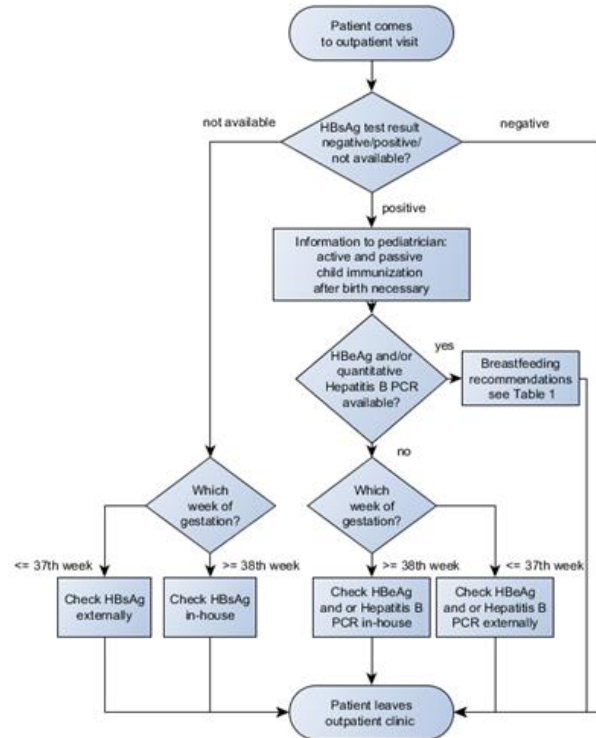
- Verdacht auf mechanische Ursache der Rückenbeschwerden
  - Verdacht einer malignen Erkrankung als Ursache der Rückenbeschwerden
  - Verdacht eines Traumas als Ursache der Rückenbeschwerden
  - Verdacht auf funktionelle oder degenerative Rückenbeschwerden
  - Verdacht auf Nervenwurzelkompression der Wirbelsäule
- Verdacht auf entzündliche Wirbelsäulenerkrankung
  - Verdacht auf bakterielle Spondylarthritis
  - Verdacht auf Spondylitis ancylosans
  - Verdacht auf Spondylarthropathia psoriatica
  - Verdacht auf Spondylarthritis bei Reiter-Syndrom
  - Verdacht auf Spondylarthritis bei Enteropathie (Morbus Crohn usw.)
- Verdacht auf metabolische Wirbelsäulenerkrankung

**Differential diagnostic support  
in  
rheumatology**

# Activiti and ArdenSuite

---

## Clinical guideline for “Hepatitis B in pregnancy: outpatient visit”



Department of Obstetrics and Gynecology,  
Vienna General Hospital/Medical University of Vienna, Austria



## Hepatitis B breastfeeding recommendations for HBsAg positive patients

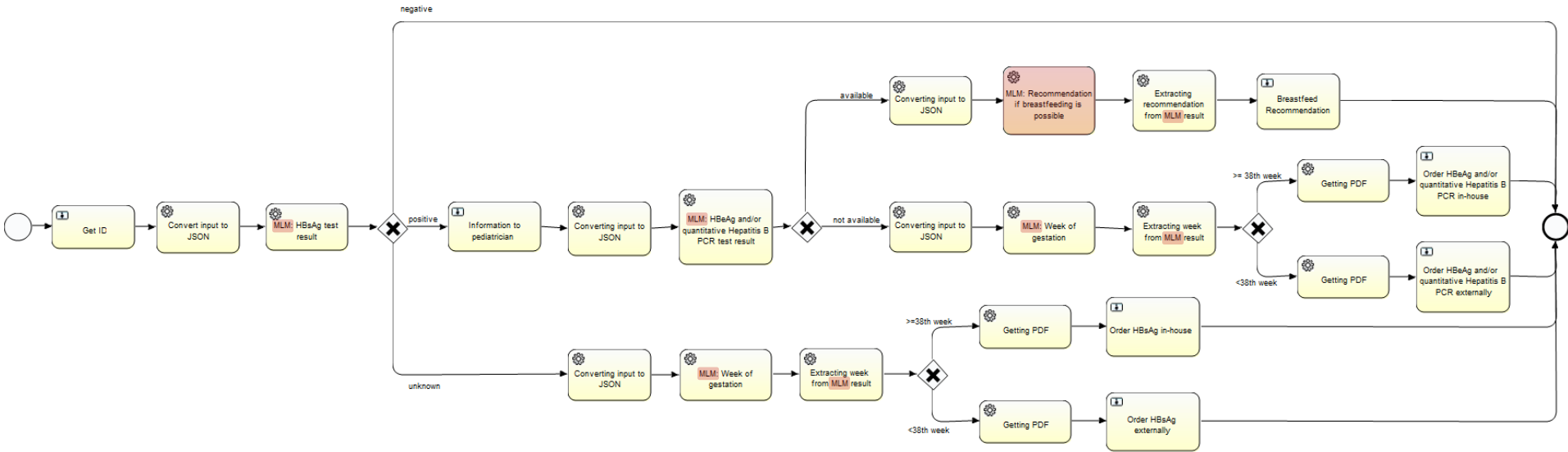
Test results	Hepatitis B PCR positive <sup>1</sup>	Hepatitis B PCR negative <sup>2</sup>	Hepatitis B PCR unknown
<b>HBeAg positive</b>	Don't breastfeed or wean from breastfeeding	Breastfeeding after immunization possible	Don't breastfeed or wean from breastfeeding
<b>HBeAg negative</b>	Don't breastfeed or wean from breastfeeding	Breastfeeding after immunization possible	Breastfeeding after immunization possible
<b>HBeAg unknown</b>	Don't breastfeed or wean from breastfeeding	Breastfeeding after immunization possible	No recommendation possible until data is available

<sup>1</sup> Positive result corresponds to  $>10^7$  genomes/ml


<sup>2</sup> Negative result corresponds to  $\leq 10^7$  genomes/ml

Note: HBeAg, hepatitis B envelope antigen; PCR, polymerase chain reaction




# Activiti BPMN workflow and MLM calls



## ... part of pediatrician–mother conversation



### Breastfeed Recommendation

 No due date  Medium Priority  Created 3 days ago


---


**Breastfeeding after immunization possible**

Part of process: 'HepatitisBInPregnancy'

---

#### People

 No owner [Transfer](#)

 **Medexter Healthcare**  
Assignee [Reassign](#)

---

#### Subtasks

No subtasks defined for this task

---

#### Related content

No related content attached for this task

---

[Complete task](#)

# Fuzzy Arden Syntax

---

# Fuzzy logic

Traditional logic is bivalent, which means that only two truth values are allowed: every proposition must be either true or false. But the inherent vagueness of many terms, apparent in the sorites paradox, suggests that this requirement is too rigid if logic is to encompass the full scope and complexity of natural language.

Fuzzy logic has been developed, initially by the computer scientist <sup>Lotfi</sup>~~Lotfi~~ Zadeh, to allow for imprecision and degrees of truth. Truth is presented as a continuum between true (1) and false (0). So, for instance, a particular proposition that is 'partly true' or 'more or less true' might be represented as true to degree 0.8 and false to degree 0.2. Fuzzy logic has been particularly important in AI (artificial intelligence) research, where 'intelligent' control systems need to be responsive to the imprecisions and nuances of natural language.

## Why Fuzzy Arden Syntax – part I?

- **Modeling linguistic uncertainty by fuzzy sets**
    - due to the unsharpness (fuzziness) of boundaries in linguistic concepts; gradual transition from one concept to another
    - modeled by fuzzy sets (e.g., fever, increased glucose level, hypoxemia)
    - a fuzzy set calculates a degree of compatibility in the range  $[0,1]$  between raw data and a linguistic clinical concept
  - **Modeling propositional uncertainty by fuzzy logic**
    - due to the incompleteness of medical conclusions; uncertainty in definitional, causal, statistical, and heuristic relationships
    - modeled by fuzzy logic truth values between zero and one (e.g., 0.6, 0.9)
    - to evaluate logical combinations of clinical concepts to draw conclusions about higher-level concepts; repeated use propagates results through an inference network
-

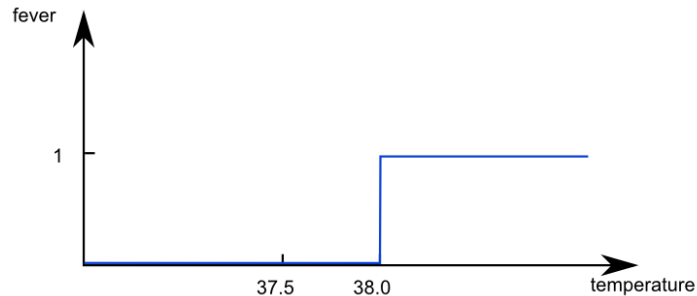
## Why Fuzzy Arden Syntax – part II?

- Modeling two-dimensional fuzzy sets and fuzzy automata
    - linguistic fuzzy states represent physiological or pathophysiological states
    - state transitions are described by linguistic instructions
    - two-dimensional fuzzy sets include time dimension
  - Modeling fuzzy control
    - heuristic, linguistic control rules
    - here: open-loop control cycle
-

## Fuzzy Sets

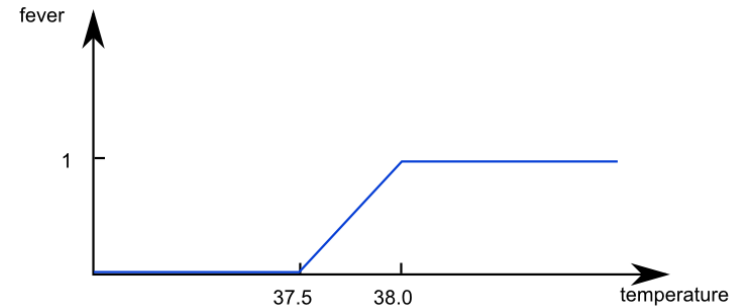
- **Crisp** boundary

- Defines a **sharp** threshold.
- Checking if a given value is greater or less than the defined crisp threshold results in either true or false.
- Borderline cases are not detected.



- **Fuzzified** boundary

- Defines a **gradual** transition
- Checking if a given value is greater or less than the defined fuzzified boundary results in a truth value between 0 and 1
- Borderline cases are detected
- Weighted results for borderline cases, all other are as usual





## Four clinical concepts in Moni-ICU

Clinical Concept (Unit)	Fuzzy Set		
	Normal Range	Borderline Range	Pathological Range
Increased body temperature (fever) (°C)	< 37.5	37.5 – 38.0 <sup>1)</sup>	> 38.0 <sup>2)</sup>
Increased C-reactive protein (CRP) (mg/dl)	< 1.0	1.0 – 6.0 <sup>3)</sup>	> 6.0 <sup>3)</sup>
Leukopenia (WBC/mm <sup>3</sup> )	> 5,000	4,000 – 5,000 <sup>4)</sup>	< 4,000 <sup>2)</sup>
Leukocytosis (WBC/mm <sup>3</sup> )	< 11,000	11,000 – 12,000 <sup>4)</sup>	> 12,000 <sup>2)</sup>

<sup>1)</sup> as defined by clinicians

<sup>2)</sup> as defined by CDC/NHSN, ECDC, and KISS for retrospective surveillance purposes

<sup>3)</sup> as defined by clinicians; CRP is an early phase protein, useful as an “infection radar” for prospective purposes

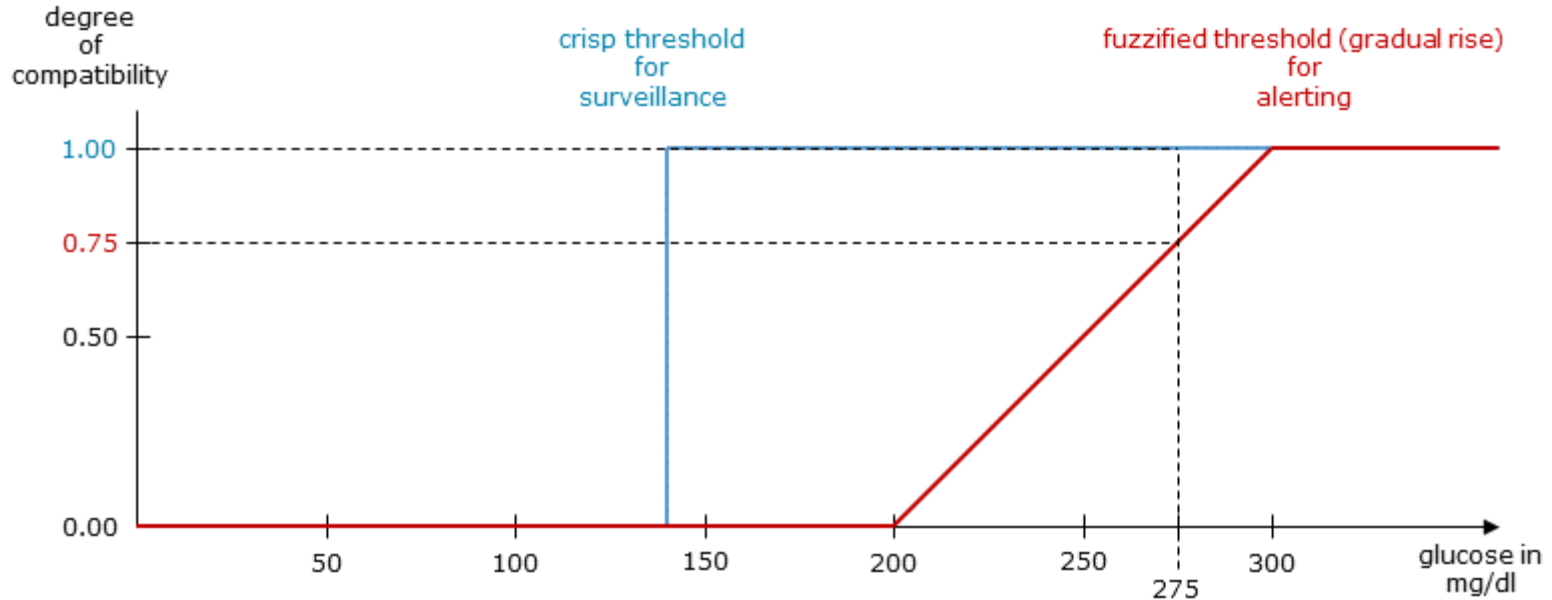
<sup>4)</sup> as defined by clinicians; white blood cell count (WBC) is a slowly reacting indicator, important for surveillance purposes

## Frequency distributions: four clinical concepts as well as the topmost HAI definitions (24,325 patient days)

Clinical Concept	Absent n (%)	Borderline n (%)	Present n (%)
Increased body temperature (fever)	16,074 (66.1)	3,421 (14.0)	4,830 (19.9)
Increased C-reactive protein (CRP)	4,383 (18.0)	5,841 (24.0)	14,101 (58.0)
Leukopenia	22,991 (94.5)	668 (2.8)	666 (2.7)
Leukocytosis	15,169 (62.4)	1,544 (6.3)	7,612 (31.3)
BSI or <sup>1)</sup> CRI2 or UTI-A or UTI-B	20,687 (85.0)	606 (2.5)	3,032 (12.5)

<sup>1)</sup> inclusive disjunction with precedence of "present" over "borderline" over "absent"

## Two different hyperglycemia definitions



Hyperglycemia (surveillance) is true is 1.00.  
Hyperglycemia (alerting) is true is 0.75.

# Momo—Microbiological analytics, reporting, and alerting

---

Queries	Templates
▼ Today	
Benchmarking P. aeruginosa AMR	12:13
Benchmarking P.aeruginosa Spectrum	12:12
Benchmarking P.aeruginosa FlexScan	12:09
Pseudomonas aeruginosa 4MRGN AMR	12:08
Pseudomonas aeruginosa AMR	12:08
AMR situation Spectrum	12:07
AMR situation FlexScan	12:06
Pathogen Statistics Spectrum	12:05
Pathogen Statistics FlexScan	12:05
Pathogen Check FlexScan	12:04
rawdatastorage_import Import	04:22
> This month	
> Older	



**Momo**  
Monitoring of Microorganisms

Momo is a multifunctional microbiology analytics tool. Analytics results can be exported as reports and are made available for use in multiple ways.

**i** *The attending physician is solely responsible for the diagnosis and therapy of a patient. Only the physician can align the data displayed by Momo with the patient's overall clinical picture. Momo is certified as a medical device, compliant with the European In-vitro Diagnostic Directive 98/79/EC. Medexter Healthcare is certified to apply all quality assurance measures according to DIN EN ISO 13485.*

**QuickScan:** Get single patient overviews with just one click using this fast clinical tool. Choose only positive, approved or all results.

**FlexScan:** Use these highly customizable queries with the full microbiological data available. Answer clinical, epidemiological, and QM questions with our 59 query parameters.

**Spectrum:** Based on a FlexScan or QuickScan result, Spectrum analyzes the data and provides frequency distributions for each or a combination of selected parameters.

**AMR:** By clicking "AMR" in your Spectrum results you can access and graphically display the complete antimicrobial resistance situation for every found pathogen.

Find help and instructions on how to use Momo in the [Momo Support Pages](#).

**Vienna General Hospital:** The Momo system at hand provides data from the microbiological laboratory information system Molis, starting with the introduction of the system on 04 Jul 2013 at 00:00 until 14 Mar 2023 at 04:00. In this time period, the following results are available:

2,041,773 Total results, including	1,386,098 Bacteria and fungi
	249,976 PCR results
	151,616 Serology results
	9,048 Toxins
	153,251 Microscopy results
	91,602 Miscellaneous (remarks, ...)
	199 Categorization pending

For the evaluation of [older data](#) (1,369,427 results) from the hospital's former microbiological laboratory information system (from 04/14/1995 to 12/31/2014), follow this link:

[https://monitag.routine.akhwien.at:9443/Momo\\_Frontend/](https://monitag.routine.akhwien.at:9443/Momo_Frontend/)

**i** We ask you to report any clinical or technical anomalies directly to [support@medexter.com](mailto:support@medexter.com). Suggestions for improvement and enhancement are highly welcomed.



How often did pathogen x occur in ward y  
in the last month?

*Clinicians*

*Infection Control*

*Quality Management*

*Medical Directors*

108 results found.

 Please note that results are only shown for departments you have permission to access.

Sent By	Collection	Collection	Sample Received	Sample Material	Sample Collection Site	Microbiology	Quantity	Approval	Amikacin (AK)	Cef
Chirurgie Intensiv	11/30/2017	12:00	11/30/2017 14:21	Urethraabstrich		Pseudomonas aeruginosa 3 MRGN	reichlich	approved	S	
Chirurgie			11/30/2017 14:10	BAL-Flüssigkeit		Pseudomonas aeruginosa (mucoid)	10E2 KBE/ml	approved	S	
						Pseudomonas aeruginosa (non mucoid)	10E2 KBE/ml		S	
Chirurgie Intensiv	11/30/2017	09:00	11/30/2017 10:24	Bronchialsekret		Pseudomonas aeruginosa	reichlich	approved	S	
Chirurgie Intensiv	11/30/2017	09:00	11/30/2017 10:24	BAL-Flüssigkeit	rechts	Pseudomonas aeruginosa 3 MRGN	10E2 KBE/ml	approved	S	
Chirurgie Ambulanz	11/29/2017	11:00	11/29/2017 14:12	Abstrich	Wunde postoperativ LVAD Pumpe	Pseudomonas aeruginosa	mässig	approved	S	
Chirurgie	11/28/2017		11/28/2017 11:26	Abstrich	chron.Wunde, re.Hüfte	Pseudomonas aeruginosa 3 MRGN	reichlich	approved	S	
Chirurgie Intensiv	11/27/2017	14:00	11/27/2017 15:42	Bronchialsekret		Pseudomonas aeruginosa	mässig	approved	I	
Chirurgie Intensiv	11/27/2017	10:00	11/27/2017 15:42	Bronchialsekret		Pseudomonas aeruginosa	reichlich	approved	S	
Chirurgie			11/27/2017 15:42	BAL-Flüssigkeit		Pseudomonas aeruginosa	10E2 KBE/ml	approved	S	
						Pseudomonas aeruginosa 3 MRGN	10E3 KBE/ml		I	
Chirurgie Intensiv	11/27/2017	10:00	11/27/2017 15:12	Mittelstrahlharn		Pseudomonas aeruginosa	> 10E5 KBE/ml	approved	S	
Chirurgie	11/27/2017		11/27/2017 14:11	Abstrich	Wunde li USCH Stumpf	Pseudomonas aeruginosa	reichlich	approved	S	
Chirurgie Ambulanz			11/27/2017 13:53	Abstrich	Driveline	Pseudomonas aeruginosa	mässig	approved	S	
Chirurgie Intensiv	11/27/2017		11/27/2017 13:25	Stuhl		Pseudomonas aeruginosa 4 MRGN	reichlich	approved		
Chirurgie Intensiv	11/27/2017	10:00	11/27/2017 12:44	Bronchialsekret		Pseudomonas aeruginosa 4 MRGN	reichlich	approved	S	
Chirurgie Ambulanz	11/27/2017		11/27/2017 12:33	BAL-Flüssigkeit		Pseudomonas aeruginosa	10E5 KBE/ml	approved	R	
Chirurgie Intensiv	11/27/2017	10:00	11/27/2017 12:23	Katheterharn		Pseudomonas aeruginosa 4 MRGN	> 10E5 KBE/ml	approved	S	
Chirurgie	11/26/2017	11:00	11/26/2017 14:30	Abstrich	postoperativ chron.Wunde Trochanter rechts	Pseudomonas aeruginosa 3 MRGN	reichlich	approved	S	
Chirurgie	11/25/2017	16:00	11/26/2017 14:30	Flüssigkeit	intramm. Hämatom	Pseudomonas aeruginosa	reichlich	approved	S	

## Pathogen statistics

 Please note that results are only shown for departments you have permission to access.

Sent By	Microbiology	Count
Chirurgie	<b>AMR</b> Pseudomonas aeruginosa	28
Chirurgie Intensiv	<b>AMR</b> Pseudomonas aeruginosa	16
Chirurgie Intensiv	<b>AMR</b> Pseudomonas aeruginosa 4MRGN	16
Chirurgie Ambulanz	<b>AMR</b> Pseudomonas aeruginosa	10
Chirurgie	<b>AMR</b> Pseudomonas aeruginosa 3MRGN	9
Chirurgie Intensiv	<b>AMR</b> Pseudomonas aeruginosa 3MRGN	8
Chirurgie	<b>AMR</b> Pseudomonas aeruginosa 4MRGN	8
Chirurgie	<b>AMR</b> Pseudomonas aeruginosa (mucoid)	4
Chirurgie Ambulanz	<b>AMR</b> Pseudomonas aeruginosa (non mucoid)	2
Chirurgie Ambulanz	<b>AMR</b> Pseudomonas aeruginosa (mucoid)	2
Chirurgie Ambulanz	<b>AMR</b> Pseudomonas aeruginosa 3MRGN (non mucoid)	2
Chirurgie	<b>AMR</b> Pseudomonas aeruginosa (non mucoid)	1
Chirurgie Ambulanz	<b>AMR</b> Pseudomonas aeruginosa 4MRGN (mucoid)	1
Chirurgie Ambulanz	<b>AMR</b> Pseudomonas aeruginosa 4MRGN (non mucoid)	1











# AMR situation for pathogen x in ward y.

*Clinicians*

*Infection Control*

## AMR situation

 Please note that results are only shown for departments you have permission to access.

Microbiology	Count	
 Pseudomonas aeruginosa	54	
 Pseudomonas aeruginosa 4MRGN	24	
 Pseudomonas aeruginosa 3MRGN	17	
 Pseudomonas aeruginosa (mucoid)	6	
 Pseudomonas aeruginosa (non mucoid)	3	
 Pseudomonas aeruginosa 3MRGN (non mucoid)	2	
 Pseudomonas aeruginosa 4MRGN (mucoid)	1	
 Pseudomonas aeruginosa 4MRGN (non mucoid)	1	

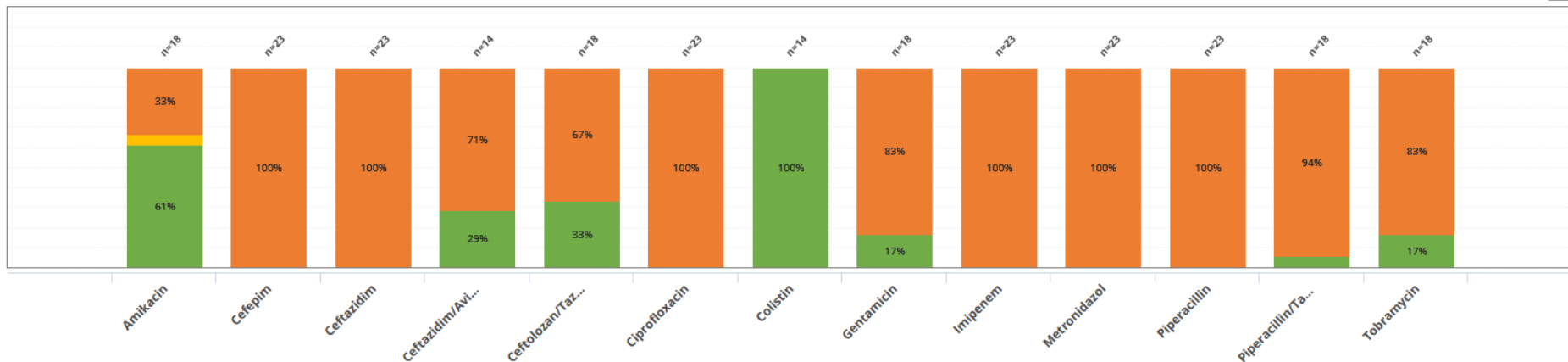
Please note that results are only shown for departments you have permission to access.

created by **Md MEDEXTER** Healthcare

### Pseudomonas aeruginosa 4MRGN

AMR Situation for Pseudomonas aeruginosa 4MRGN

● R ● I ● S



Antibiotics/Antimycotics	n	Resistant		Intermediate		Sensitive		
		absolute	relative	absolute	relative	absolute	relative	
Amikacin	18	6	33.33%	1	5.56%	11	61.11%	^
Cefepim	23	23	100.00%	0	0.00%	0	0.00%	
Ceftazidim	23	23	100.00%	0	0.00%	0	0.00%	
Ceftazidim/Avibactam	14	10	71.43%	0	0.00%	4	28.57%	
Ceftolozan/Tazobactam	18	12	66.67%	0	0.00%	6	33.33%	
Ciprofloxacin	23	23	100.00%	0	0.00%	0	0.00%	
Colistin	14	0	0.00%	0	0.00%	14	100.00%	
Gentamicin	18	15	83.33%	0	0.00%	3	16.67%	v

# Ontologies—The being of programs.

*Part of Interface*

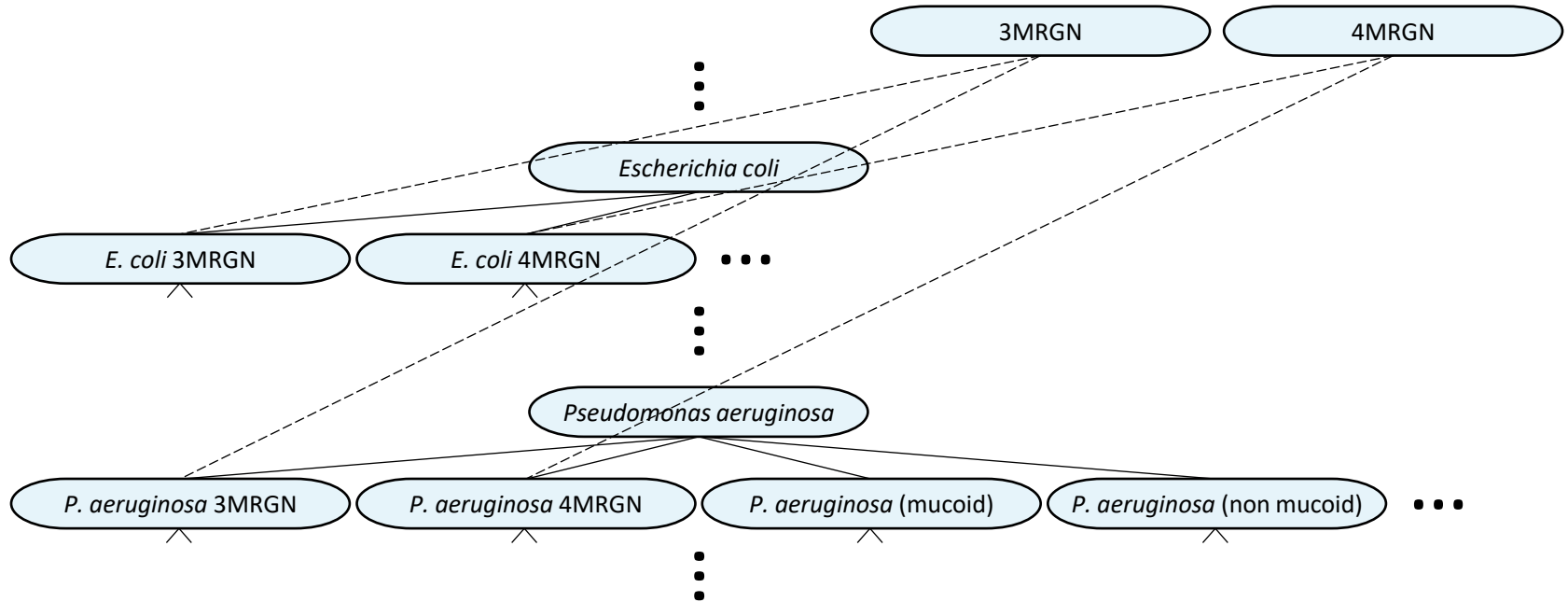
# Ontologies for departments, sample material, microbiological and virological results, and antibiotics/antimycotics

16 results found.

 Please note that results are only shown for departments you have permission to access.

m/f	Sent By	Sample Received	Sample Material	Microbiology	Amikacin (AK)	Amoxicillin/Clavulansäure (AUG)	Ampicillin (AP)	Ampicillin + Sulbactam (SA)
f	Nephrologie Ambulanz	12/29/2017 14:28	Mittelstrahlharn	Escherichia coli	S	R	R	R
f	Nephrologie Ambulanz	12/29/2017 14:28	Mittelstrahlharn	Enterococcus species				
f	Nephrologie	12/01/2017 12:10	Abstrich	Corynebacterium species				
f	Nephrologie	12/01/2017 12:10	Abstrich	Escherichia coli	S	S	R	S
f	Nephrologie	12/01/2017 12:10	Abstrich	Enterococcus faecium			R	
f	Nephrologie	12/01/2017 12:10	Abstrich	Staphylokokken Koag.neg.				
f	Nephrologie	12/01/2017 12:10	Abstrich	Candida glabrata				
f	Nephrologie	12/01/2017 12:10	Abstrich	Candida parapsilosis				
f	Nephrologie	12/01/2017 12:10	Abstrich	Staphylokokken Koag.neg.				
f	Nephrologie	12/01/2017 12:10	Abstrich	Corynebacterium species				
f	Nephrologie	12/01/2017 12:10	Abstrich	Enterococcus faecium			R	
f	Nephrologie	12/01/2017 12:10	Abstrich	Candida glabrata				
f	Nephrologie	12/01/2017 10:03	Mittelstrahlharn	Corynebacterium species				
f	Nephrologie	12/01/2017 10:03	Mittelstrahlharn	Staphylokokken Koag.neg (nicht saprophyticus)				
f	Nephrologie	12/01/2017 10:03	Mittelstrahlharn	Kein Wachstum von Pilzen				
f	Nephrologie	12/01/2017 10:03	Mittelstrahlharn	Enterococcus faecium			R	

## Section of Momo's ontology for microorganisms

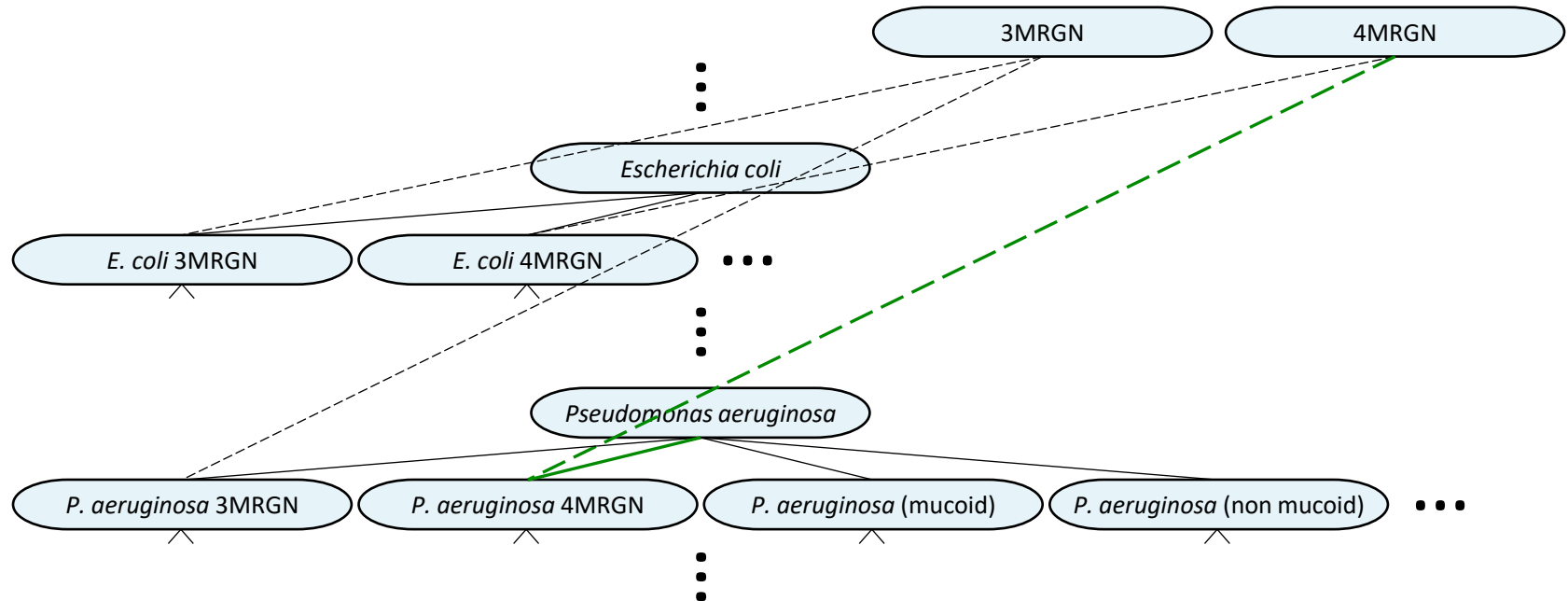


# Alert service with Arden Syntax.

*Clinicians*

*Infection Control*

## Bottom-up reasoning in Momo's ontology



"*Pseudomonas aeruginosa* 4MRGN"  $\Rightarrow$  *Pseudomonas aeruginosa*, *Pseudomonas*, *Pseudomonadaceae*, bacteria, culture, microbiology, 4MRGN



## Alert MLM with multidrug-resistant bacteria

```
maintenance:
  title: Alert Check Microbiology;;
  mlmname: alert-check-micro;;
  arden: version 2.9;;
  version: 0.4;;
  institution: Medexter Healthcare, Vienna, Austria;;
  author: Knowledge engineering group;;
  specialist: Clinical specialising group;;
  date: 2023-02-14;;
  validation: testing;;
library:
  purpose: mlm to evaluate if alerting should be considered;;
  explanation: checks the given input for any alert-worthy terms and returns decision;;
  keywords: ;;
  citations: ;;
  links: ;;
knowledge:
  type: data_driven;;
  data:
    (cause, parents) := Argument;
    Result := OBJECT [NeedsAlert, Notification];
    ;;
  priority: ;;
  evoke: ;;
```

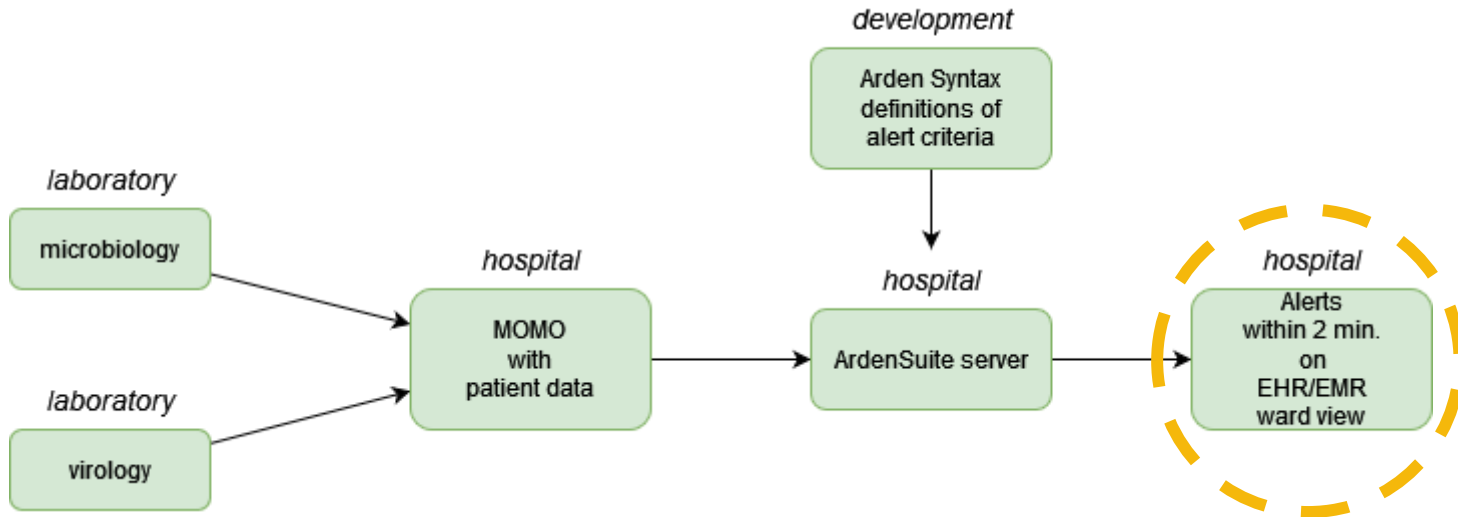
```
logic:
  IF "3MRGN" IS IN parents THEN
    result := NEW Result WITH true, cause || " was found as subconcept of 3MRGN.";
    positiveResult := true;
  ENDIF;
  IF "4MRGN" IS IN parents THEN
    result := NEW Result WITH true, cause || " was found as subconcept of 4MRGN.";
    positiveResult := true;
  ENDIF;
  IF "MRSA" IS IN parents THEN
    result := NEW Result WITH true, cause || " was found as subconcept of MRSA.";
    positiveResult := true;
  ENDIF;
  IF "VRE" IS IN parents THEN
    result := NEW Result WITH true, cause || " was found as subconcept of VRE.";
    positiveResult := true;
  ENDIF;
  IF "ESBL" IS IN parents THEN
    result := NEW Result WITH true, cause || " was found as subconcept of ESBL.";
    positiveResult := true;
  ENDIF;
  IF "Candida auris" IS IN parents THEN
    result := NEW Result WITH true, cause || " was found as subconcept of Candida auris.";
    positiveResult := true;
  ENDIF;
  IF NOT EXIST positiveResult THEN
    result := NEW Result WITH false, "No alert needed.";
  ENDIF;
  conclude true;
  ;;
action:
  return result;
  ;;
urgency: ;;
end:
```

# Alert MLM with pandemic-causing viruses

```
maintenance:
  title: Alert Check Virology;;
  mlmname: alert-check-viro;;
  arden: version 2.9;;
  version: 0.4;;
  institution: Medexter Healthcare, Vienna, Austria;;
  author: Knowledge engineering group;;
  specialist: Clinical specialising group;;
  date: 2023-02-14;;
  validation: testing;;
library:
  purpose: mlm to evaluate if alerting should be considered;;
  explanation: checks the given input for any alert-worthy terms and returns decision;;
  keywords: ;;
  citations: ;;
  links: ;;
knowledge:
  type: data_driven;;
  data:
    (cause, parents) := Argument;
    Result := OBJECT [NeedsAlert, Notification];
    ;;
  priority: ;;
  evoke: ;;

logic:
  IF "PCR Akut Influenzavirus-A RNS" IS IN parents THEN
    result := NEW Result WITH true, cause || " was found as subconcept of PCR Akut Influenzavirus-A RNS.";
    positiveResult := true;
  ENDF;
  IF "PCR Akut Influenzavirus-B RNS" IS IN parents THEN
    result := NEW Result WITH true, cause || " was found as subconcept of PCR Akut Influenzavirus-B RNS.";
    positiveResult := true;
  ENDF;
  IF "PCR Akut RSV RNS " IS IN parents THEN
    result := NEW Result WITH true, cause || " was found as subconcept of PCR Akut RSV RNS.";
    positiveResult := true;
  ENDF;
  IF "PCR Coronavirus SARS CoV-2 " IS IN parents THEN
    result := NEW Result WITH true, cause || " was found as subconcept of PCR Coronavirus SARS CoV-2.";
    positiveResult := true;
  ENDF;
  IF NOT EXIST positiveResult THEN
    result := NEW Result WITH false, "No alert needed.";
  ENDF;
  conclude true;
  ;;
  action:
    return result;
  ;;
  urgency: ;;
end;
```

## Arden-Syntax-based Alert service



## Demo: finally EHR's view of active patients on the ward

b4	Patient4	02.02.1983	40	4	Mar 15 14:15 PCR Coronavirus SARS-CoV-2	
					Mar 14 07:52 Pseudomonas aeruginosa 3MRGN	
b5	Patient5	01.01.1983	40	5		
b6	Patient6	04.04.1952	71	6		
d1	Patient7	04.02.1993	30	7	Mar 15 10:32 Pseudomonas aeruginosa 4MRGN	
d2	Patient8	01.02.1983	40	8		
d3	Patient9	01.02.2000	23	9	Mar 15 12:12 PCR Akut Influenzavirus-B RNS	

---