

LEXMED

An automatic diagnostic system for acute appendicitis



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LEXMED-Query via www.lexmed.de

Personenangaben	nicht bekannt	Werte	
Geschlecht	<input type="radio"/>	<input checked="" type="radio"/> männlich <input type="radio"/> weiblich	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
Altersgruppe	<input type="radio"/>	<input type="radio"/> 0-5 <input type="radio"/> 6-10 <input type="radio"/> 11-15 <input type="radio"/> 16-20 <input checked="" type="radio"/> 21-25 <input type="radio"/> 26-35 <input type="radio"/> 36-45 <input type="radio"/> 46-55 <input type="radio"/> 56-65 <input type="radio"/> 65-	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
Untersuchungsergebnisse	nicht untersucht	Werte	
1. Schmerzquadrant	<input checked="" type="radio"/>	<input type="radio"/> ja <input type="radio"/> nein	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
2. Schmerzquadrant	<input checked="" type="radio"/>	<input type="radio"/> ja <input type="radio"/> nein	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
3. Schmerzquadrant	<input type="radio"/>	<input checked="" type="radio"/> ja <input type="radio"/> nein	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
4. Schmerzquadrant	<input checked="" type="radio"/>	<input type="radio"/> ja <input type="radio"/> nein	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
Abwehrspannung	<input type="radio"/>	<input checked="" type="radio"/> lokal <input type="radio"/> global <input type="radio"/> keine	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
Loslassschmerz	<input type="radio"/>	<input checked="" type="radio"/> ja <input type="radio"/> nein	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
Erschütterungsschmerz	<input type="radio"/>	<input checked="" type="radio"/> ja <input type="radio"/> nein	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
Rektalschmerz	<input checked="" type="radio"/>	<input type="radio"/> ja <input type="radio"/> nein	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
Darmgeräusche	<input type="radio"/>	<input type="radio"/> schwach <input checked="" type="radio"/> normal <input type="radio"/> vermehrt <input type="radio"/> keine	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
Sonographisch auffällig	<input checked="" type="radio"/>	<input type="radio"/> ja <input type="radio"/> nein	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
Pathologisches Urinsediment	<input checked="" type="radio"/>	<input type="radio"/> ja <input type="radio"/> nein	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
Rektaler Temperaturbereich	<input type="radio"/>	<input type="radio"/> -37.3 <input checked="" type="radio"/> 37.4-37.6 <input type="radio"/> 37.7-38.0 <input type="radio"/> 38.1-38.4 <input checked="" type="radio"/> 38.5-38.9 <input type="radio"/> 39.0-	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>
Leukozytenbereich	<input type="radio"/>	<input type="radio"/> 0-6k <input type="radio"/> 6k-8k <input type="radio"/> 8k-10k <input type="radio"/> 10k-12k <input checked="" type="radio"/> 12k-15k <input type="radio"/> 15k-20k <input type="radio"/> 20k-	<input style="border: 1px solid black; background-color: #cccccc; padding: 2px 5px;" type="button" value="?"/>

LEXMED-Diagnosis¹

Diagnostic result	Appendix inflamed	Appendix perforated	negative	other disease
Probability	0.67	0.06	0.22	0.05

Suggested treatment: **Appendectomy**

¹The LEXMED-project was funded by the state of Baden-Württemberg within the research-program „Innovative Projekte“.

Knowledge Sources

Database

15000 patient records

Baden-Württemberg,
1995

Expert Knowledge

Dr. Rampf

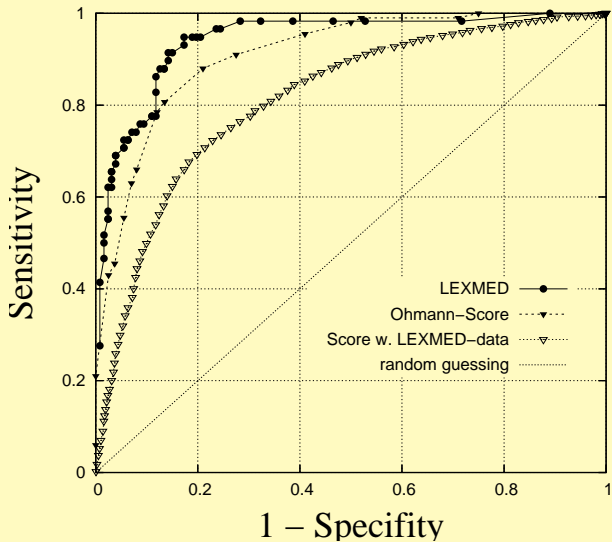
Dr. Hontschik

Performance

Error rate of LEXMED on the database: 21%

Error rate of physicians on the database: 30%

ROC-Curve



Cost savings by LEXMED²

LEXMED: average extra costs per patient: \approx 1200 DM.

total extra costs:

$$15.000 \text{ patients} \cdot 1200 \text{ DM/patient} = 18.000.000 \text{ DM}$$

Physicians: 15.000 patients, among them 5000 healthy

total extra costs:

$$5000 \text{ patients} \cdot 6000 \text{ DM/patient} = 30.000.000 \text{ DM}$$

With LEXMED \approx **12.000.000 DM** per year could be saved.

²estimated on the data base (Baden-Württemberg, 1995)

Applications of LEXMED

- Ambulant clinic
- Resident doctors
- Tutor systems in medical education
- Patient self diagnosis
- Quality management (for health care providers)

Generalisation: Acute Abdominal Pain

The following diseases cover **98%** of all acute abdominal pain cases.

- 1 Non specific abdominal pain (NSAP) (34%)
- 2 Appendix inflamed, but not perforated (24%)
- 3 Appendix perforated (4%)
- 4 Acute gall bladder disease (10%) 72%

- 5 Ileus (intestinal obstruction) (4%)
- 6 Gynecological diseases (4%)
- 7 Urinary tract infection (4%)
- 8 Acute pankreatitis (inflammation of the pancreas) (3%)
- 9 Renal colik, nephritis (3%)
- 10 Duodenal perforation, active gastric ulcer (3%)
- 11 Acute diverticulitis (2%)
- 12 Malignant tumor (2%)
- 13 Vascular disease (2%)
- 14 Dyspepsia (1% ?)
- 15 Morbus Crohn (0,5%) 98%

- 16 Other diseases (2%)

Requirements for technology transfer

We are looking for:

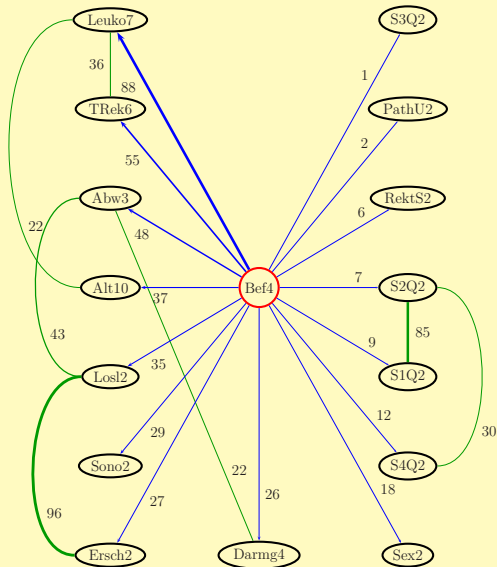
- Business partners, e.g.
- Medical software company
- University hospital
- Pharmaceutical industry

We want to achieve:

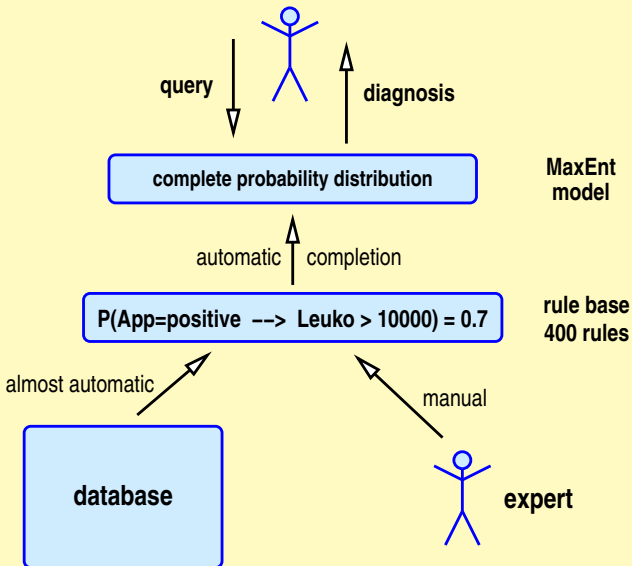
- Commercialisation
- R&D cooperation

We need: Money, databases

The Independence Graph



Knowledge Processing



Cost Matrix

Therapies	probability for diagnosis				
	Appendix inflamed	Appendix perforated	negative	other disease	
	0.25	0.15	0.55	0.05	
Operation	0	500	5800	6000	3565
Emerg.-Op.	500	0	6300	6500	3915
send home	12000	150000	0	16500	26325
other treatment	3000	5000	1300	0	2215
watch stationary	3500	7000	400	600	2175

Decision based on minimal cost: watch stationary

Diagnostic Quality

Sensitivity: proportion of **sick** patients, that are correctly classified (true positive)

Specificity: proportion of **healthy** patients, that are correctly classified (true negative)

Goal: Sensitivity = 100%, Specificity = 100%