Normandie Université

Système d'Aide à la Décision Médicale (SADM)

Computer-Aided Decision Support Systems (CDSS)

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LIMICS

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LIMICS INSERM U1142, Sorbonne Université

- **Main fields of research**
  - CDSS (former field in the ’80s and ‘90s)
  - Knowledge engineering
  - Terminologies and ontologies, semantic web
  - Information retrieval & automatic indexing

CDSS: definitions

MeSH definitions… and its limits

- **Decision support systems, clinical (n=9,089)**
- Computer-based information systems used to integrate clinical and patient information and provide support for decision-making in patient care.

- **Decision making, computer-assisted (n=100,899)**
- Use of an interactive computer system designed to assist the physician or other health professional in choosing between certain relationships or variables for the purpose of making a diagnostic or therapeutic decision.

- Not located in the same tree **(n=108,297) AND ISRAEL (n=1,016) (France 3,567)**
  - As a terminologist, **Decision support systems, clinical IS A Decision making, computer-assisted**

- Pour en savoir plus :
  - Clinical Decision Support Systems. MA Musen, B Middleton, RA Greenes. In: Biomedical Informatics (EH. Shortliffe, JJ. Cimino, Eds), Springer, 2014.
  - Systèmes d'aide à la décision en médecine. Rapport à la Haute Autorité de Santé (2010).

HeTOP français SADM

Recherche sans troncature (sans wildcard)
Ne pas chercher dans les définitions
Sélection terminologies filtrer les concepts traduits

Vos recherches

8 ressource(s) trouvée(s) en 0,08 s

- **Meilleurs candidats**
  - prise de décision assistée par ordinateur [Descripteur MeSH]
  - prise de décision assistée par ordinateur [HUI]
  - prise de décision assistée par ordinateur [Terme EFMI]
  - Erreur d'administration de médicament [Terme de bas niveau MedDRA]
  - Nerve-locating anesthesia kit, continuous-administration (physical object) [Concept SNOMED CT]
  - pouvoir psychologique [Descripteur MeSH]
  - QE2 éthique professionnelle [Q-code]
  - QA71 sousdosage, sans blessure ni préjudice [Catégorie CIM-11]
- **MeSH (2)**
- **HUI (1)**
- **CIM-11 (1)**
- **Dictionnaire MIMO (1)**
- **MedDRA (1)**
- **SNOMED CT (1)**
- **Q-Codes (1)**

Prise de décision assistée par ordinateur (Descripteur MeSH)

Description | Hiérarchies | Relations | PubMed / Doc'CISMeF | **Curation***

Arborescence complète

- Catégorie Sciences de l'information
  - sciences de l'information*
    - informatique*
      - informatique médicale*
        - applications de l'informatique médicale*
          - **prise de décision assistée par ordinateur***
            - diagnostic assisté par ordinateur*
              - Interprétation d'images assistée par ordinateur*
                - Interprétation d'images radiographiques assistée par ordinateur*
            - thérapie assistée par ordinateur°
              - pharmacothérapie assistée par ordinateur*
              - radiothérapie assistée par ordinateur*
                - planification de radiothérapie assistée par ordinateur*
                - radiothérapie conformationnelle*
                  - radiothérapie conformationnelle avec modulation d'intensité

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Prise de décision assistée par ordinateur (Descripteur MeSH)

Description | Hiérarchies | Relations | PubMed / Doc'CISMeF | Curation* | Traduction

NIH NLM | Inserm | BioPortal | RDF/XML

Voir toutes les langues On | Ajouter une métadonnée

Identifiant d'origine

D003658

Libellé préféré

prise de décision assistée par ordinateur
decision making, computer-assisted
rozhodování pomocí pocítace | entscheidungsfindung, computergestützte | Toma de Decisiones Asistida por Computador | Tietokoneavusteinen päätöksenteko
odlucivanje uz pomoc racunala | Processo decisionale assistito da computer | コンピュータ支援意思決定 | Computerondersteunde besluitvorming
Datamaskinstøttet beslutningstaking | Podejmowanie decyzji wspomagane komputerowo | Tomada de Decisões Assistida por Computador
РЕШЕНИЙ ПРИНЯТИЕ АВТОМАТИЗИРОВАННОЕ
Beslutsfattande, datorstött | 决策, 计算机辅助

Définition du MeSH

Utilisation d'un système informatique interactif conçu pour aider le médecin ou tout autre professionnel de santé dans le choix entre certaines relations ou variables afin de prendre une décision diagnostique ou thérapeutique. [Traduction effectuée avant 2008]

Use of an interactive computer system designed to assist the physician or other health professional in choosing between certain relationships or variables for the purpose of making a diagnostic or therapeutic decision.

Définition CISMeF

Les systèmes d'aide à la décision médicale (SADM) sont des outils informatiques capables de traiter l'ensemble des caractéristiques d'un patient donné afin de générer les diagnostics probables de son état clinique (aide au diagnostic) ou les traitements qui lui seraient adaptés (aide à la thérapeutique). Le terme SADM recouvre aujourd'hui un ensemble d'outils variés, plus ou moins complexes.

Synonyme MeSH

computer assisted decision making | computer-assisted decision making | decision making, computer assisted
Datastøttet beslutningstaking

Synonyme CISMeF

décision assistée par ordinateur | système aide décision médicale

Acronyme CISMeF

SADM
CADM

Synonyme DeCS

Toma de Decisiones Asistida por Computadora | Toma de Decisiones Asistida por Ordenador | Toma de Decisiones Computarizada
Toma de Decisiones Médicas Asistida por Computador
Toma de Decisiones Médicas Asistida por Computadora | Toma de Decisiones Médicas Asistida por Ordenador | Tomada de Decisões Médicas Assistida por Computador

T/O

Dictionnaire MIMO : Thésaurus d'informatique médicale MIMO

Version : 2022 - Éditeur : European Federation for Medical Informatics Association

https://efmi.org/

Langues disponibles :

EFMI EUROPEAN FEDERATION for MEDICAL INFORMATICS

HOSMARTAI AI for the smart hospital of the future

Rechercher un terme dans la terminologie :

L'association de la Fédération Européenne pour l'Informatique Médicale propose un dictionnaire multilingue d'informatique médicale afin de promouvoir l'échange d'informations, de connaissances et d'expériences entre les différents acteurs du secteur de l'informatique médicale. Tous les termes de ce thésaurus seront traduits dans plus de 30 langues.

European Federation for Medical Informatics (EFMI) association provides a multilingual thesaurus of medical informatics to promote data and knowledge sharing between actors of this sector. All terms will be translated into more than 30 languages.

Statistiques

Nombre de concepts : 1405

Traductions :

Explorer la terminologie en naviguant dans son arborescence

Termes MIMO

CGU - Contact

Decision in medicine… and health

- The goal of medicine is to obtain the best strategy, which leads to the maximum benefit for the patient (and the population), whereas the risks and the costs should be minimized

- Two main steps in the medical decision
  - Decision about diagnosis
  - Decision about therapy

Decision in medicine … and health

- How a physician (or HP) is taking a decision?
  - Complex processus, which needs reasoning, based on facts and confronting to knowledge

- Before CDSS, it is necessary to study this complex processus to perform an adequate decision in medicine (and health)

Basis of a decision

- Facts
  - All the facts that can be retrieved from patient interview , the examination , lab tests , imaging , procedures…
  - Clinical skills
- Knowledge
  - Most up-to-date knowledge,
    - in the memory of the HP
    - In a (electronic) book or Web site
  - More and more knowledge are integrated into clinical guidelines
  - Computer-aided (assisted) access to guidelines or computerized guidelines (contextual knowledge)

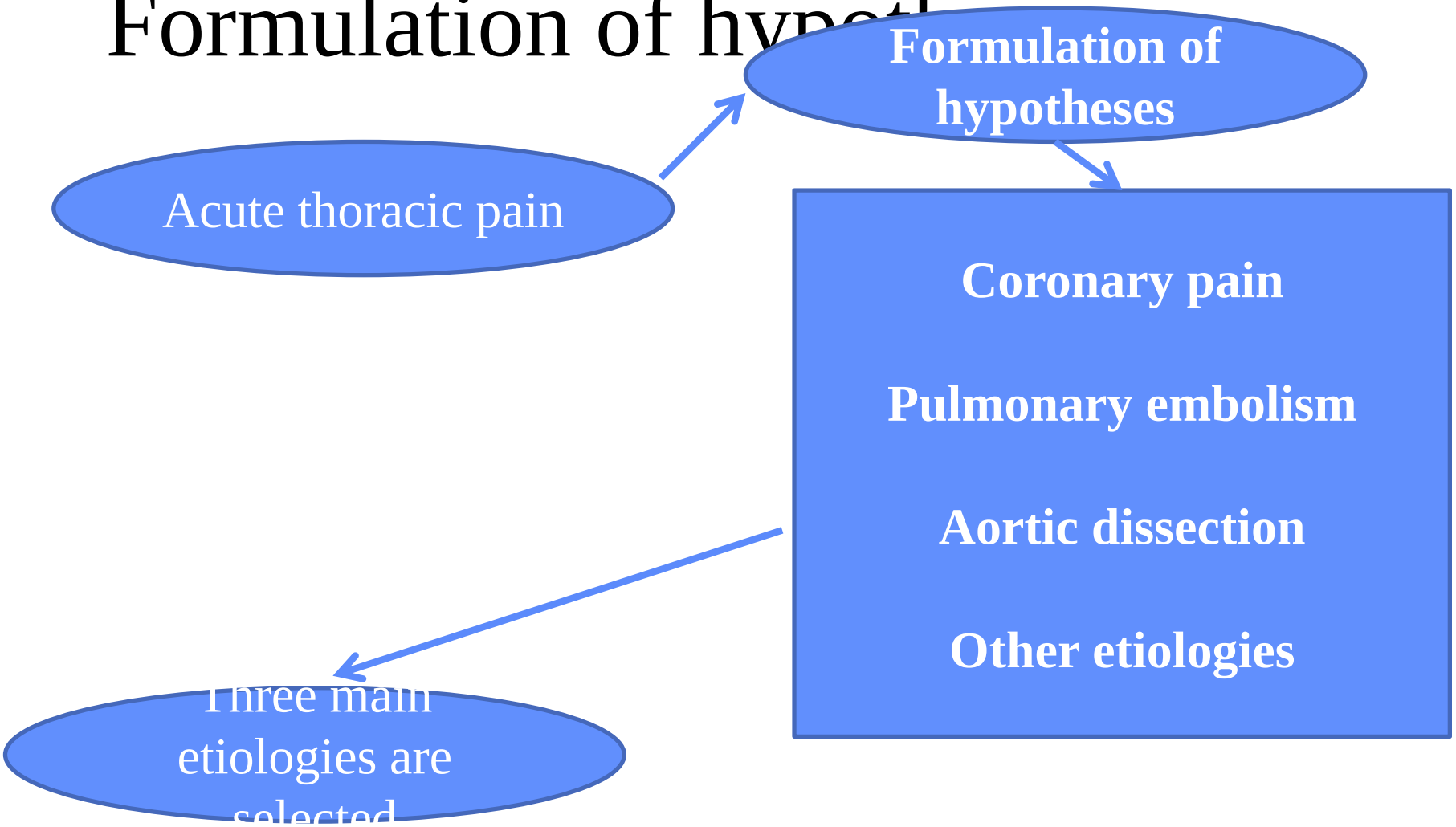
Methods of reasoning

- Several methods of reasoning exist:
  - Deduction
  - Abduction
  - Induction
  - Causal
- These methods may be combined in a global process =>

Hypotheses & deducing, which is the most used process in medical diagnosis

Hypotheses & deducing reasoning

Formulation of hypot



Hypotheses & deducing reasoning

Evaluation of hyp

eses

Coronary pain

Pulmonary embolism

Aortic dissection

Search of sign in favour of this hypothesis

pain

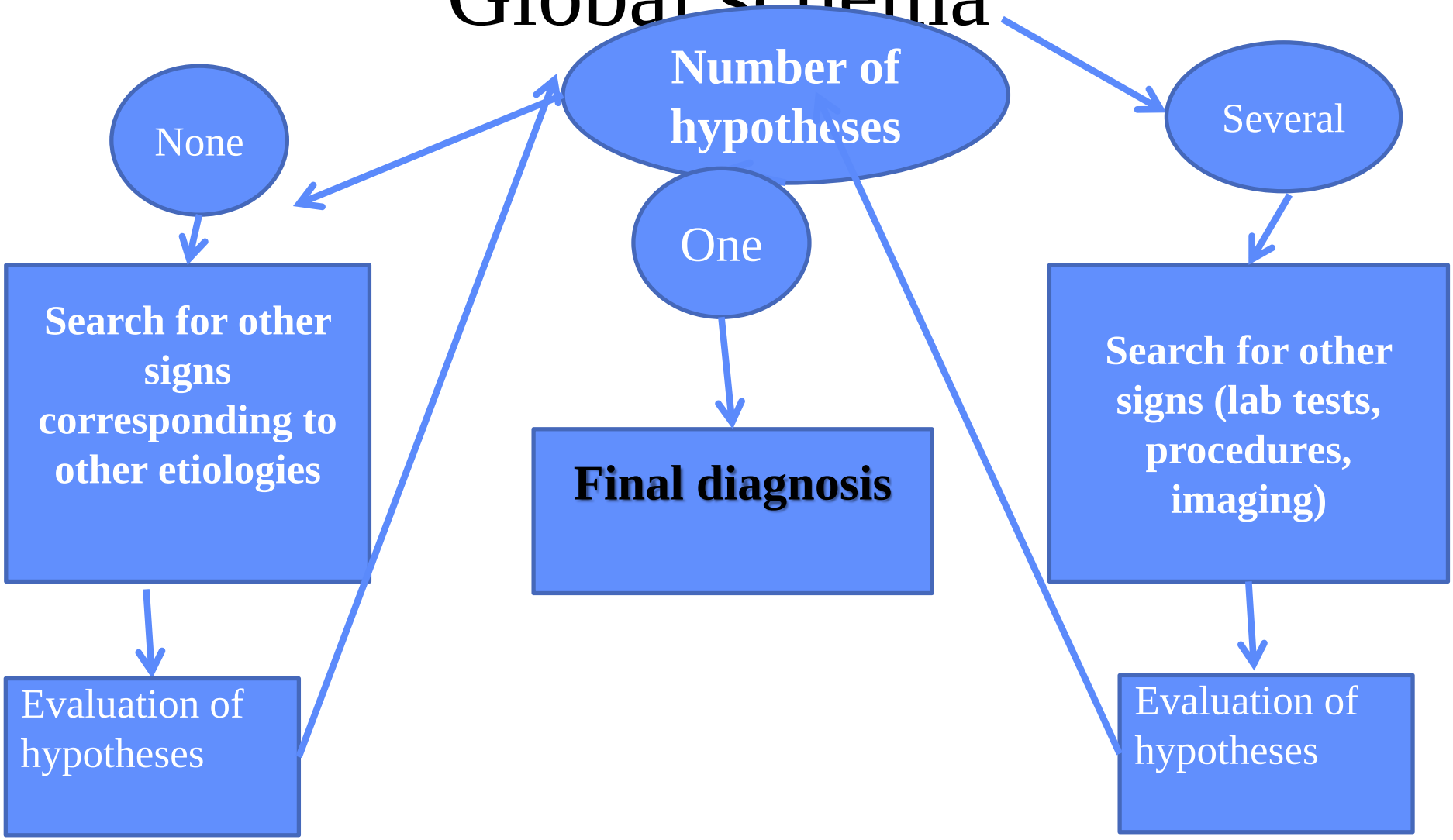
- history
- retrosternal pain
- irradiation
- EKG

- Marfan, arterial hypertension
- irradiation => back
- Abolition of pulse
- Aortic insufficiency

→ Evaluation of hypotheses

Hypotheses & deducing reasoning

Global schema



Computer-aided decision

- All the phases of a medical decision could be computer-assisted
  - Gathering data, using interactive actions
  - Access to knowledge bases (information bases)
    - Drug databases, genetic databases
    - Terminologies and ontologies => teaching +++
    - Computerized guidelines, InfoButtons, documentary databases?
  - Every step of the decision process, including reasoning +++

Computer-aided decision

- Decision process
- Objective: to allow the physician to take care of the patient with the CDSS to the best of the patient, minimizing the risk (first, do not harm)
- Several types of CDSS
  - Algorithm (computerized guidelines)
  - Expert systems
  - Probabilistic systems
  - Neural network (black box)

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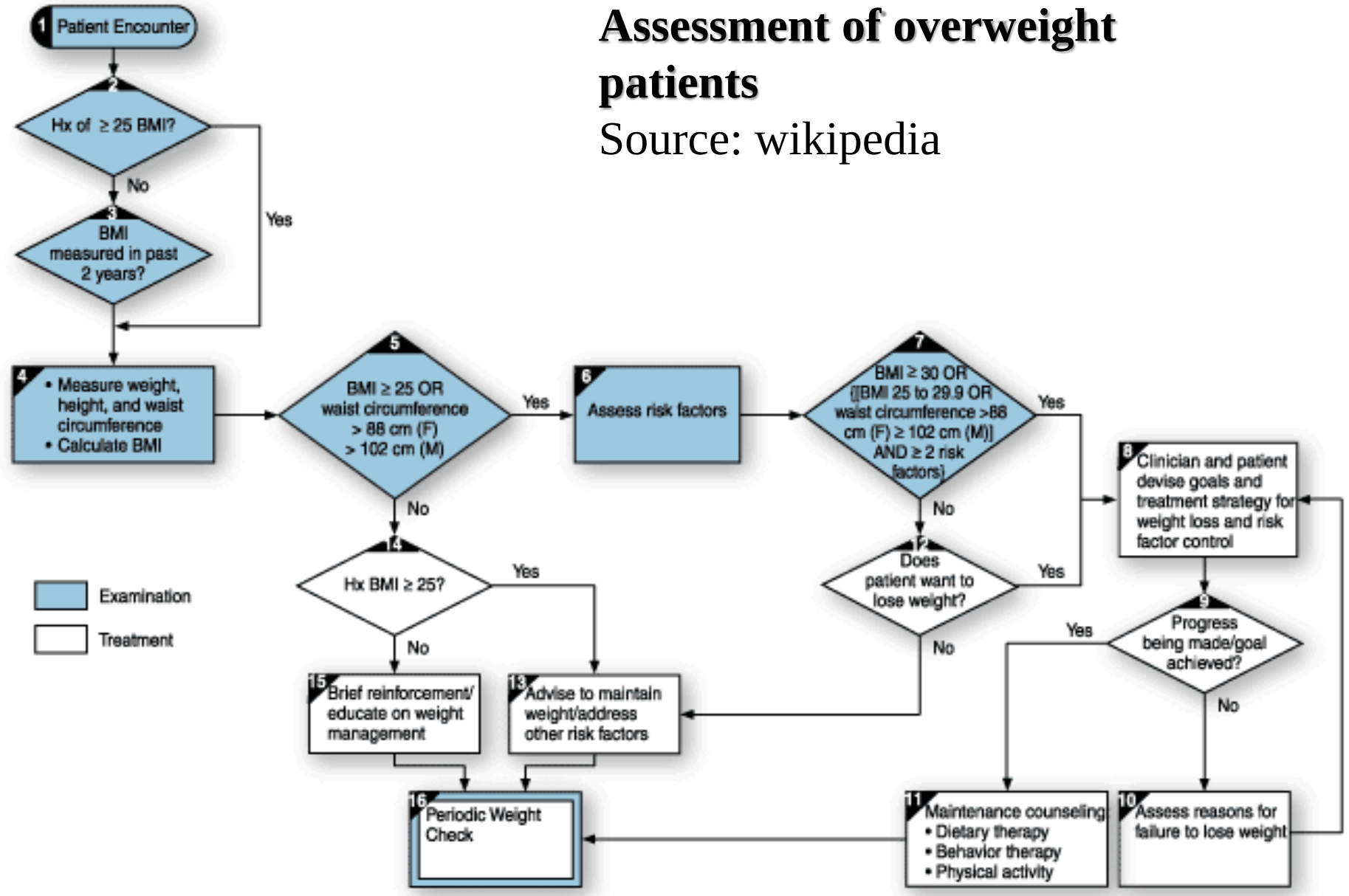
Algorithm

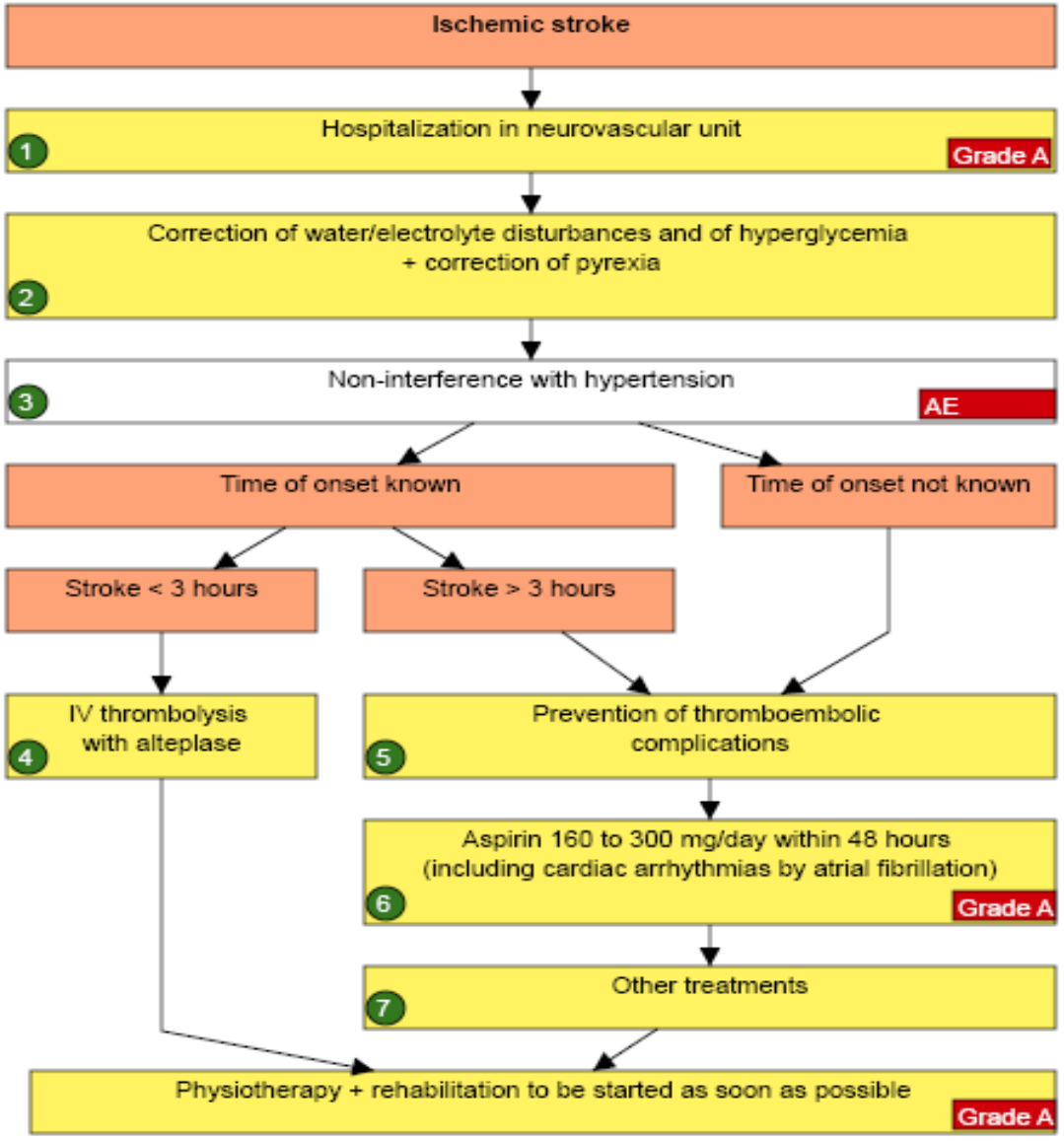
- Simplest method but really easy to understand for a MD
- Nodes (questions or decisions) & arcs
- Tree or graph
- Decision tree (theory of decision)
  - Ponderation of each node
- Vidal Recos
  - 175 algorithms for GPs
  - Paper book: quite a success (n>50,000)
  - Electronic book integrated into Vidal suite (including a drug database)

Assessment of overweight patients

Source: wikipedia



* This algorithm applies only to the assessment for overweight and obesity and subsequent decisions based on that assessment. It does not include any initial overall assessment for cardiovascular risk factors or diseases that are indicated.



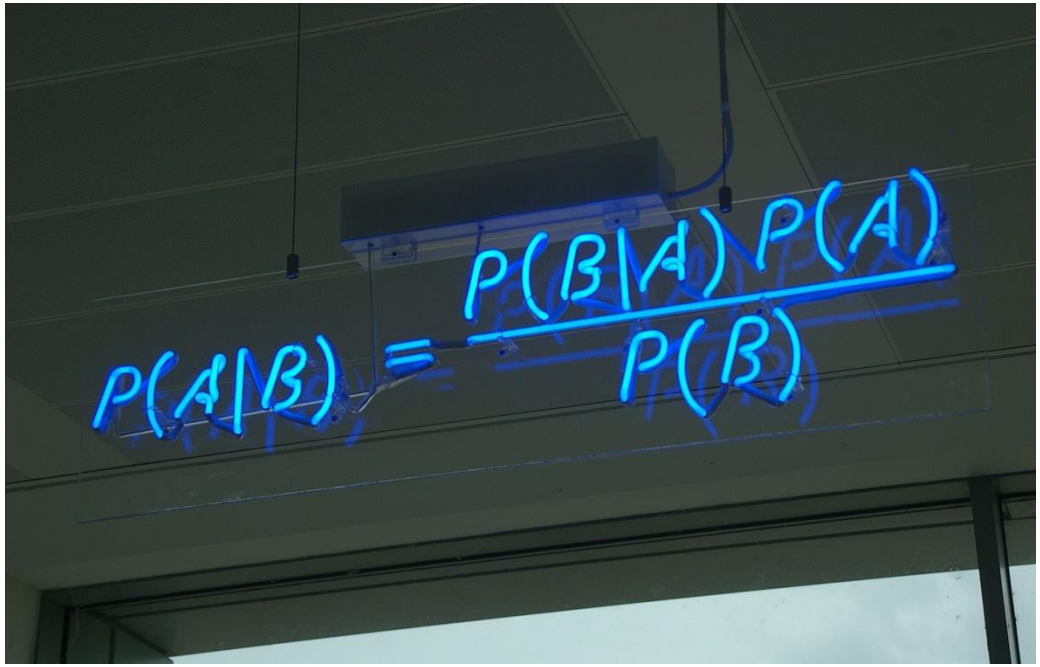
Ischemic stroke
Vidal Recos **2005**

Mainteance of CDSS +++

½ life in medicine = 7 years

PhD in SIBM (A. Merabti)
Automatic detection of knolwedge modification among tow guidelines on the same subject

Bayes theorem



Conditional probabilities

P(A/B) difficult to compute

More easy to compute p(B/A)

Each hypothesis has a probabiilty, which evolve according to the presence or absence of a sign (or a procedure)

Stop if a threshold is obtained

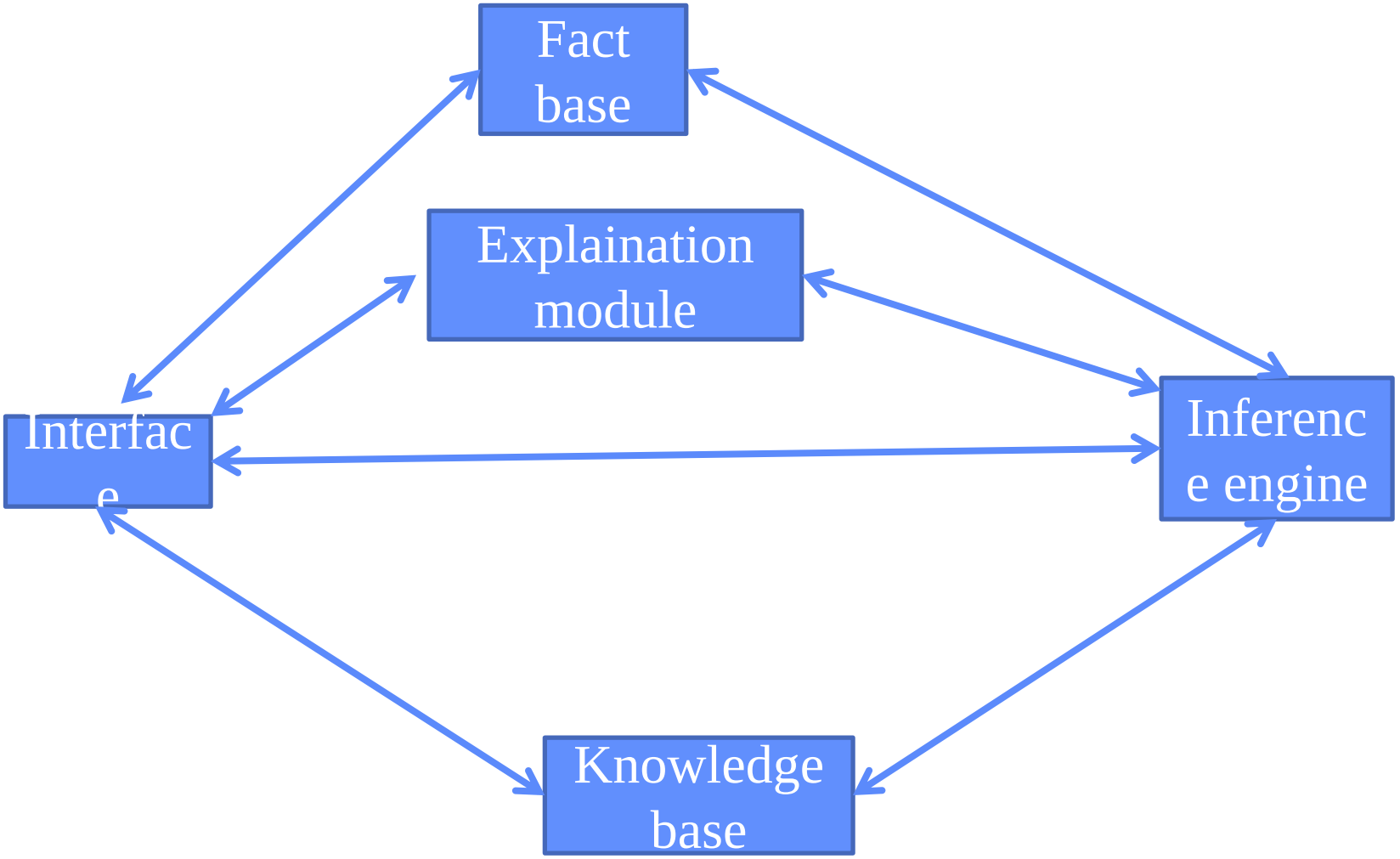
Population database necessary+++

One of the most famous CDSS in the history
De Dombal et coll. Human and computer-aided diagnosis of abdominal pain: further report with emphasis on performance of clinicians. BMJ **1974**
Leeds on ‘acute’ abdomen
As efficient as the senior surgeon
Much less efficient outside Leeds

Expert systems

- Main idea is to dissociate knolwedge and computerization (inference engine)
- Mimicking the process of human expert
- From production rules, ES are able to process the reasoning
- Production rules
  - If A and B then C
  - If thoracic pain and troponin then diagnosis = myocardial infarction
  - Introduction of a likelihood coefficient
    - If A and B then C (x), with x $\in$[0, 1]

Expert systems



Expert systems

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- From production rules, ES are able to process the reasoning
- Production rules
  - If A and B then C
  - If thoracic pain and troponin ⇧
    then diagnosis = myocardial infarction
  - If betablockers then… (explosion of the concept ‘betablockers’ to all the drugs of this therapeutic class)
- Mycin (most famous ES in medicine)
- Internist (all the knowledge of internal medicine)

Alerte fatigue +++

- Very important phenomena when HP use CDSS
- Too many alerts => stop using the CDSS
- Very well documented with drug databases (testing the drug interactions using CPOE)
  - Four levels of drug interactions
  - Only the two more serious activate an alert
    - Could be sometimes dangerous

CDSS evaluation

- Inspired by clinical trial
- Four phases
  - Phase I: validation in silico (in the lab); coherence of the knowledge
  - Phase II: evaluation in vitro (in the lab), including
    - GUI evaluation (ergonomy, +/- qualitative evaluation)
    - Feasability study: quantitative evaluation on a small sample
  - Phase III: formal evaluation
    - Randomized trial (a group with CDSS and a group without CDSS)
    - E.g. in France, current trial with/without DP in three medical specialties
  - Phase IV: post-marketing;
    - iterative evaluation over time (testing the maintenance of the CDSS)
    - evaluation outside the place of development (testing the portability)

CDSS evaluation: based on systematic reviews

CDSS are a way to overall improve healthcare

- ≈ 2/3 of published studies, use of CDSS led to an improve of healthcare
  - o Prescription are in phase with clinical guidelines (66/100 studies – systematic review of Garg in 2005
  - o Reducing the relative risk of prescription errors (8/10 studies – systematic review of Ammenwerth in 2008
  - o Reducing the relative risk by more than half of potential drug side effects when using CPOE (14/25 studies – systematic review of Ammenwerth in 2008)
- in the other cases, no improvment or worse => e-vigilance (FDA)

FIRST DO NOT HARM

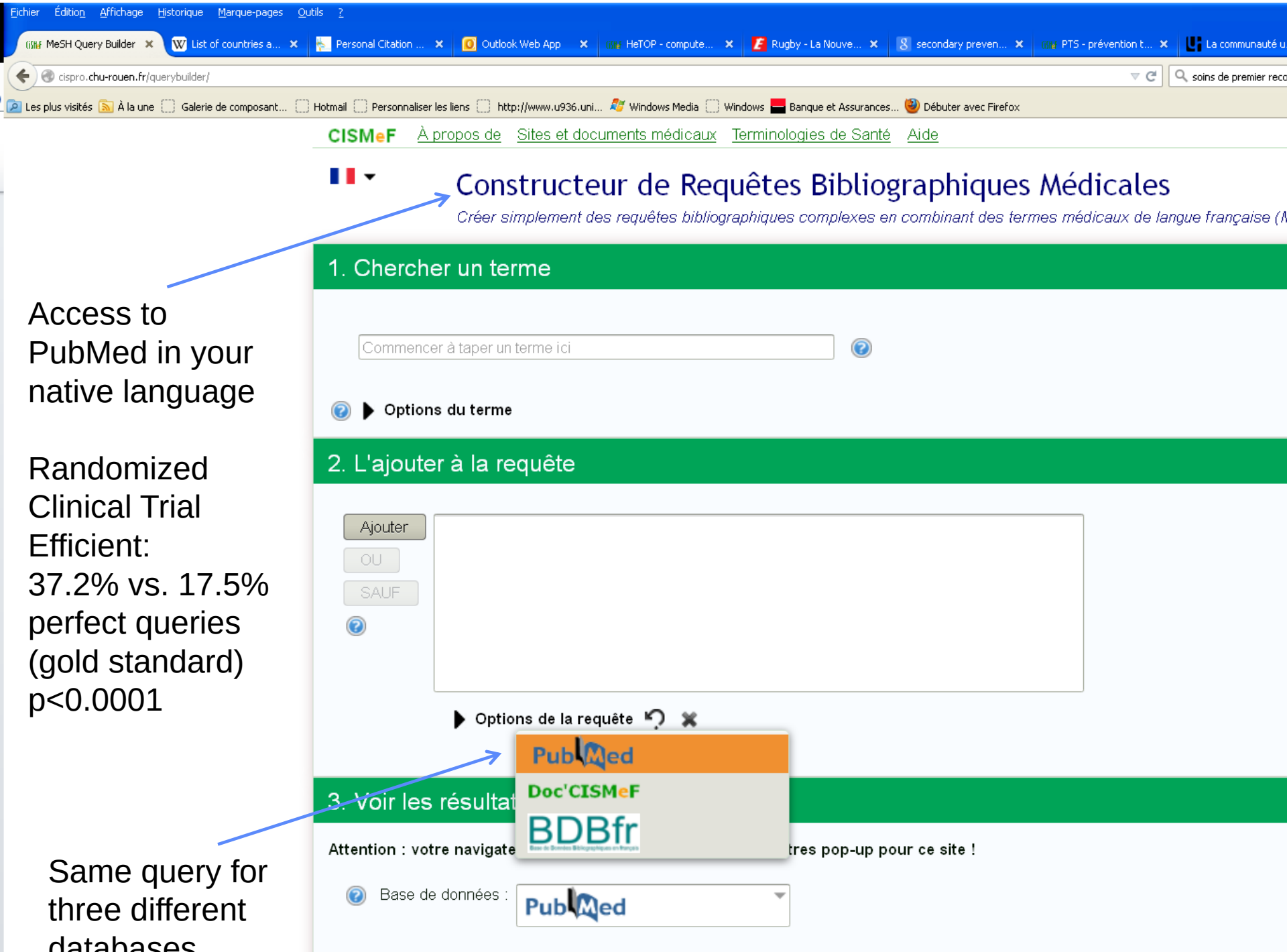
- Certification of CDSS +++ clinical information systems => CMIO (new job opportunity)
- Mean amplitude of improving are still relatively modest (systematic review of Shojania in 2010);

Significan clinical improvment :

- o 5 to 10% in ≈ 1/3 of the 28 studies ,
- o >10% in ≈ ¼ of these studies

Fuzzy limits: CDSS?

- Documentary Information Systems
  - PubMed alone **+/-**
  - CRBM: access to PubMed in Franch, automatic translation: **yes**
- InfoButton
  - Defined by JJ. Cimino (US)
  - Accessed to contextual knowledge
  - French version (D2IM)
- CPOE
  - Yes, when testing drug interactions
  - Alert fatigue +++

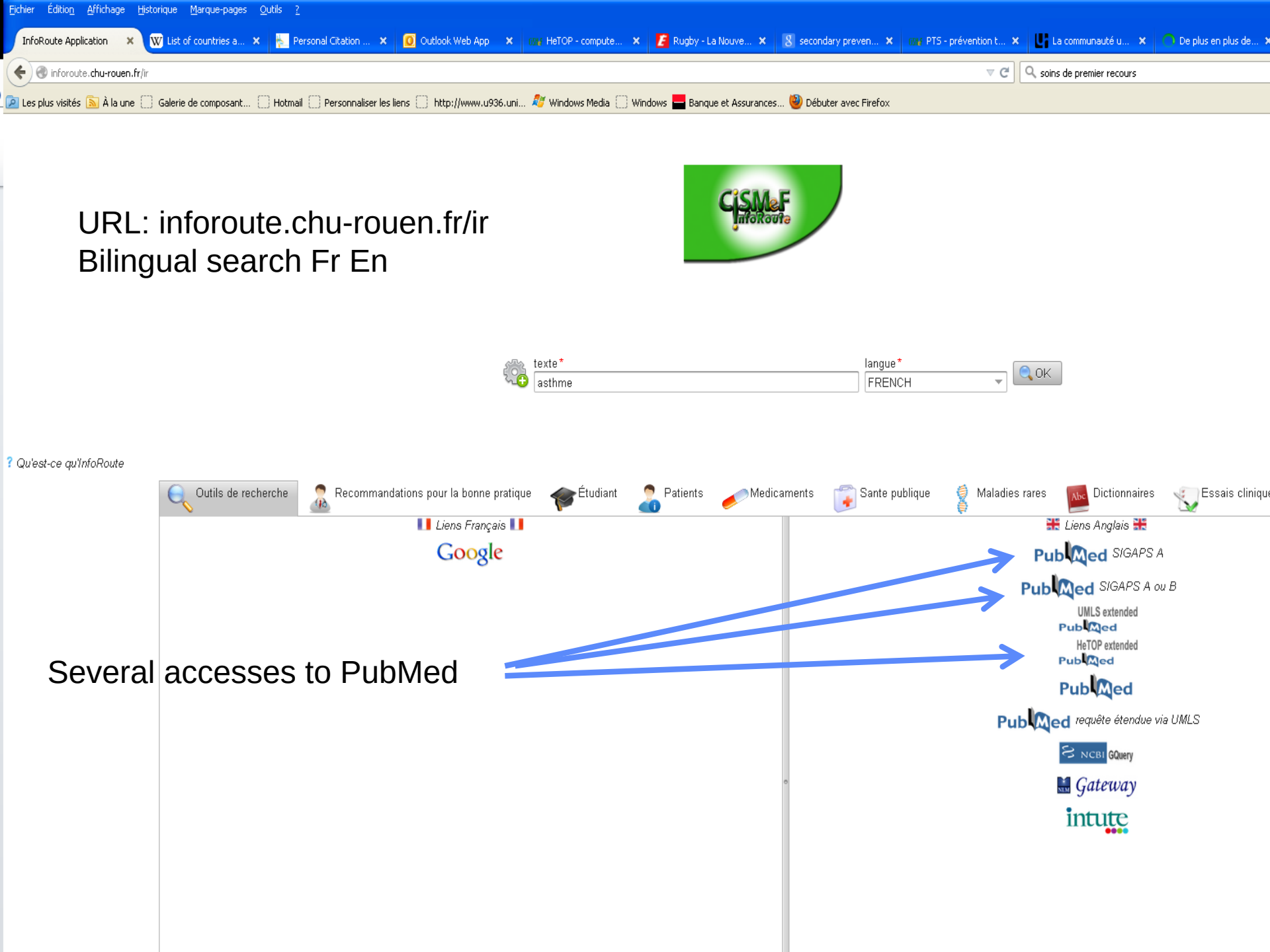


Access to PubMed in your native language

Randomized Clinical Trial Efficient:
37.2% vs. 17.5% perfect queries (gold standard)
p<0.0001

Same query for three different databases

URL: inforoute.chu-rouen.fr/ir
Bilingual search Fr En



Several accesses to PubMed

CDSS: not a big success overall

- Thousands of CDSS developped in the last 50 years
- Few were properly evaluated (randomized trial)
- Less in real use
- When in use in few institutions in the US
  - More CDSS are implemented, more the results are positive
  - Postive feedback
  - Integration of CDSS into health (hospital) information systems

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CDSS: main key factors of success

- Well adapted to work process
  - Standard forms to knowledge engineering used by CDSS
  - Integration of CDSS into health (hospital) information systems
    - Avoid double entry; avoiding double interface to manage
    - MD staying in his/her software
- Automatic triggering of CDSS, without interfering with the MDs => avoiding alert fatigue
- Providing the right information (knowledge) to the right person at the right time

CDSS: main key factors of success

- For computerized guidelines
  - Display an action and not an observation
    action: reduce the prescription of drug X by Y mg because of creatinin clearance
    observation: the creatinine clearance is diminished
  - Execute the proposed guidelines in your own EHR
    - Formalization of guidelines (RDF/XML)
    - UK NHS Quality Outcomes Framework for GPs
    - Clinical Decision Support Initiative, US AHRQ
    - In France, HAS (equivalent to US AHRQ) << Vidal (private company)

Clinical Decision Support Consortium

- Partners Healthcare (Boston)
- Department of Biomedical Informatics (Regenstrieff Institute, Veterans Health Administration, Kaiser Permanente)
- Private companies (Siemens, GE Healthcare, NextGen)
- Objectives
  - State of the art
  - Develop a model and methods to translate the knowledge included in guidelines to create efficient CDSS

GLIDES

- **GuideLines Into DEcision Support**
- Yale University + Nemours Foundation
- Objectives
  - Develop computerized guidelines about chronic diseases and primary prevention
  - Evaluate on GE Healthcare & EPIC Systems

CDSS: and now?

- National initiatives to promote CDSS
  - In Europe, besides UK and nordic countries, few countries are using CDSS
- Three main obstacles:
  - Resistance of end-users
    - Not enough integrated in the daily practice
    - Loss of time
  - Complexity and costs of CDSS KBS; huge difficulties to reuse it and to share it (maintenance +++)
    - Semantic interoperability
- Relative consensus to promote CDSS in OECD countries
  - Security, confidentiality, vigilance of CDSS
  - Certification of clinical information systems; rewarding good practice; pay for reporting; already existing in the US (FDA)

Future of CDSS?

- Artificial Intelligence
  - Deep learning: a real success in imaging
  - Few tools already approved by FDA +++ (diabetes)
  - Black box
- Integration of CDSS into health (hospital) information systems
  - Already a fact in four main institutions in the US
- Apps
  - Calculation of several paramters (BMI)
  - Internet of things
    - Integration of Internet of things into health (hospital) information systems => semantic interoperability

Trois critères pour faire le bon choix

- un contenu fondé sur des données probantes et fiables sur le plan clinique (données actuelles de la science ; EBM en anglais) ;
- la possibilité d'utiliser le SADM au chevet du patient lors de la pratique clinique ;
- des informations aussi actuelles que possible.

Ce document a été réalisé par la Cellule TICE Médecine de la Faculté de Médecine de Rouen (Courriel : Florence.Charles@univ-rouen.fr).