

# How Doctors Think



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# How Doctors Think

Disclosing medicine to patients and programmers  
Strengthening the patient-doctor-programmer dyad

August 14, 2019

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Hans Hendrickx & Linda Lorenz

# How Doctors Think

## Part 0. Introduction: New opportunities for best healthcare

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August 14, 2019

This series of blogs about 'How Doctors Think' intends to analyze in detail how doctors arrive at diagnosis, advice, and therapies. Understanding these processes is valuable not only for doctors, but also for patients, programmers, and 'saviors of medicine,' who try to solve the perceived crisis of healthcare in their peculiar ways. These blogs follow the 'workflow,' as opposed to the 'cookbook medicine' and simple protocols or guidelines, which too often lead to tunnel vision and errors. Our vision is that explaining the essence of the medical domain to the patient and the programmer will demystify medicine. And thus, helps understand routes to help further the patient-doctor-programmer dyad by together creating essential tools for best healthcare.

Tools: [Domain 'Patient' - II](#) | [Domain 'Doctor' - II](#) | [Domain 'Programmer' - II](#) | [the Dyad](#)

## The problem of healthcare

Medicine has become [industrialized](#) and [commercialized](#). Over 50 years, I, first author, have seen medicine brutalized by marketers, politicians, architects and IT-companies, who promised to solve all 'problems of medicine' by [political choices](#), [Disney formula](#), '[healthcare needs leaders](#)', '[healthcare-needs-privatization](#)', [healing buildings](#) with *à la carte menus*, and the 'biggest solution ever invented by man', [the Electronic Patient Record](#), and the so-called [digital hospital](#). The problem is that all these developments have [cannibalized healthcare](#) to the bone, and have caused [closures of hospitals](#), and [moral injury](#) and [burnout symptoms](#) in 50% of healthcare workers. Forgotten is, that there are patients who go to doctors, and they want their problems fixed. [William Osler](#) talked about "The good doctor treats the disease, the best doctor the patient." It all is about the patient-doctor dyad and both their contexts. [Medicine is in demise](#).

This series of blogs intends to describe the essential elements of medicine that need to be supported and

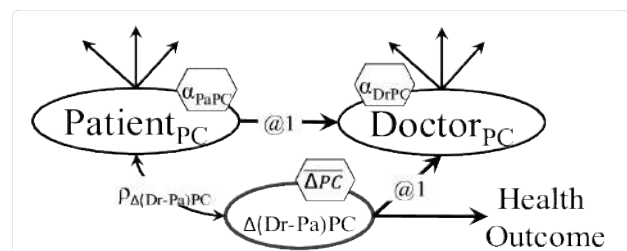


Figure 1: Medicine is about patients, doctors, and their contexts. [in](#) [DOI](#)

nurtured. We focus on the first face to face of patient and doctor because that very first encounter lays [the grounding for the patient-doctor dyad](#). The standards for this process have developed over 5000 years.

[Medicine has been brutalized](#) and needs to reinvent itself. [Porter and Kaplan](#) discovered that in healthcare it is all about 'the patient'. It seems, to economists this was a surprise. This series of blogs describes how patients and doctors formed for over 5000 years an effective team, that now can be supported by modern [IT and infrastructures](#). To do so, they need to team up with the best programmers.

"The solution is NOT that complex...Re-create the position of the patient. From patient-central into be embraced in the (treatment) team."

*Porter and Kaplan* [Source](#) | [Video interview](#)

## How to turn the tide?

If the conclusion is that indeed medicine needs modernisation, it is logical to study [the core business](#), not to follow [hypes](#). Many doctors have improved their workflow, their diagnostic skills, their understanding of medicine, diseases, symptoms, and treatments. Doctors publish a lot, and medicine has a long tradition of systematic sharing their findings. Medicine borrowed systematic recordings from [astrological observations](#),

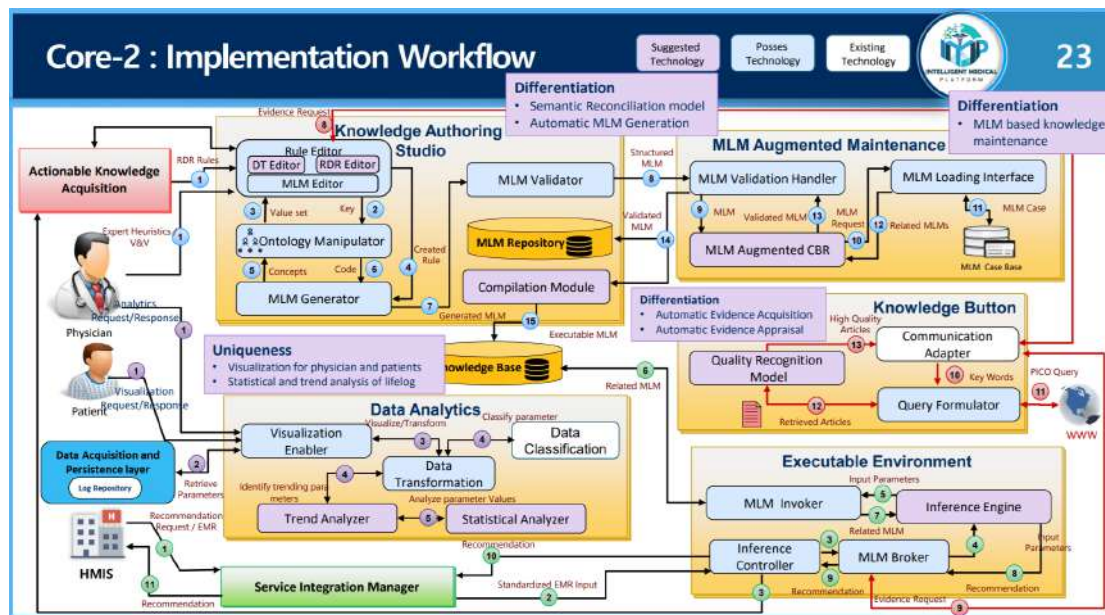


Figure 2: This is the best medical care architecture we found in literature. Please view the stages and workflows carefully. [🔗](#) [🔗](#)

and has used case reports for over 5000 years. The organisation of patient-data has been copied from the [casebooks](#) used by lawyers.

Our focus is on the first encounter of patient and doctor. This encounter has been upgraded by evidence-based methods as described by [Smith et al.](#) and by [Tierney et al.](#) Medicine is a self-learning domain and needs once more to [reinvent itself again](#).

## Can programmers help?

The modernization of medicine could be supported by [meaningful health solutions](#) created by programmers. Yes, but only if it is a [joined venture](#). In the 70-ties, [Harry Pople](#), a programmer, and Jack Meyers, a doctor, discovered the power of teaming up these two disciplines. They created [Caduceus](#), the first digital diagnostic tool.

The most logical step is to start at the first problem patients encounter when they have a medical complaint, which is 'Do I need a doctor?' If the patient decides to see a doctor, the next problem is [how to present the case?](#) For the doctor, the biggest problem is [how to get all needed information?](#)

We explore the patient journey in detail and show the complexities and resistances to effectively practice what doctors is [taught in medical school](#).

IT has to offer a lot to medicine because doctors have to digest [information](#) constantly, always under [time-pressure](#), and work in an environment with frequent [interruptions](#) and [stress](#). Also, IT has to offer patients a lot. As Pople and Meyers discovered, doctors think and work differently from programmers. Yet, they can mix their domains to arrive at good products. Only recently tools have become available to teach doctors to program and to teach programmers medicine. This




Figure 3: Medical history taking is time-consuming. [Medical History Video Medical Council of Canada](#)

series of blogs intend to help that process, to build multi-domain-teams between patient-doctor, [doctor-programmer](#), and patient-doctor-programmer. These teams open routes to [democratize medicine](#) and [programming](#).

## Links to good eHealth

[Do I need a doctor? - II](#) | [Healthnetwork Brussels](#) | [OneMedicalPassport](#) | [Isabel Diagnostic Help](#) | [Reviews of eHealth](#) | [Workflows in Medicine IMP](#) | [Resistances to eHealth](#)

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# How Doctors Think

## Part 1. Basic diagnostic support

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August 14, 2019

Patients want to know the cause of their symptoms. To illustrate the basic process of finding the diagnosis, this blog describes the way Dr. White solves a problem of fever in animals. He created this basic database for Diagnostic Support 'Consultant' in the 70ties. We demonstrate how doctors use the basic and efficient technique of 'search in a known set. 'Fever' in animals has over 800 possible diagnoses. After triage and making use of context, the number decreases to 32. From there it remains a complex process to solve the case.

Tools: [Consultant](#) | [Vet Triage](#)

## Emergency call

Dr. White receives a call about a 3 years old warm-blooded otherwise healthy stallion Blacky with a fever of 43.9°C. He likes to be thorough, 'Every patient, a triage'. This means that he wants to evaluate the need, extent and time frame, for life-saving care. Normal horse temperature is up to 38.5°C. In casu the temperature is 43.9°C, so Dr. White is alarmed and asks several questions about the vital signs: Q1. How is the horse breathing, how high is the pulse rate, and Q2. is he behaving normally? Answer: Breathing is 50/min, which is higher than normal up to 18/min; Heart rate is 85/min, which is too high for his age. The answer: The behavior is that the horse is much less active than normal, but sometimes is restless, a sign of colic.

This means there is a reason for him to see the horse within 30-60 minutes. Q3: Did the horse exercise excessively or could he have heat stroke? Answer: No. That means there is no reason to assume the high temperature is based on hyperthermia. Q4: Did he drink properly? Answer: No, only a few liters in the last 12 hours.

Dr. White knows that he should investigate further within 30-60 minutes and asks the owner to give the horse some extra water, pending his arrival. He should check the temperature, heart rate and respiratory rate,

Category 1	Category 2	Category 3	Category 4	Category 5
Resuscitation	Emergency	Urgent	Semi-urgent	Non-urgent
				
Examples: Heart attack, major car accident	Examples: Severe blood loss, overdose	Examples: Head injury (conscious), breathing difficulties, infection	Examples: Sprained ankle with possible fracture, eye inflammation	Examples: Cut not requiring stitches, common cold
Deadline: Immediate (seconds)	Deadline: Within 10 minutes	Deadline: Within 30 minutes	Deadline: Within 1 hour	Deadline: Within 2 hours

Figure 1: Each medical encounter starts with a Triage to decide on the urgency of the appropriate medical care. [↗](#)

every 30 minutes. Dr. White thinks about the case during his trip through the fields to the stables. In his experience *not* considering the worst case scenario easily leads to tunnel vision and missed diagnosis, which is prevalent in about 40% of cases, and may lead to death or endanger the patient as well as his whole environment in case of contagious infections. Schatner has written a great overview of 'Teaching clinical medicine', a good read about how doctors are trained. Diagnosing means full hands on deck.

## Differential diagnosis

What may be the cause of this fever? First of all, Dr. White worries about the worst-case scenario, the 7+ causes in horses of sudden death and the furious diseases killing horses within 24 hours. Also, crossing his mind are deadly intoxication, fever after vaccinations and use of medications. You can try to get as grasp of the possible causes of this fever in this horse following the next steps in Consultant: search by 'signs', click 'sign list', select a system, 'all', find 'fever, pyrexia, hyperthermia', scroll down, add to signs, search for diagnosis (855 possible diagnoses!), choose species 'equine', and check again (the number is down to 308), adding colic brings the number down the possible causes to



## How Doctors Think

### Part 1. Basic diagnostic support

Search by Signs

Species: Equine

Sign Keyword: fever

Search Sign List Clear

Signs:

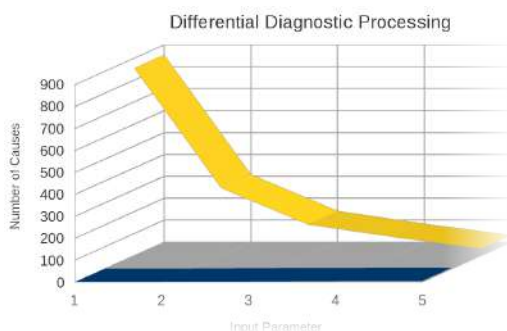
- ☒ Diarrhea
- ☒ Bloody stools, feces, hematochezia
- ☒ Fever, pyrexia, hyperthermia
- ☒ Dullness, depression, lethargy, depressed, lethargic, listless
- ☒ Colic, abdominal pain

Search for Diagnoses

32 Possible Diagnoses

Acute idiopathic colitis  
Algae, cyanobacterium, algal poisoning in large animals  
Anaphylaxis, drug, vaccine, reaction  
Anthrax, bacillus anthracis

**Figure 2:** Over thirty years, Dr. White created 'Consultant' DDS for Veterinary Medicine. Shown is the animal family and a series of symptoms and signs. The more symptoms are combined the shorter the list of possible diagnoses becomes. [Consultant](#)



**Figure 3:** Combining identifiable data with symptoms and signs narrows down the possible diagnoses, the 'query a known sample' technique. [Consultant](#)

142. At arrival, it becomes clear that during the last 24 hours Blacky has a combination of [colic and diarrhea](#). The number of possible causes goes down to 84. Blacky is becoming slightly more [lethargic](#) now, and Dr. White also finds a little [blood in the stool](#). The number now decreases to 32, of which a large number is unlikely, such as snakebite, poisoning, and a series of diseases which would have developed in slower pace. Dr. White remembered seeing a flock of geese and he remembered the [connection of salmonellosis](#) in 50% of geese and the sensitivity of [warm-bloods](#) for horse-salmonellosis.

Dr. White decides to take some blood for investigations to confirm this possible diagnosis. He also worries about infection of other horses at the stables. Blacky is taken to the vet-clinic for intensive treatment, with a variety of measures including infusions of fluids. After several days he is recovered and running around as before. Indeed, the cause of [salmonellosis](#) was confirmed.

## Context

This blog demonstrates that the technique Dr. White uses is the model of 'search in a known set.' His thinking has a [categorical approach](#). This is quite an effective method if the disease is in the set of known data. In Fig. 3 we can see that more information helps nar-

rowing down the number of possible diagnoses. An interesting phenomenon is that after medical school, doctors solve diagnostic problems more and more by presumed [probabilities](#) and [order sets](#). This makes it possible to start treatment even without knowing the cause of the disease. In medical practice often [intuitive judgment](#) and 'doubt and analysis' are used. These ways of thinking may be effective, but easily lead to [tunnel vision](#) and [failed or missed diagnoses](#). During their life, most patients experience these failures of medicine. [Knowing the Medical Context is essential](#) for quality medical care. Categorical reasoning is mainly based on *perceived* probabilities and leads to 80/20 medicine. 'To be a great physician, you must understand the whole story.', a paraphrase 150 years ago of [William Osler's](#) 'Medicine is a science of uncertainty and an art of probability'. The problem is that medicine is not codified in a known and limited set of categories.


The mental [model of distal causes](#) is a more advanced version of this categorical thinking, which involves looking beyond what *appears* to be the cause and finding the *real* cause. It can also help us to solve problems, rather than relying on band-aid solutions. ([Paraphrased from Farnam](#))

Compared to Dr. White, in human medicine, we have the advantage of far more accessible knowledge and budget.

## Links to veterinary sites

[Pet Symptom Checker](#) | [Penn Vet](#) | [Sites for Vet help](#) | [Top Vet Sites for Help](#) | [Worst Case Scenario](#) | [SOAP](#) | [Book list of vet DDx](#) | [Vet Symptom Checkers](#)

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# How Doctors Think

## Part 2. Next steps in diagnostic support

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August 15, 2019

In this blog we expand the diagnostic process with some context like gender, age, travel history, red flags and references for further study. This time, we make use of the Diagnostic Support System, DSS, Isabelhealthcare, that starts with over 3000 possible causes of fever and profuse diarrhea in a human patient. In the end, a group of 40 causes remains. The categorical and probabilistic approaches are used again. This shows that current DDS systems can only start helping doctors and that it remains difficult to diagnose even if excellent modern IT is used. IT should facilitate workflow better, step by step. Medicine remains an art and hard work.

Tools: [IsabelHealthCare](#) | [RightDiagnosis USA only](#) | [Medical History Taking](#) | [ClinicalMed UCSD](#)

## Triage for level of care

**Self-triage** Patients call for help after they have encountered a problem, in this case 'fever and profuse diarrhea', and have concluded that they need help. This process is supported by many tools, like 'Do I need a Doctor' (nl) - (en) or [symptom checkers](#) (nl) - (en). In the future, these tools need to be combined with [Emergency Apps](#), [First Aid Apps](#), and access to [emergency services](#). The [reliability of self-triage](#) still needs much improvement.

**'Professional' triage** Self-triage apps necessarily choose for 'digital models'. After patients have decided to contact medical services, they again encounter a myriad of [triage-systems](#), [phone-triage](#), [kiosk-triage](#), [video-triage](#), [voice-avatar-triage](#), [emergency-triage](#), [nurse-triage](#), [pen-and-paper-triage](#), [hybrid triage systems](#). The effectiveness is [poorly studied](#), and almost always lack direct human interaction. Often the [non-medical staff](#) is conducting the triage, which may lead to additional barriers to the proper care.

The professional triage, the first contact of health professional and patient, is becoming ever so important in an age of digitization and [dehumanization](#) of

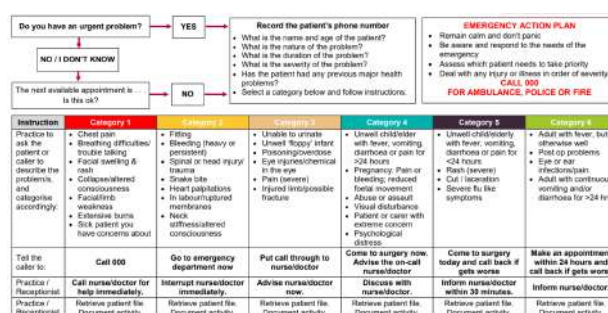


Figure 1: Phone triage system for non-clinical staff. [Practice-assist.com.au](#)

medicine. Notably, this is true during shortages of medical professionals. Triage on paper, phone or by proxy, have become an unsupervised 'normal' business-necessity (see also [Torrey](#) and [Meskó et al.](#)), at the [cost of failures](#). The patient has to put up with a lot of healthcare even before actually seeing the doctor, the prelude towards [doctor-less healthcare](#)?

## Appointment time

**Face to face** The human brain is able to not only process information from simple queries to a patient or a computer database, but also 'accepts inputs from perception, recollection, and cognition as equally valid cascading query triggers' ([Shirley in Mapping the Mind 1983](#)), and passing these concepts down as a gestalt, [Powell 2015](#). Every doctor learns the importance of [face to face contact](#), yet medicine is transforming towards a '9-5 digital office job', or worse a desk job from a [screen](#) only. Patients are diagnosed, followed and treated from [screens and hearsay](#).

After receiving a call about [fever and profuse diarrhea](#), doctors will follow the categorical and probabilistic approach described in Part 1. At first sight, this is a fairly simple process. However, patients want their doctor not to find a diagnosis, but the right one, out of 3000, diagnosis. For best healthcare the context of

The screenshot shows the IsabelHealthCare interface. On the left, the 'Clinical Features' section includes dropdowns for Age (young adult 17-29yrs), Gender (Female selected), Pregnancy (Not specified), and Travel History (Western Europe). Below these are text input fields for 'fever' and 'diarrhea profuse'. On the right, the 'Ranked Diagnoses' section shows a list of conditions with associated organ systems and red flag icons. The conditions listed are Hyperthyroidism, Thyroid Storm, Tuberculosis, Renal Failure, Acute Renal Failure, Idiopathic Postpartum Acute Renal Failure, and Toxic Shock Syndrome. The organ systems listed are Endo, Infec, and Nephro. A 'Red Flags' tab is also visible.

Figure 2: IsabelHealthCare adds Red Flags and additional information for further reading. IsabelHealthCare

the patient is obligatory, which demands the **broader context** of the patient and his symptoms, and a physical exam. Of **15 minute appointments**, -6 minutes are spent on administration, -1 minute of welcome and introduction, -1 minute of undress and washing hands, and chitchat, -6 minutes are left for the medical history taking and exam, leaving 1 minute to think about the 3000 possible causes of your fever. Half of patients get less than **5 minutes total time**.

## Short cuts

In practice, the **time pressure** of doctors leads to cutting you off after **11 - 23 seconds**, and then moving on towards red flags, mnemonics or common causes, and escapes like 'if the complaint gets worse come back.' Instead of thinking about the real diagnosis, thinking becomes tunneled towards the most common cause. Within one minute, even 80/20 medicine is too much to manage. In later blogs, we will discuss in more detail the use of thinking techniques and resistances to best healthcare, and why doctors get **burn out from moral injury**.

**Red Flags** Red Flags are signs and symptoms which may direct us towards either **killing and furious diseases or conditions**, 20 in this case. Red flags for fever are for example very high fever, epileptic insult, and skin rash related to lethal meningitis; for diarrhea dehydration or shock, see figure 3, are well known red flags.

**Skipping medical history and physical** The diagnostic process demands time and is very complicated. Every experienced doctor will have a long **list of misdiagnosis**. Neglecting detailed medical history taking and considering all context are literally lethal practices. Wachsman Reliance on the **patient's self-diagnosis** and **reliance on AI** are negligence.

## New technologies are needed

The tools shown in these blogs show that **humility** is an asset for each doctor! **'Physician, humble thyself!'** BMJ 2009 Also, they show the challenge programmers in healthcare face. **Good IT is difficult**, as well.

Table 1. Clinical Red Flags for Serious Infection in Children Older than One Month

Global assessments	Circulatory/respiratory	Other factors
Parental concerns	Crackles	Decreased skin elasticity
Physician instinct	Cyanosis	Hypotension
<b>Child behavior</b>	Decreased breath sounds	Meningeal irritation
Changes in crying pattern	Poor peripheral circulation	Petechial rash
Drowsiness	Rapid breathing	Seizures
Inconsolability	Shortness of breath	Unconsciousness
Moaning		

NOTE: These red flags are associated with a positive likelihood ratio of greater than 5 for serious infection in this population.

Figure 3: Red Flags play an important role in each triage, starting at the self-triage. Professional use of red flags can be divided into several layers, **context triage**, **symptom triage** and **disease triage**. HAMILTON 2013

In these blogs we describe in detail the workflow and parallel thinking process of doctors. The demonstrated tool by Isabel shows the beginning of good diagnostic help. However, it should adhere to the principles derived from of **Curly's law**, combine other short cut techniques such as **pathognomics**, **mnemonics** and **most important symptom clusters**. It should give the **breadcrumbs** of the processing it does, and the **algorithms** it uses to facilitate the workflow of diagnosis.

The secret of best IT in healthcare is **'Follow the thinking of the doctor.'**

## Links to symptom checkers

InferMedica Symptom Checker | BabylonHealth | EveryDayHealth | ScienceDirect about SCs | PubMed on SCs | PubMed on SCs | ThuisArts | Moet ik naar de Dokter | Fever in children below 36 months

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# How Doctors Think

## Part 3. Online diagnostic search support

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August 15, 2019

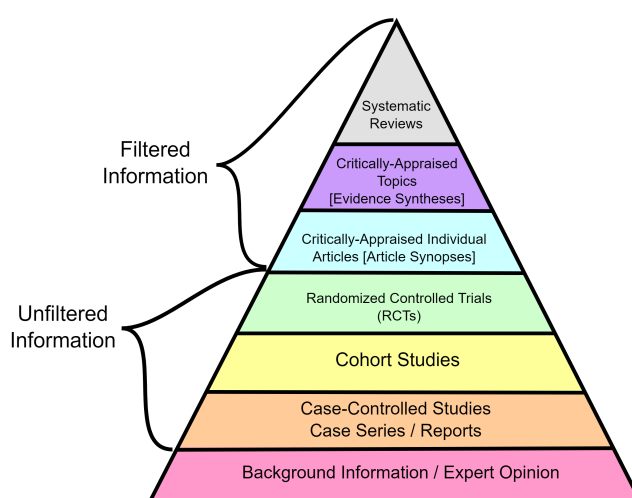
**L**ike in previous blogs, we use fever as the common lead-symptom to illustrate our message 'Good Health-IT follows the thinking of the doctor.' We can find online information about fever. However, over 400.000.000 online fever-resources is overwhelming. Several tools and tricks may help to find the needed information to assist diagnosis. Despite all this information, Fever of Unknown Origin, FUO, and fever, in general, remains a big problem, not only in underdeveloped countries. The challenge is how to scrape, store, categorize, and present all this information. We show how doctors think, and how information should be disclosed to be helpful during a 5 minute appointment.

Tools: [Google](#) | [Health refdesk](#) | [NCBC](#) | [HON](#) | [HeathDirect](#) | [How to recognize ... \(your search\)](#) | [Health A..Z](#) | [Meds A..Z](#) | [Algorithms](#) | [Red Flags](#) | [Intelligent Medicine Platform](#) | [CDC - NHL](#) | [NICE](#) | [QLD](#) | [Symptom ontology](#)

## Search online

Solving the diagnosis for fever starts with knowledge. With 342 million hits, [Google](#) is an overwhelming start. Luckily, [RefDesk](#) has a google tool to select only the more relevant sources. Still, the search for 'fever and skin rash' presents millions of hits. The [US National Medical Library](#) gives 30.000 hits, [PubMed](#) 3.657 articles. [Honsellect](#) provides a list of 74 medical terms first, then the selection of 'fever' offers a myriad of related context terms and specific sites, which are considered trustworthy.

With [Honsellect](#), if you know or consider a specific diagnosis, like for example hyperthermia, you may find very informative information with more palatable numbers. Google finds 127 million hits, [HON](#) finds 1 with less than 40 specific references. Although these tools provide useful information, none of them follows or assists the thinking process of doctors. Patients should use specific questions like 'What is the normal temperature in my baby?' at [Healthtap](#), or go to sites



**Figure 1:** To search for trusted medical information is difficult. Unfortunately, often, trusted materials require payments. [↗](#)

like [Thuisarts NL](#), [NHSInform UK](#), [FamilyDoctor USA](#). Even better is to look for sites that make use of context data, like sex and age, and check for combinations of symptoms, like [thuisarts NL](#), [HeathDirect AU](#), or sites like 'Moet ik naar de dokter'.

## Literature

The production of peer-reviewed medical literature has exploded. In 2009 all scientific publications since 1665 passed the 50 million mark. Each year over 2.5 million articles are added. [Boon](#) Medicine takes a massive chunk of all these publications, [Medline](#) indexed over 900.000 new articles in 2018. Medicine has [over 130 sub-specialties](#) and worldwide pharmaceutical clinical testing expenditures alone account for over [50 billion USD](#). R&D spending is increasing more in healthcare than in any other industry. These activities lead to this overwhelming amount of publications.

The medical literature is dominated by English re-

sources like Medline. However, finding good publications in other languages is possible, f.e. [Chinese](#), [German](#), [Spanish](#), [Indian](#), and is available in translated texts. We always look for suitable [open-access materials](#), like for example [Omnic](#)s or [Dovepress](#).

## Books

Books can be found through [Google](#), [Springer](#), [Amazon](#), or find free books through [Freebooks4Doctors](#).

[Merck manuals](#) provide secure online access to trustworthy information, including [Merck manual for patients](#), and [for doctors](#).

## Programmers can help doctors

In previous blogs, we have shown how doctors are trained to use [algorithms](#) and [mnemonics](#) for inference. These types of inference are good for creating shortcuts to limit appointment times. However, it does not provide best medical care. Daily, as a doctor, I have experienced the dilemma of time pressure versus quality.

Programmers are good at creating tools to online view [XRays](#), [laboratory results](#), [to email online](#), maintain protected [documents filing systems](#). However, they lack knowledge of the medical domain. That is [why doctors, and programmers teamed up](#) since the [70-ties](#). ([kqed.org](#))

In this series of blogs, we hope to bring doctors and programmers together by lifting the veil of both domains, to further the [participatory design of medicine](#). Doctors need [IT that is designed](#) for the good of patients and doctors, follow their workflow and thinking.

"..doctors with basic coding skills could think about medicine on a systems-level.."

Matthew Wetschler [Source](#)

### Add context to find better information:

- | [Fever general](#)
- | [Fever of unknown origin](#)
- | [What is fever?](#)
- | [What is hyperthermia?](#)
- | [Fever patterns](#)
- | [How to recognise fever?](#)
- | [High fever >40](#)
- | [Low grade fever 37.5 - 38](#)
- | [Low temperature and septic shock](#)
- | [Red Flags in children](#)
- | [Red Flags in adults](#)
- | [Red Flags in elderly](#)
- | [Red Flags traveling](#)
- | [Red Flags in pregnancy](#)
- | [Red Flags with heart valve](#)
- | [Red Flags with transplants](#)
- | [Fever + vaccinations](#)



**Figure 2:** 'It is impossible to know what is trustworthy medical information. Best is to select sites from known and trusted sources.' [HON](#)

- | [Long lasting fevers](#)
- | [Incubation times of infections - Terms explained](#)
- | [Latent times of infections](#)
- | [Waiting period times of infections](#)
- | [Infectious period times of infections](#)
- | [Quarantine of infections](#)

- | [Red Flags fever + Diarrhea](#)
- | [Red Flags fever + Skin rash](#)
- | [Red Flags fever + Skin rash Images](#)
- | [Red Flags fever + abdominal pain](#)

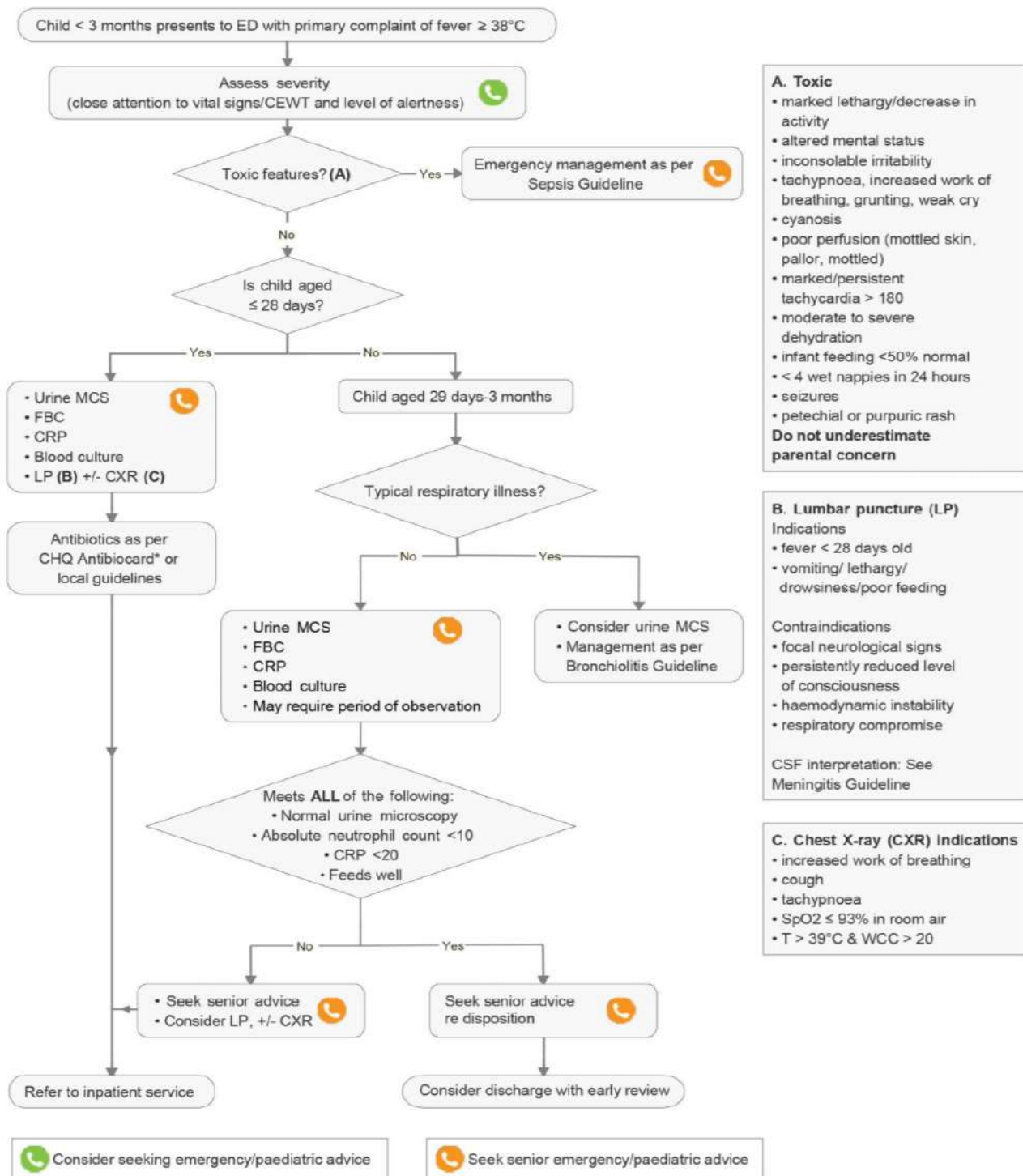
- | [Fever and viral infections](#)
- | [Fever and bacterial infections](#)
- | [Fever and zoonosis](#)
- | [Fever and fungi](#)
- | [Fever and food](#)
- | [Fever and plants](#)
- | [Fever and intoxication](#)
- | [Fever and radiation](#)

- | [PubMed on Symptom Checkers](#)
- | [ThuisArts](#)
- | [Moet ik naar de Dokter](#)
- | [Fever in children below 36 months](#)
- | [Self-Triage](#)
- | [IT helps doctors?](#)

- | [Wikipedia](#) | [Wikihow](#) | [Wikiversity](#) | [Wikidata](#)

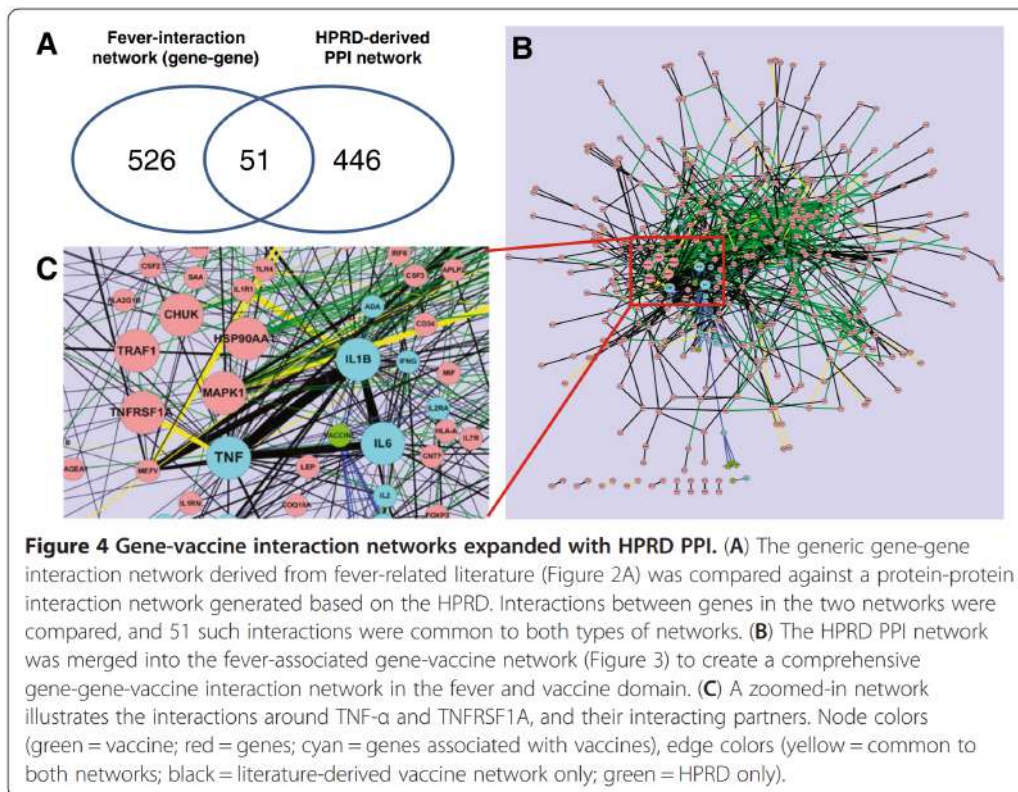
[MPOSP](#) envisions a world where patients create and share their own professionalized Casebook. They become true healthcare-team members.

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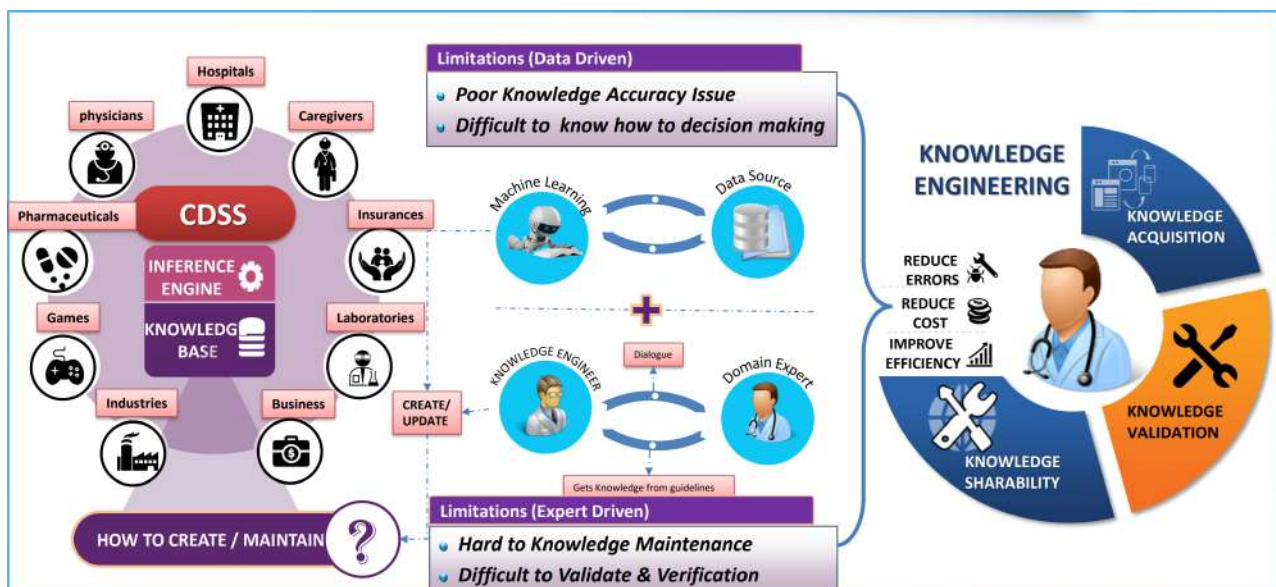


**Figure 3:** This algorithm, part of a guideline, is an excellent example of online help for doctors. It contains triage, red flags, symptoms, diagnostic and therapeutic suggestions. It also indicates the needed level of expertise. Now, study this algorithm and imagine the complexity for doctors under pressure of missing a furious and deadly disease. For programmers this sample illustrates the complexity of medicine, and the challenges to create workflows with normalisation of Expert Knowledge. Also, how would you use AI in this situation, knowing that the wrong decision tree easily kills the patient within the next 24 hours? [childrens.health.qld.gov.au](http://childrens.health.qld.gov.au)





**Figure 4:** The conclusion of this big data mining study: "Our ontology and centrality-based literature mining strategy identified genes and their potential interactions in the general fever interaction network and a subset of genes and gene interactions in the vaccine-specific fever interaction sub-network." Fever after vaccination is a serious clinical problem. For doctors to determine the diagnosis is a challenge. Fever can be caused by bacterial, viral, fungi, parasitic infections, medications, cancer, auto-immune diseases, surgery, prions, heat stressors, vaccinations, radiations, intoxications. This is not a complete list. The logical step to take is to assist patients before they seek medical assistance, to help them prepare before an appointment, to assist the workflow of their doctor by sharing professional context review of symptom, medical history, and context. With the results of this study, it remains the question how to integrate this knowledge into daily workflows of doctors. [Hur et al. 2012](#)



# How Doctors Think

## How Doctors Think Part 4. Probabilistic reasoning

Hans Hendrickx MD PhD<sup>1</sup> and Linda Lorenz MSc<sup>2</sup>

<sup>1</sup> MediPrepare Open Source Project, Zeist, Netherlands [in](#) [DOI](#)

<sup>2</sup> VUmc, Amsterdam [in](#) [DOI](#)

August 15, 2019

This blog gives some examples of the frequent use of probability in medicine, art of probability. We demonstrate some tools to explain how the percentages of the presence or absence of a symptom could help. We make use of two examples, 1. the diagnostic value of fever in Group A Hemolytic Beta-Streptococcus pharyngitis, GAHBS-infection of the throat, and 2. the diagnosis of subgroups of sleep apnea. Simple algorithmic reasoning is helpful; adding statistics improves diagnostic accuracy at the expense of even more complexity. Scientific data are available in large amounts. However, because of time pressure, doctors have to make choices based on experience, and they have to deal with uncertainty at each patient encounter. Even using available data does not solve all diagnostic challenges. 'Medicine is a science of uncertainty and an art of probability' and will remain so for a long time to come. [Science Based Medicine](#)

Tools: [Bayesian Calculator](#) | [Medcalc](#) | [CER, EER, NNT, ARR, RRR calculators](#) | [demo calculator numbers](#) | [Questionnaires scoring complexity](#) | [Probabilistic reasoning](#)

## Probability calculations

**Is fever indicator of GAHBS?** [GAHBS](#), Group A Hemolytic Beta-Streptococcus, causes 500.000 deaths worldwide. [It presents with a sore throat.](#) A virus or bacteria can cause a sore throat. The last one, GAHBS, needs treatment with antibiotics.

Go to the [calculator](#) and set the prevalence of fever at 0.1 (10%) for patients presenting for an appointment with pharyngitis (sore throat).

In GAHBS, the true-positive rate of fever is 0.24 (24%). If GAHBS is not present, the so-called false-positive rate is 0.11 (11%), more than doubling the chance of hitting the right diagnosis.

**Is nasal congestion an indicator of GAHBS?** In GAHBS, nasal congestion is absent in 0.51 (51%), in a viral cause of sore throat nasal congestion is absent in

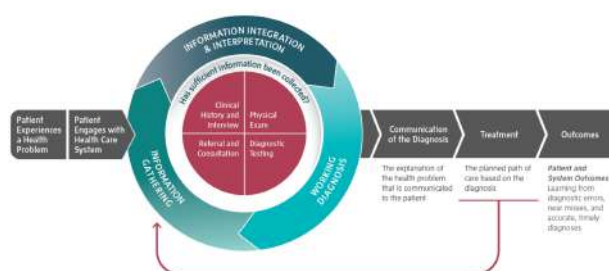


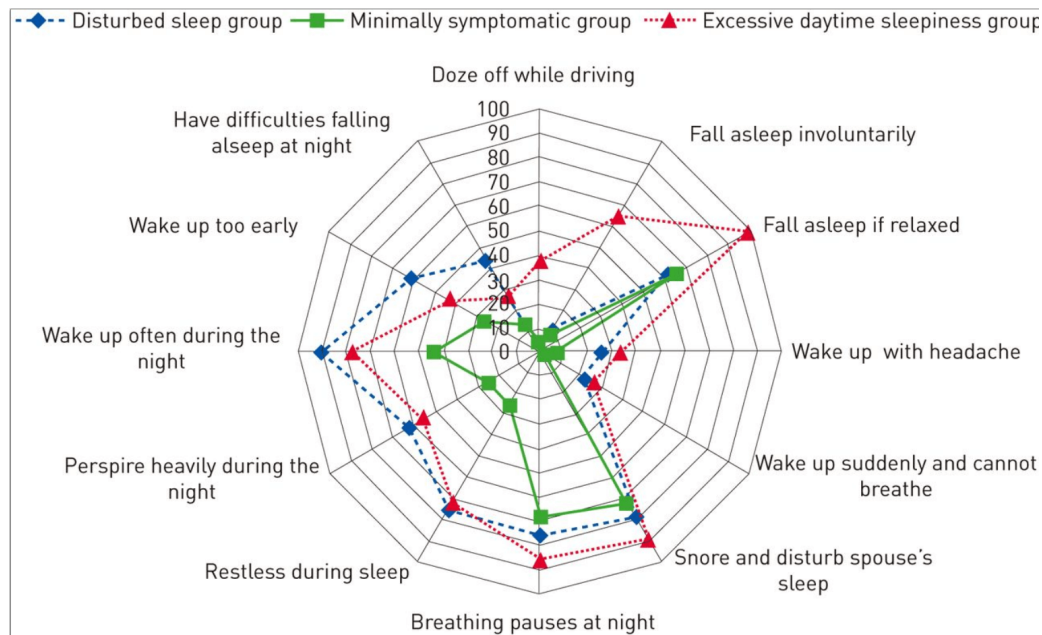
Figure 1: The diagnostic process, image from the Institute of Healthcare Improvement can split up into small processes with their specific characteristics of probability. [↗](#)

0.378%. In this case, we see that not having nasal congestion seems to increase the likelihood, 0.13 (13%). Thus, the *absence of a symptom* may help to find the right diagnosis.

**Breast Cancer and mammography** Use the [Bayesian Calculator](#). The prevalence of breast cancer in women is 0.008 (0.8%). Mammography finds 90% of those cancers with a sensitivity of 0.9. With 1000 women screened, the percentage of false-positives is 7% with a specificity of 0.92 (93%). From the calculations, we see that of these 1000 women, 8 have breast cancer, 1 cancer will not be detected, 69 will be false-positive tested. In the 76 positive tests, 7 (9%) will indeed proof true-positive.

**Combining symptoms** [Sleep apnea](#) can be diagnosed by careful [Medical History](#) taking. The symptoms can group into disturbed sleep group, minimally symptomatic group, and the excessive daytime sleepiness group. In their article [Baily et al.](#) have calculated, see fig 2 and view online, the [OR, odds ratio](#), of symptoms. Modern data science tools like the assembly of [software packages in Anaconda](#), make it possible to analyze and graphically translate all these statistics into useful information.





**Figure 2:** The cluster diagnosis of sleep apnea. *Bailey et al.* The presence of a *pathognomic sign or symptom* means that a particular disease is present beyond any doubt. In this case, one of the mentioned signs, 'Fall asleep if relaxed,' is such sign.

## Medical Statistics

**Medical Statistics** is the science of summarizing, collecting, presenting and interpreting data in medical practice and using them to estimate the magnitude of associations and test hypotheses. The above examples show how medical statistics is used. However, it also shows that applying group statistics to individual patients creates new uncertainty and *decision-stress*. *Raha* criticises statistical hypothesis testing in clinical research. *Masic et al.* on EBM: "Evidence Based Medicine: is a conceptual approach of the physician in making decisions related to the individual patient."

In clinical practice, we always should ask the question "What if this patient is the Queen or King, or my child?" In that case, even if the statistics on sore throat indicates that it probably is not caused by GAHBS, I still would consider prescribing antibiotics. The reason is the probability of death.

In medical statistics several *paradoxical phenomena* are well described, such as the *Simpson's paradox* and *Berkson's paradox*. Statistics help us understand medicine much better, but it does not replace human medical decision making.

Interesting in general is the *Paradox of Primary Care*, which states that spending more money on Primary Care may paradoxically lead to more deaths. The explanation probably is that results depend on the difference between groups of care, patients with specific diseases, multi-disease patients, or all groups together. *Probability in medicine* remains a probable probability.

"99 percent of all statistics only tell 49 percent of the story."

*Gents with no cents, Ron DeLegge II* [Source](#)

## Programmers can help doctors

Doctors need help to harness the overwhelming stream of data and master continued uncertainty. Programmers should be realistic about big and small data analysis. After many years of boosting *Dr. Watson*, IBM, can surpass oncologists, it has arrived in Gartner's '*Through of Disillusionment*'.

As health professionals, we believe that programmers first should focus on putting patients to work as a team member and *workflow improvement*. In figures below we give some samples of meaningful projects. These projects are parts of the *IMP-IT-Architecture*. A primary task is to create access to data in intuitive ways, such as developed by *TheBrain*, which originated 25 years ago out of the game industry. The age of *gamification of medicine* has arrived and may link medicine and programming.


## Links to data science in medicine

Patients can help: [Prepare Appointment](#) | [Write your own medical history](#) | [MediPrepare](#)

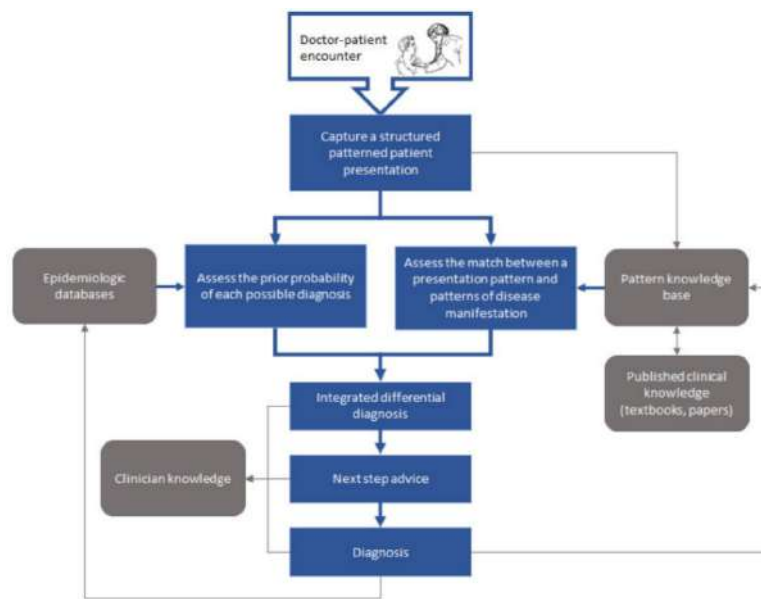
Doctors can help: [Doctor-Programmer Dyad](#) | [Dr. Data Scientist](#)

Programmers can help: [Visirule \(Prolog AI driven questionnaire\)](#) | [HumanBrainProject](#) | [Intelligent Medical Platform](#) | [TheBrain](#)

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## How Doctors Think How Doctors Think Part 4. Probabilistic reasoning



**Figure 3:** Cahan et al. have written 'A Learning Health Care System Using Computer-Aided Diagnosis,' a must read for programmers who intend to help healthcare professionals, a must-read. [Cahal et al.](#)

Major associated signs and symptoms								
Common causes	Breast nodule	Erythema	Fever	Itching	Lymphadenopathy	Nipple discharge	Nipple retraction	Peau d'orange
Areolar gland abscess	•		•					
Breast abscess (acute)	•	•	•					•
Breast cyst	•							
Fat necrosis	•	•					•	
Fibrocystic breast disease	•					•		
Intraductal papilloma	•					•		•
Mammary duct ectasia	•	•		•	•	•	•	•
Mastitis	•	•	•				•	
Sebaceous cyst (infected)	•	•						•

**Figure 4:** This matrix is a typical representation of tables created by [Prolog based AI processing](#). In medicine, doctors rely on information about major symptom groups to help to diagnose. [Lippincott](#)

## F



Facial pain - red flag symptoms

7 Feb 2018



Fever in adults - red flag symptoms

CPD 23 Jan 2018



Fever in children - red flag symptoms

CPD 9 May 2018

CPD

**Figure 5:** Red Flags are signs and symptoms that flash alerts to severe or deadly diseases. After collecting the current complaints, Red Flags should be investigated first to avoid misdiagnosis with serious consequences. [GPOne A..Z](#) View the [NICE](#) 'Traffic light system for identifying the risk of serious illness' as well.

## COMMUNICABLE DISEASES

Disease / iLLness	Pathognomonic Sign
Chicken pox (Varicella)	Maculo-papular rash
Cholera (El tor)	Rice watery stools
Diphtheria	Pseudomembrane
Gonorrhea (Drips)	Dysuria, Genital discharge
Meningitis	Kernig's & Brudzink's sign
Measles (RubeoLa)	Koplick's Spot's (small whitish macules on soft palate)
German Measles (RubeLLa)	Forscheimer's spots (small red macules on soft palate)

**Figure 6:** Pathognomic signs and symptoms are vital for the diagnostic process because they are short cuts to diagnose specific diseases quickly. In this list are a variety of signs and symptoms, that are part of specialty domains in medicine, such as dermatology or neurology. [Scribd](#)

# How Doctors Think

## Part 5. Meet the Professional Patient

Hans Hendrickx MD PhD<sup>1</sup> and Linda Lorenz MSc<sup>2</sup>

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<sup>2</sup> VUmc, Amsterdam [in](#) [en](#)

August 16, 2019

In this blog we start describing the workflow of the patient and the doctor in case of an illness. Healthcare starts where the patient or the environment becomes aware of a complaint or medical problem. As everything in medicine, the onset of illness is embedded in uncertainty. At that point the patient has to deliver decisions, management, time, effort, money, information, and responsibility into being a patient and lead the team, the 'Professional Patient' is born.

Tools: [Anosognosia](#) | [Impaired Illness Awareness](#) | [Cultural Context of Illness](#) | [Patient's Delay](#) | [Do I need a Doctor?](#) | [Self or Auto-Triage](#) | [The Professional Patient](#), Rose and Kamloops 1965 - [Chanel White 2016](#)

## What is illness?

We want to avoid discussions about the semantics of illness and its cultural values. Defining illness is difficult because the word often is used as a metaphor and in fact, is a value of judgment. [Boyd - Good](#) That said, we believe that [culture](#) is part of the [patient's context](#). Extremes such as [Anosognosia](#) or [the maladaptive denial of illness](#) or [culture-borne illness](#) illustrates that the definition has its own complexities.

## Illness and becoming a patient

At the moment, patients become aware of an ailment, they delay seeking healthcare. Over [60% avoids or delays](#) care because of financial issues, over [80%](#) is concerned about costs. [Procrastination from fear](#), varying between worry, fear, anxiety till panic or death anxiety, is not uncommon in patients with cancer, even delays [up to 5 years](#).

Patients have to do work, even before being a patient, and a recognizable workflow. It is essential and possible to reduce delay times for seeking healthcare. Each step in the [Andersen Model of Total Patient Delay](#) benefits from specific interventions. Modern IT-tools



**Figure 1:** After becoming aware that they may need healthcare, patients receive help from several sources. [NHS](#) Some free or commercial tools have become available to screen your self [or](#) quickly get access to the GP. [iPlato](#)

may play important roles in this battle with different challenges in each stage: [Detection](#) of symptom or sign (time 0), [appraisal delay](#) while inferring the illness (time 1), [illness delay](#) or the decision delay to make an appointment (time 2), [behavioral delay](#) to get access to care (time 3), [scheduling delay](#) of first appointment (time 4), [treatment delay](#) (time 5).

Patient delay is understandable because even for doctors, it is complicated to diagnose and advice. '[Patientsknowbest](#)' tries to engage the patient by giving control of 'organizing your own circle.' With all these responsibilities, becoming a patient becomes a job. '[Huffpost](#).'

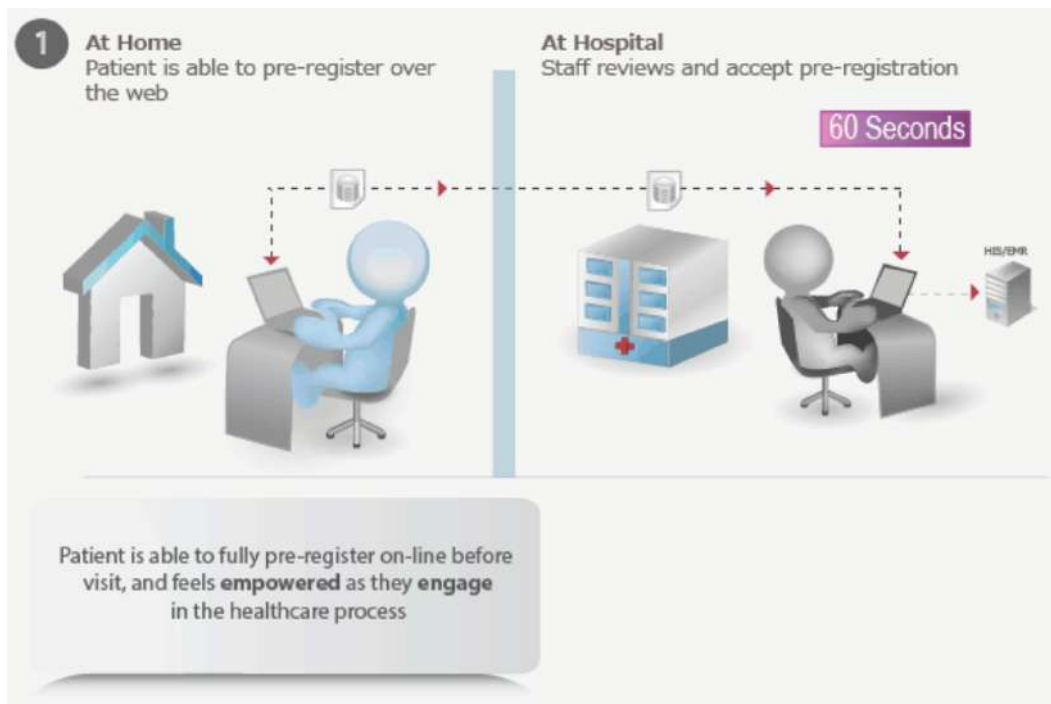
"Make the doctor extract the history. Remember, you're paying him."

*Ian Rose 1965 [Ian Rose](#)*

## The Professional Patient

After the decision about the need for care, and to become a patient, the [access to healthcare](#) becomes next





**Figure 2:** Slowly, thinking about Patient's Workflows passes the view that patients are commodities. Patients become team members of their own healthcare group, and have a work flow of their own. [Shamsgroup](#)

hurdle. Being ill is [demanding](#) in many ways. It is not unusual to spend half a day for a 5-10 minute appointment. Worldwide, average appointment times are [less than 5 minutes](#). Patients suffer financial losses because of their illness, by not being able to work, spending [out-of-pocket costs](#) for extra traveling to appointments, and parking.

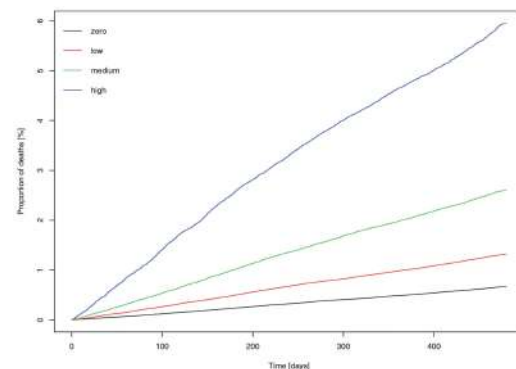
The problem is that the doctor is no longer a reliable partner. Long time ago, patients would get surgery at the surgery, usually the doctors residence. Family members would attend to the needs during recovery. At the creation of hospitals in each town, the [industrialization of medicine](#) started the [commoditization](#) of the patient.

Inevitably, these developments lead towards patients who [want to take control](#). [Chanel White](#) eloquently describes how patients have become co-workers. Non-performance delivers bad results, as reflected in higher mortality rates. [McQueenie](#)

## The Team

The role of the financier of healthcare strengthens the patients as a professional. Therefore, it is surprising that [patient advocacy groups](#) in the world have not teamed up with [Allied Health Professionals](#) and the [WHO](#) to take charge of the worldwide healthcare crisis, 'Who pays the piper calls the tune.' [source](#)

[Patient-doctor-programmer](#) teams should work together: patients pay, doctors deliver the care, [programmers facilitate](#). [Billions are wasted](#); there is plenty of money to reinvent healthcare. [Each patients CEO of his healthcare](#).



**Figure 3:** Mortality rates over 1.5 years of 4 groups of no-show patients, missing 0, <1, 1-2 or more GP appointments per year in the years before measurements started. [McQueenie](#)

## Developments

[Patient Centered Medicine](#) | [Patient Empowerment](#) | [Failures of EHR](#) | [Beyond the Hype](#) | [Burnout, moral injury and human rights violations in healthcare](#) | [Patient in Team Context](#) | [Hybrid working](#) | [Humans are neither analog nor digital like quantum computers](#)

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# How Doctors Think

## Part 6. Pre-Appointment work

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August 16, 2019

In this blog, we describe the pre-appointment workflow of the patient. For many patients, the decision to seek healthcare proves a complicated road with numerous hurdles. After that, the practical work starts: 'How to get to the appointment?', 'How to pay for care, and present the complaints?', 'Who could join me?', and 'How to best present the illness or complaints?.'

Tools: [Why health insurance](#) | [Create your own medical file](#) | [MediPrepare](#) | [Health-optimization system](#)

## Pre-Appointment times

[Andersen Model of Total Patient Delay](#) describes the five different processes patients go through before they schedule an appointment. View them in blog 5. Many [resistances for making an appointment](#) exist, for example: not needing one, preoccupation with work or study, lack of intelligence, over [80% is concerned](#) about costs, and [procrastination from fear](#).

The [best patient is the prepared patient](#). Most patients can do that very well. They can prepare self, for example, for a [cruise](#), and sources like [WikiHow](#) lead the way to write the medical history and prepare for illness. [Legal casebooks](#) show how important good health information is.

[Medical context](#) plays a pivotal role in finding the correct diagnosis, therapy and care needs. Every patient should create and maintain a personal medical casebook. Being prepared makes life easier. [Deloitte](#)

"..potential health hazards are also a risk with cruise ship travel. Staying informed and preparing for these potential hazards can help you stay healthy and get the most out of your cruise vacation."

[CDC source](#)

In recent years [contextual medicine](#) has become [new](#) buzz for what doctors already know for 5000 years, which is that understanding the broad context of pa-

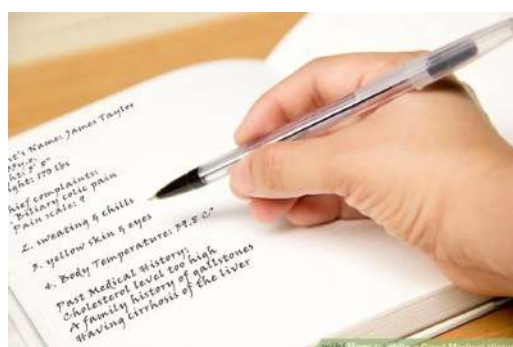


Figure 1: Write your own Medical History to share with all healthcare workers.' [WikiHow](#) - [Online alternative](#)

tients is needed to accurately diagnose and find the best treatment and care.

## Arranging access to care

If the patient calls to schedule an appointment, a [list of questions](#) is asked, such as registration, payments, insurance, urgency, preferences, and scheduling. [Schedule-Aware workflow analysis](#) and [walk-in clinic workflow](#), [Emergency-Response Workflow](#), [Triage workflow](#) help solve many of these problems.

After date and time of the appointment are set, there are serious concerns at the clinic's site about available information to improve workflow and about the [15-20% no-shows](#).

The yearly number of doctor visits range between 2.8 in Sweden and 17 in Korea. [source](#) Worldwide, patients get access times to their GP varying between 47 seconds in Bangladesh and 22.5 minutes in Sweden. [Irving et al.](#) Analysis of a typical 15.7 minutes appointment show that six topics pass and the current main complaint receives only 5 minutes. [source](#) Patients realize that their doctors suffer under time pressure, and that definitions of periods (e.g., "fast," "slow," "plenty," and "soon") vary widely and are unpredictable. [Source](#) Therefore, it is understandable that patients always are

## How Doctors Think Part 6. Pre-Appointment work

<b>SUMMARY and ALERTS</b> Explain the codes..	<b>Numbers and Risk Scores:</b> 42 years old <b>ASA</b> (use highest value) 3 2 3 4   <b>BMI</b> , cm - kg, ABW IBW 50.0 46.0, WHtR   $\Delta$ kg1Y: - 2, + 5, max 112 kg   <b>GHQ</b> 4   1 jaar geleden 4   <b>Meds</b> 4 / Eigen kosten 2   <b>METS</b> 4   <b>NYHA</b> 2 /1y 1   Smoking <b>PY</b> 45.0, I quit in 2000   <b>Beeh Score</b> 8 <b>Disabilities:</b> resulting into mild complaints   vision impairment   <b>Specialists consulted:</b> <b>Yes</b> <b>Allergy:</b> + 1980 -, hayfever antibiotics, food, kiwi, banana,   <b>Type of Allergy:</b>   asthmatic attack   hay fever
<b>CURRENT COMPLAINTS</b> <b>YES</b>	<b>swelling belly button, start?:</b> yesterday, <b>repeat?:</b> yes, 2 years ago, <b>cause?:</b> now moving furniture, <b>worse by?:</b> bending, <b>better by?:</b> rest and paracetamol, but now it does to resolve and I feel sick, <b>related to?:</b> moving, <b>treatment so far?:</b> tylenol and rest, <b>any concerns (1-10)?:</b> 8, <b>pain score?:</b> 7, <b>other observations or remarks?:</b> do I need surgery?   pain in right shoulder <b>Most recent vital signs:</b>   BP mmHg 160/89   HR/min 89   O <sub>2</sub> Sat% 95   RespR/min 24   37.5 °C <b>Serious problems in last 3 months:</b> stroke   urinary tract infection
<b>KNOWN MEDICAL PROBLEMS</b> <b>Yes</b>	<b>Consulted Specialist other:</b> neurologist   - , <b>Circulation:</b>   high blood pressure, since 2000 <b>Lungs, Upper airway:</b>   asthma or COPD 1st 1980, since childhood <b>Internal Medicine:</b> Internal medicine specialist: - 2018, DM II <b>Endocrine, Metabolic</b>   diabetes I or II, 1st 2006, type II, therapy: tablets and diet, insulin up to 30 IU, complications: cardiovascular, retinopathy, <b>Digestive, Alimentary Tract:</b>   acid regurgitation 2005, on and off   Urinary tract infection 1st,   TIA or CVA 1st,   Female problems: - ,   heavy menstruations ,   stretch marks <b>Weight problems:</b>   overweight since 1990, always have been heavy Other specialists:   - ,
<b>ONCOLOGY</b>	

**Figure 2:** This image is part of the medical chart, created by MediPrepare from data derived from a dynamic and intelligent online questionnaire. All separate steps to generate this document are well established parts of medical practice. However, the automated intelligent translation of the collected data and their presentation into easily recognizable patterned information. [MediPrepare](#)

stressed at appointments. [source](#)

Patients have to work hard to 'get yourself heard'. [source](#) They realize that they have to arrive prepared to present their case, preferably as doctors are taught. [source](#) If not, their chance of receiving best care becomes low.

## The Professional Patient

Patients meet numerous challenges: They want doctors to make decisions, but, at the same time, they like to contribute their opinion and get involved in decision making [source](#) Patients wish to control their health; if the doctor does not further this feeling, the patient will become less satisfied with the visit. [source](#).

Patients should also be aware that they, as their doctors may have [biases](#). Some doctors admitted having a negative bias for example towards patients with a different language, emotional problems or obesity. Positive bias was with elderly, low intelligence and race difference from self. [source](#)

Doctors may add to the best functioning patient-doctor-dyad by providing services that can be automated by smart programming facilities, such as specific disease information, reminders for appointments and medication refills. Paradoxically, some doctors reject tools that would [make their jobs easier](#), even tools that reduce costs are rejected.

Patients have to adapt to the new healthcare paradigms, doctors have to do the same. Eventually, they share the same goals, happiness and best healthcare. [Sir William Osler](#) said, "The good physician treats the disease; the great physician treats the patient who has the disease."

For patients it may be revealing that lately [burnout](#)



**Figure 3:** The communication-gap in medicine is something patient-doctor dyad should solve. Happy patients and happy doctors produce best healthcare. [source](#)

[complaints of doctors](#) is grounded in moral injury. It is this sign of resistance to the [industrialization of medicine](#) and [demise of good healthcare](#). Cooperation in teams will solve problems for all. [source](#).

## Appointments

[Simple online pre-admission](#) | [Medical scheduling software](#) | [Preparing for your appointment](#) | [Second opinion prep, the golden standard of prep](#)

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# How Doctors Think

## Part 7. Workflow optimization

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August 16, 2019

This blog deals with workflow optimization. Workflow analysis, a much-neglected field in healthcare, is critical to optimize the working environment. Most doctors always experience time pressure, are often interrupted, and at the same time have to make decisions constantly. Workflow analysis in healthcare is helpful and to programmers it helps to optimize the design of new workflows, tools and apps. The EPD has been preoccupied with 'commodification' of healthcare, and neglecting workflows of healthcare workers and quality of care. This has created the EPD paradox with billions of dollars spent, resulting in failing healthcare. The effects of the EPD on clinical workflows has been neglected.

Tools: [Workflow Analysis Tools](#) | [Processmaker Open Source](#) | [Get started instructions](#) | [Workflow Paradox in Health-IT](#) | [WofLan](#) | [FDA for Software](#)

## Workflow analysis

Quickly, delving into the [workflow analysis field](#), it becomes clear that this is a specialty such as medicine with its jargon, techniques, and inventions. Discussing the jargon helps to understand this field of science better, and at the same time presents the numerous opportunities to improve the context of doctor's activities. We only scratch the subject, but we want to introduce this domain because it helps to understand the complexities of the work by patients, doctors, and programmers.

The [current state map](#) is the graphical description of the situation before any interventions. In [LEAN](#) this would follow the [brainstorm session](#) and the announcement of the investigating team, the [charter](#).

[Creation of data maps](#) is used to create cycle times, work times, and identification of task performers, the What, Why, How, Who.

The [future state process](#) is developed to improve procedures, eliminate waste, motivate employees, and reduce cycle time.

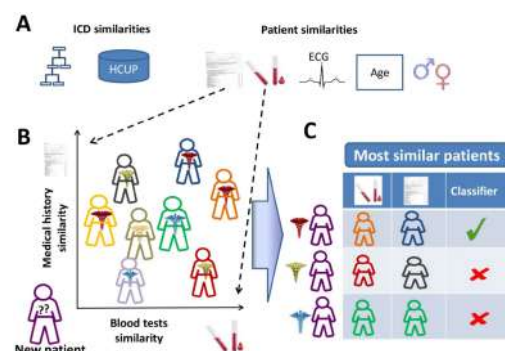


Figure 1: One example of specialized workflow analysis looking at clusters of patients related to their ICD coding.' [Gottlieb et al.](#)

The [implementation plan](#) completes the milestones for implementation, establishes time frames, assigns ownership of assigned tasks, and develops the communication plan. [Kissflow](#) helps small settings; many [other workflow tools](#) are available. University departments use their workflow tools, such as [WofLan](#), WORKFLOW ANalyzer, which is a Petri-net-based tool to analyze the correctness of a workflow, and the department [FMT](#) at University of Twente. [Pothoven 2010](#)

[Workflow Management System](#) is a "system that completely defines, manages and executes "workflows" through the execution of software whose order of execution is driven by a computer representation of the workflow logic". This creates opportunities to simulation and update cycles.

## The EPD paradox

Doctors, like all other professionals, enjoy working in a [supportive](#) and [facilitating](#) environment, and they like to have [control](#) of environment. However, the scale and complexities of healthcare have created management mologs where financial control is placed in the hand of non-medical professionals, and [foie gras management](#) and other [aberrations](#) are commonly exercised. The

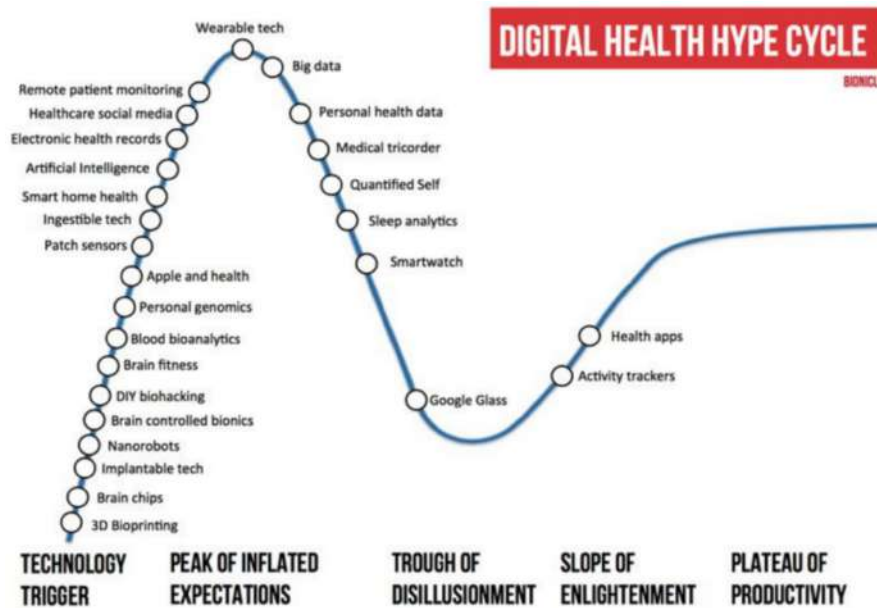


Figure 2: eHealth is an example of hap snap adaptation in hype cycles with disruptive and disastrous results.  
[Hempel - Klick](#)

result of this development leads to doctors distancing from their working environment and even more disruptions of workflows. It is no surprise that doctors suffer from [moral injury](#) resulting in [burnout](#) as the red flag symptom that makes the doctor the [canary in healthcare](#). Many view the uncontrolled scale of commercialized healthcare the reason of the demise of medicine.

Another reason is the introduction of EPD in the last 30 years that has cost society trillions of dollars, and did not deliver the better healthcare and lower costs. Healthcare has not only been [hijacked](#) by cyberattacks, also hype-jacked by [IT-Hypes](#). After 1970 we have seen the EPD-hype becoming [increasingly disruptive](#). The paradox is that billions of dollars have been spent on hype of eHealth provides better healthcare, but reality shows high cost of [deaths](#), [mishaps](#), [errors](#), [burnouts](#), [outages](#), [disruptions of patient-doctor relationship](#), [financial ruin of hospitals](#). Curiously, the EPDs forgot to design-in the patient and doctor, not to speak of safety and security.

The most bizarre hype-quote by Anja Moonen, a senior manager of an insurance company, is advertised in a dutch newspaper NRC-add 'The healthcare worker in 2040 is 100% virtual.' [NRC](#)

## Designing principles

The lessons from the EPD paradox is that new tools need testing and evaluation for paradoxical effects, actually the [design paradox](#) has been recognized as a domain in design sciences. [Function focused](#) design, [human focused](#) design, [patient centered](#) design, [workflow focused](#) design, [user focused](#) design, [human behavior driving](#) design from game-industry, they all have given good examples of good IT design. Medicine needed

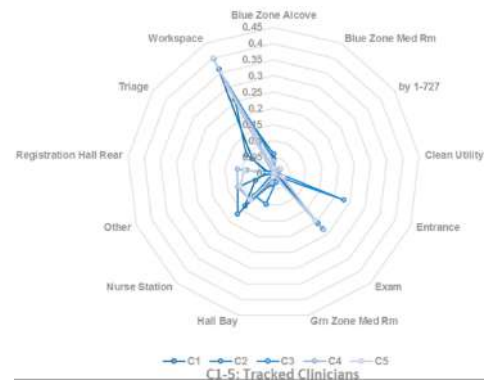


Figure 3: Part of workflow analysis is the tracking probabilities of healthcare workers. [Vankipuram et al.](#)

5000 years and has over 135 [medical specialties](#) and specialty paths, IT will need more than 30 years to mature and more the 20 specialties it has now. Medicine is complex, IT is complex. Good [healthcare designs](#) are complex. The logical first step is to facilitate the patient-doctor team.

## Appointments

[Simple online pre-admission](#) | [Medical scheduling software](#) | [Preparing for your appointment](#) | [Second opinion prep, the golden standard of prep](#)

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# How Doctors Think

## Part 8. Medical History Taking

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<sup>2</sup> VUmc, Amsterdam [in](#) [en](#)

August 17, 2019

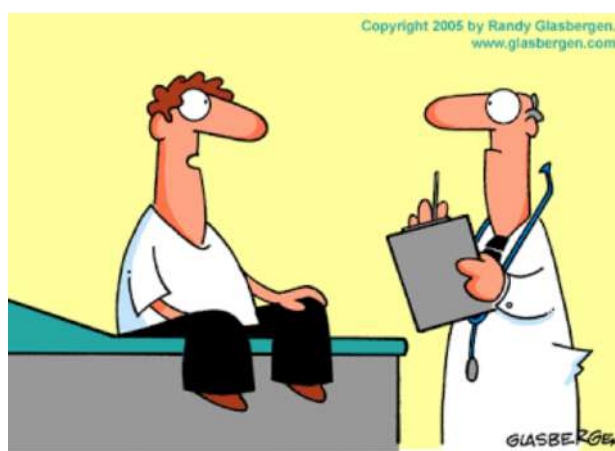
This blog describes the one single most crucial tool of doctors to correctly diagnose diseases, Medical History Taking. It is time-consuming, and doctors like to take short cuts. On average Medical History Taking takes 5-25 minutes. Given the real average talking time of appointments of less than 5 minutes, it is a time-consuming and impossible task. That is the reason why doctors like to skip it or use shortcuts and tools to prepare patients, such as forms and questionnaires. The patient can self-diagnose or find 'how to deals' with symptoms in 34% if using good symptom checkers. The challenge is to collect the whole context and detailed symptom analysis, needed for 100/100 vision. Nobody wants the wrong diagnosis, advice or therapy, and certainly not missed lethal diagnoses, such as cancer or deadly infection. Medical History Taking remains the most critical expertise doctors have.

Tools: [Triage](#) | [History Taking](#) | [Context Casebook](#)

## Medical History Taking

Symptom checkers could help patients diagnose their complaints in about 34%. [Semigran et al.](#) This study indicates that patients can diagnose their symptoms, and with the right tools can find online medical help. However, triage and self-diagnostics both need evaluation and improvements. Patients have a responsibility as well, see our 'Meet the Professional Patient,' to make a balanced choice to visit or not visit a medical professional, and to provide accurate and complete information to the best of their knowledge. [UCLAHealth](#) Being a good patient is complex, hard and responsible work, as is the work by the doctor.

As expected, doctors do a better job. At a department of medicine, in 90% they find the correct diagnosis combining Medical History, Physical exam and basic test. "The patient's history emerged as the key element in formulating the diagnosis either alone (20%), in combination with the examination (another 40%),



**"I already diagnosed myself on the Internet. I'm only here for a second opinion."**

Figure 1: Medical history taking is more complex than lay people think. However, my experience is that asking the patient's opinion many times hits the nail on the head. [Tapmed](#)

or in addition to the basic tests with or without the physical examination (33%)." [Paley et al.](#) If carefully managed, doctors in a referral medical clinic should be expected to diagnose correctly in about 80% of cases. [Cooke](#) Patients see their GP in about 75% face to face appointments for health problems. [Rasendal et al.](#) This means that the GP in 12 of 100 patients fails to pinpoint the diagnosis if he takes a careful history, performs a physical exam and makes use of basic tests.

Just remember one thing. Whether the patient is a patient in real life, or a patient in an exam, they are a human being. A person. At some point, they'll be you.

Larkin [x](#)

The problem is that 20% of patients are not at all diagnosed or receive the wrong diagnosis. In some studies, this number is as high as 40%. [VeryWellHealth](#) Whatever the exact percentage is, the patient should



Send Comments to: <a href="#">Charlie Goldberg, M.D.</a>		
<a href="#">Introduction</a>	<a href="#">Breast Exam</a>	<a href="#">Write Ups</a>
<a href="#">History of Present Illness</a>	<a href="#">The Pelvic Examination</a>	<a href="#">The Oral Presentation</a>
<a href="#">The Rest of the History</a>	<a href="#">Male Genital/Rectal Exam</a>	<a href="#">Outpatient Clinics</a>
<a href="#">Review of Systems</a>	<a href="#">The Upper Extremities</a>	<a href="#">Inpatient Medicine</a>
<a href="#">Vital Signs</a>	<a href="#">The Lower Extremities</a>	<a href="#">Clinical Decision Making</a>
<a href="#">The Eye Exam</a>	<a href="#">Musculo-Skeletal Exam</a>	<a href="#">Physical Exam Lecture Series</a>
<a href="#">Head and Neck Exam</a>	<a href="#">The Mental Status Exam</a>	<a href="#">A Few Thoughts</a>
<a href="#">The Lung Exam</a>	<a href="#">The Neurological Exam</a>	<a href="#">Commonly Used Abbreviations</a>
<a href="#">Cardiovascular Exam</a>	<a href="#">Physical Exam Check Lists</a>	<a href="#">References</a>
<a href="#">Exam of the Abdomen</a>	<a href="#">Medical Links</a>	

**Figure 2:** Dr. Goldberg's system approach is not based on mnemonics, although he could not resist mentioning the OLD CARTS. [UCSD](#)

be aware of the responsibilities for presentation; the doctor should be humble enough to diagnose and share insecurity to patients critically. Every doctor should ask the patient "What do you think yourself is the cause?" and every patient should ask the doctor "If you had this complaint, what would be your diagnosis you do?".

## Histories for 30.000+ diseases

In medical school, Medical History Taking is a task every student learns by heart. [MediStudents](#) This task compares very well to [questions](#) journalists and police investigator ask. The goal is to find the truth and nothing but the truth. We make a distinction between the 'general Medical History Taking,' view figure 2, from medical school, and the questions related to specialist questions. Each of the 130+ specialties has its own questions, like for [allergy](#), [gynecology](#). Also, there are specific questions about the [5.000+](#) symptoms and signs, such as the [Red Flags](#). Each of the 30.000+ specific diseases has specific questions to be answered, for example, [HHT](#), or the [9.000](#) orphan diseases.

## Different styles of History Taking

Early [written medical documents](#) described the 'what to do's.' [Ancient case reports](#) show descriptions of disease with remarkable detail, a system still used today. To present a case requires careful medical history taking and over 5000 years doctors have developed [additional requirements](#) to communicate, such as anatomy and the [nosology](#) of disease. With his landmark book 'The Principles and Practice of Medicine' William Osler set the outlines for the outline of modern medical medicine.

Medicine has become part of evidence-based sciences; the [art of Medical History Taking](#) is no exception. The biggest challenge of modern clinical practice is [time constraint](#) at the cost of proper Medical History Taking and eye-to-eye contact with the patient. The medical context is lost with dear consequences. New ways, for example with business intelligence may be discovered to help doctors solving this squeeze. [Mettler et al.](#) Often forgotten is the use of already existing tools such as [questionnaires](#). The first questionnaire dates back to

1838. [Statistical Society of London](#) The [General Health Question](#) is in use since 1943. [Bolwing](#) In psychology and psychiatry, the use of questionnaires has become very successful. Questionnaires have become essential parts of medical armamentarium ([sources](#)), as well as integral part of daily practice. [OneMedicalPassport](#)

## The art of listening

Listening seems [lost art](#). Doctors tend to be in a rush. In one video study, only 36% of patients were asked why they came; of those asked, 67% were interrupted within 11 seconds. [Omojola](#)

Maybe, part of losing this art of listening relates to the complexity of multicultural mix of patients ([source](#)), the focus on biomedics ([source](#)), techno stress ([source](#)), cognitive overload ([source](#)), poor workflow support ([source](#)). Nowadays, there are many reasons doctors fail. [source](#)


All Contrary to popular belief, the simple yet complex art of listening is, in and of itself, a clinical intervention, for the healing that comes from being listened to is often greater than any cure. Listening constitutes the very heart and soul of the clinical encounter.

Mary T Shannon [x](#)

## links to Medical History

[Symptoms and signs](#) | [Current Complaint](#) | [Review of Systems](#) | [Allergies](#) | [Medications](#) | [Procedures](#) | [Vaccinations](#) | [Family History](#) | [Admissions](#) | [Disabilities](#) | [Activities and Occupations](#) | [Books on Medical History Taking](#) | [Why is Medical History Taking important?](#) | [IT and Medical History](#) | [Multilingual medical history taking](#)

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# How Doctors Think

## Part 9. Triage, proxy of Patient-Urgency

Hans Hendrickx MD PhD<sup>1</sup> and Linda Lorenz MSc<sup>2</sup>

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<sup>2</sup> VUmc, Amsterdam [in](#) [DOI](#)

August 17, 2019

This blog describes the triage, proxy of true patient-urgency. The type of triage depends on the context, war, natural disaster, mass casualties, emergency services, GP clinic, or specialty clinic like pre-operative screening. Necessarily, triage starts the collection of patient data and context, beginning at the auto-Triage by the patient self. Triage not only starts the assembly of data in context but at the same time may become a source of severe biases with significant repercussions in the subsequent health-chain. In earlier blogs, we discussed triage as well; now we are placing triage in the broader context it deserves.

Tools: [Auto-Triage](#) | [Hospital Triage](#) | [Trauma Triage](#) | [Pediatric Triage](#) | [S.T.A.R.T. algorithm](#) | [Errors at Triage](#) | [ASA score](#)

## Context of triage

The doctor has no clue about the urgency when patients arrive. The triage sorts patients and matches them to their needs of available resources. Often triage is performed by someone else. That means that the proper communication of the triage-results is needed, for example by [badges](#). [Triage in Mass Casualties](#) or [war](#) requires a different approach, then at a [labor clinic](#), an [eye clinic](#), or an [emergency room](#). Expertise and detailed information on medical history and vital signs, such as blood pressure, oxygen saturation, and level of consciousness are required; and high quality communication to transfer those data. Good triage needs training and evaluation. [Bazm et al.](#)

## History Taking and triage

[Missing contextual information](#) from patients' stories, such as allergies, recent chemotherapy, or organ transplantation increases the probability of dangerous mishaps. [Roscoe et al.](#) During triage all senses should be used, including verbal information about

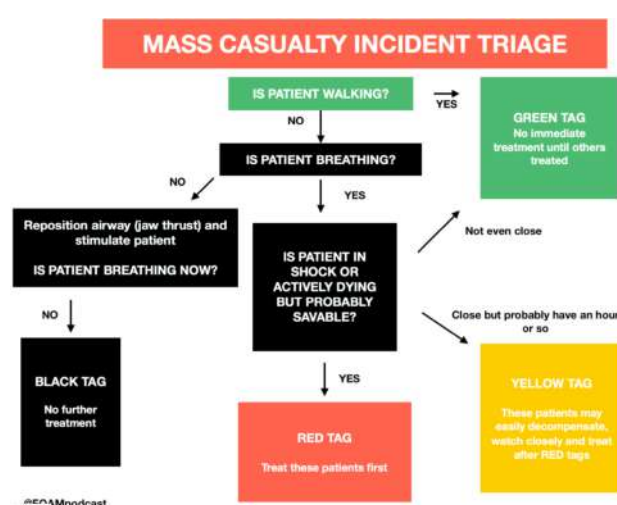


Figure 1: Triage in Mass Casualty Screening is different from that in emergency rooms or phone-triage in a GP-practice. [↗](#)

the medical history, measurements of vital signs, and observations of the patient's appearance and behavior. The missing of critical information is the reason that phone triage quickly results in accidents, in particular in the group of high urgency patients. [Huibers et al.](#)

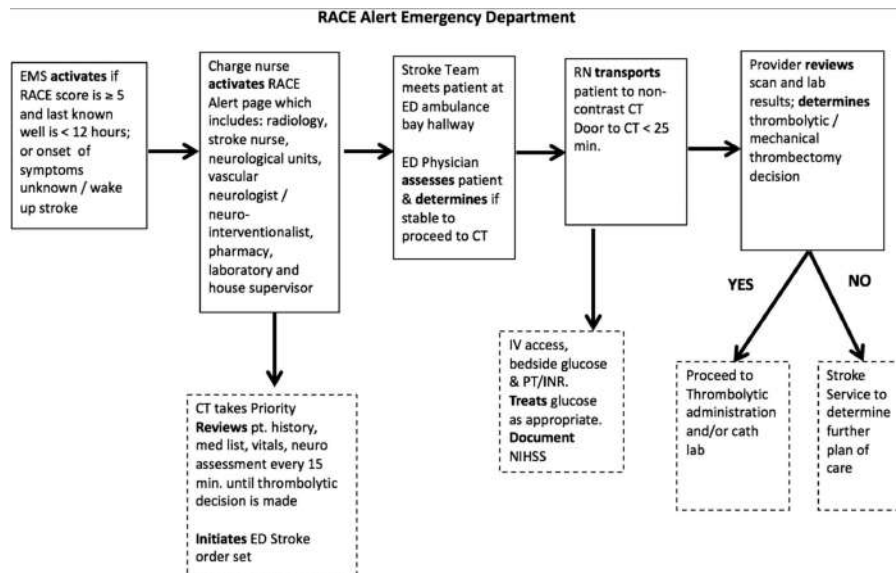
"Telephone triage is ubiquitous, but its safety is not."

Wheeler Source

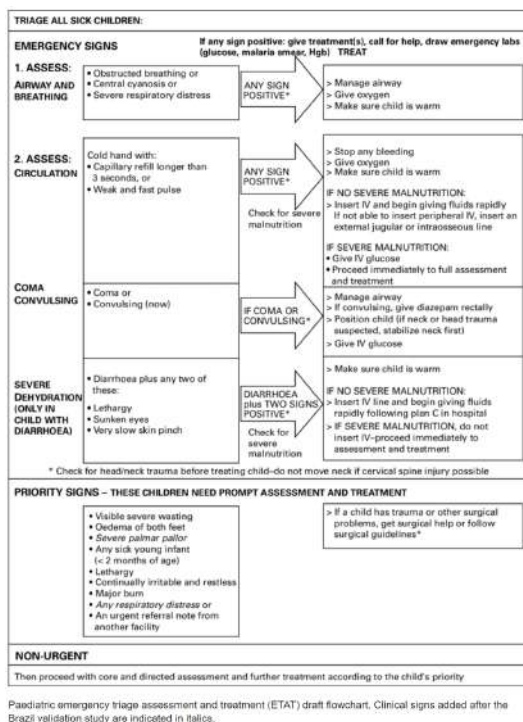
The industrialization of medicine seems to lead to more knowledge and increased experience gaps between the person performing the triage and the doctor. [Wheeler et al.](#) In part, [CDSS](#), [guidelines](#) and [risk management](#) can solve these problems.

The appeal of triage systems depends on its purpose and context. For emergency services, it is very efficient to use professional and very experienced triage personnel. Good triage is a profession by itself. [Activities of Triage Nurse](#) However, in emergency care, the triage is viewed as obsolete by some colleagues. [Dr. Rick Bukata](#)

## How Doctors Think Part 9. Triage, proxy of Patient-Urgency



**Figure 2:** The handling of stroke events in elderly has evolved in multistep triage. Emergency services staff is trained in [Rapid Arterial Occlusion Evaluation \(RACE\)](#) score. If prehospital this score is equal or above 5, the patient is transported without delay to the closest Cerebrovascular Interventional Stroke Center. The reason is that certain interventions are successful in the first hours only. [Saidi et al.](#)



**Figure 3:** Each age group has its own specific triage context. [Molyneux et al.](#) For triage in elderly view this [this source](#).

Others like to develop a "Triage RIGHT". [Helman and Ovens](#)

## Universal Triage

Traditionally triage has been used for initiating levels of emergency care. Triage is not only useful in case of

emergencies. The dream of clinicians is to have a one-number measure that reflects the medical condition of the patient. The [ASA score of physical status](#) is in the 40ties developed by the Anesthesia Society of America, and still worldwide in use: ASA scores 1 (healthy), 2 (minor morbidity), 3 (severe systemic disease), 4 (3+ constant threat to life), 5 (moribund), till 6 (brain death), with E in case of an emergency. It belongs to the same category of indicators as [Severity of Illness Index](#). Although not perfect, the [ASA score](#) is reliable and used worldwide. Many other scores have been developed, such as [SORT](#), [NELA](#), and [ACS NSQIP](#). However, for practical clinical triage, the ASA score seems the best for quick and effective triage.

"..all too often, people think because they are using a big data platform they'll magically see into a crystal ball and discover all sorts of new insights, patterns, and trends."

Westphal

## Links to triage

[DO I need a Doctor - nl](#) | [Guide to urgency for non-medical staff](#) | [Phone triage books](#) | [Emergency triage books](#) | [Universal Triage - Algorithm](#)

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# How Doctors Think

## Part 10. Current Complaint

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<sup>2</sup> VUmc, Amsterdam [in](#) [en](#)

August 19, 2019

This blog describes why medical history taking is so important. It is the one single most important tool of doctors to correctly diagnose diseases. The beauty of this is, that Medical History taking theoretically could be performed online by patients, if they are helped by quality and intelligent dynamic questionnaires. On average Medical History Taking costs 5-25 minutes of doctor's time. Before patients have made up their minds that they need a doctor, they would be able to find the diagnosis of complaints in 34% by using symptom checkers.

Tools: [Triage](#) | [History Taking](#) | [Review of Systems](#) | [Allergies](#) | [Medications](#) | [Procedures](#) | [Vaccinations](#) | [Family History](#) | [Admissions](#) | [Disabilities](#) | [Activities and Occupations](#) | [Context](#)

## Medical History Taking

Symptom checkers could help patients diagnose their complaints in about 34% [Semigran et al.](#). They may fail diagnosis and proper triage. Patients have to make an 'educated guess' to see a doctor; not using triage and diagnostic tools, may result in delays or dangerous developments of their complaints. Current triage systems and self-diagnostics both need critical evaluation and improvements. Patients have a responsibility to make a balanced choice to visit or not visit a medical professional and to provide accurate and complete information to the best of their knowledge. [UCLAHealth](#) Being a good patient is hard and responsible work, as is the work by the doctor.

As expected, doctors do a better job than patients. Medical history taking is very important because "The patient's history emerged as the key element in formulating a diagnosis either alone (approximately 20% of all diagnoses), in combination with the patient's examination (another 40%, approximately), or in addition to the basic tests with or without the physical examination (33%)." [Paley et al.](#) If carefully managed doctors in a referral medical clinic should be expected



**Figure 1:** During each medical encounter, a full context Case-book should be available for review by the doctor. Patients can create this easily by online help, as well as with modern, meaningful eHealth tools. [WikiHow MediPrepare](#)

to correctly diagnose in about 80% of cases. [Cooke](#) In addition, good history taking is necessary for full context information, which is crucial for the choice of therapy and further care. By the courts, skipping is viewed as [negligence](#).

The bottom line is that 20%, in some studies up to 40%, of patients are not diagnosed or receive the wrong diagnosis. [VeryWellHealth](#) The patient is responsible for the presentation of the complaint; the doctor should be humble enough to diagnose and share uncertainties to patients critically. Every doctor should ask, "What do you think yourself is the cause?" and every patient should ask, "If you had this complaint, what would be your diagnosis?"

## Standard and ad hoc questions

In medical school, Medical History Taking is a task every student learns by heart. [MediStudents](#) After Triage and the collection of current complaints, further details are collected through [mnemonics](#), [Red Flags](#),



## How Doctors Think Part 10. Current Complaint

CMS	"OLDCARTS"	"OPQRST" <sup>[4][5]</sup> or "PQRST" <sup>[6][7]</sup>	"LOCATES"	"CLEARAST" <sup>[8]</sup>	"LIQOR AAA" <sup>[9]</sup>	"SCHOLAR" <sup>[10]</sup> (("S" = Symptoms)	"COLDER AS"
location	"L": Location	"R": Region and Radiation	"L" : Location	"L": Location	"L": Location	"L:" Location	"L:" Location
quality	"C": Character	"Q": Quality of the pain	"C": Character	"C": Character	"Q": Quality	"C:" Characteristics	"C": Character
				"R": Radiation	"R": Radiation	see above	"R": Radiation
severity	"S": Severity-how disruptive	"S": Severity	"S": Severity	"S": Severity	"I": Intensity	see above	"S": Severity
duration	"O": Onset "D": Duration	"O": Onset	"T": Time	"T": Time frame	"O": Onset	"O:" Onset "H:" History	"D:" Duration
timing	"T": Timing	"T": Time	see above	see above	see above	see above	"O": Onset
context	"A": Aggravating factors		"E": Environment				
modifying factors	"R": Relieving factors	"P": Provocation or Palliation	"A" Alleviating/Aggravating Factors	"E": Exacerbation	"A": Aggravating factors	"A:" Aggravating factors	"E:" Exacerbation
				"A": Alleviation	"A": Alleviating factors	"R:" Remitting factors	"R:" Remitting factors
associated signs & symptoms			"O": Other symptoms	"A": associated symptoms	"A": Associated symptoms	see above	"A": Associated symptoms

**Figure 2:** Mnemonics are quite popular in medical school; after medical school only 20% of doctors use them. However, the common knowledge encapsulated in mnemonics is of significant value. [Wikipedia](#)

[pathognomics](#), [significant symptom lists](#), [algorithms](#), [patterns](#), [spot diagnosis](#), [gestalt diagnosis](#). Many of these supporting ways of finding accurate diagnosis are grounded in simple database structures. The challenge for programmers is to democratize the diagnostic process intelligently.

## The art of listening

Listening seems lost quality. Doctors tend to be in a rush. In one video study, 64% of patients were not asked why they came, and of those asked, 67% were interrupted within 11 seconds. [Omojola](#) Most appointments worldwide last less than 5 minutes [Reuters](#)

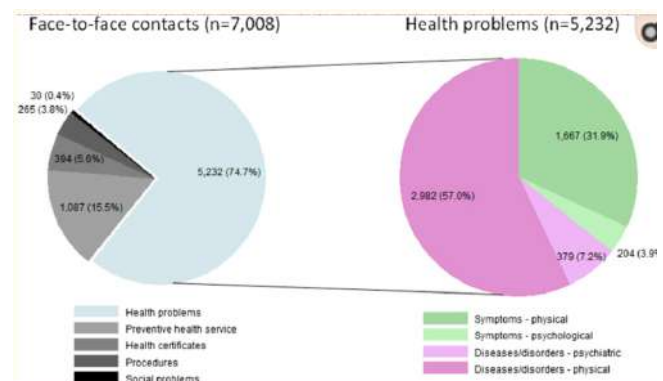
Maybe, part of losing this art of listening relates to the complexity of the multicultural mix of patients ([Paternotte](#)), the focus on [biomedicines](#), [technostress](#), [cognitive overload](#), [lack of workflow support](#). Nowadays, there are many reasons [doctors fail](#).

All Contrary to popular belief, the simple yet complex art of listening is, in and of itself, a clinical intervention, for the healing that comes from being listened to is often greater than any cure. Listening constitutes the very heart and soul of the clinical encounter.

Mary T Shannon [x](#)

## Programmers can help

Programmers, together with doctors, can help patients by creating tools to online collect answers to [intelligent](#)



**Figure 3:** Health problems in the GP office. [Rosendal](#)

[questionnaires](#). Subsequently, those answers need to be presented as structured information, in a way [doctors immediately recognize](#). Then, the doctor can continue from there, saving on average [20 minutes](#).

It is no surprise that medical programming, combining the medical and IT domains, is becoming a [specialty art and science](#).

## Links to current complaints

[Current Complaints](#) | [Presenting Symptoms](#)

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# How Doctors Think

## Part 11. Current Complaint Diagnostic Cues

Hans Hendrickx MD PhD<sup>1</sup> and Linda Lorenz MSc<sup>2</sup>

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<sup>2</sup> VUmc, Amsterdam [in](#) [DOI](#)

August 19, 2019

This blog describes diagnostic clues. The overwhelming load of possible causes of signs and symptoms, the thinking process needs direction towards a manageable list of probable diagnosis. Doctors make use of several techniques, such as the mnemonics. Other methods and tricks are the 'Time patterned symptoms, Mnemonics, Red Flags, Most significant symptoms, Pattern recognition, Gestalt, Syndromes, Visual cues, and Gamification of Medicine.

Tools: [Symptom Ontology](#) | [Disease trajectories](#) | [Pattern Recognition](#) | [History Taking](#) | [Decision-Making Shortcuts](#) - [Errors](#) | [Visirule](#)

## Signs and Symptoms

Signs and symptoms are different phenomena. In practice, doctors use them 'en groupe,' and then speak of symptoms or [syndromes](#). Sometimes, not having a symptom like for example pain, may be of significance. In [leprosy](#) and [diabetic neuropathy](#), or [congenital analgesia](#), the lack of pain is a significant finding, which may create a clue or shortcut towards the correct diagnosis.

In up to 50% of patients, the GP may find [Medically Unexplained Symptoms](#), MUS, ; in [Emergency Care](#) this is a well known problem as well. Reasons for MUS may be that a disease is in its [preclinical phase](#), or [diagnostics are negative](#), [somatization](#), [hypochondria](#), [dissociative disorder](#), [psychogenic pain disorder](#), [fictitious disorder](#), or the [Munchausen syndrome](#).

## Diagnostic shortcuts

Time pressure of doctors invites them to make use of tricks. We will discuss a series of these tricks. Often, Red Flags create a shortcut to life saving diagnosis, in for example [fever and skin rash](#). [does not always](#). Unfortunately, shortcuts create the danger of [tunnel vision](#), which should be avoided at all cost.

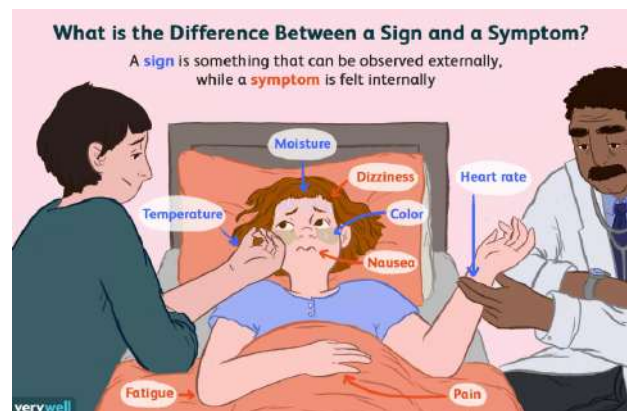
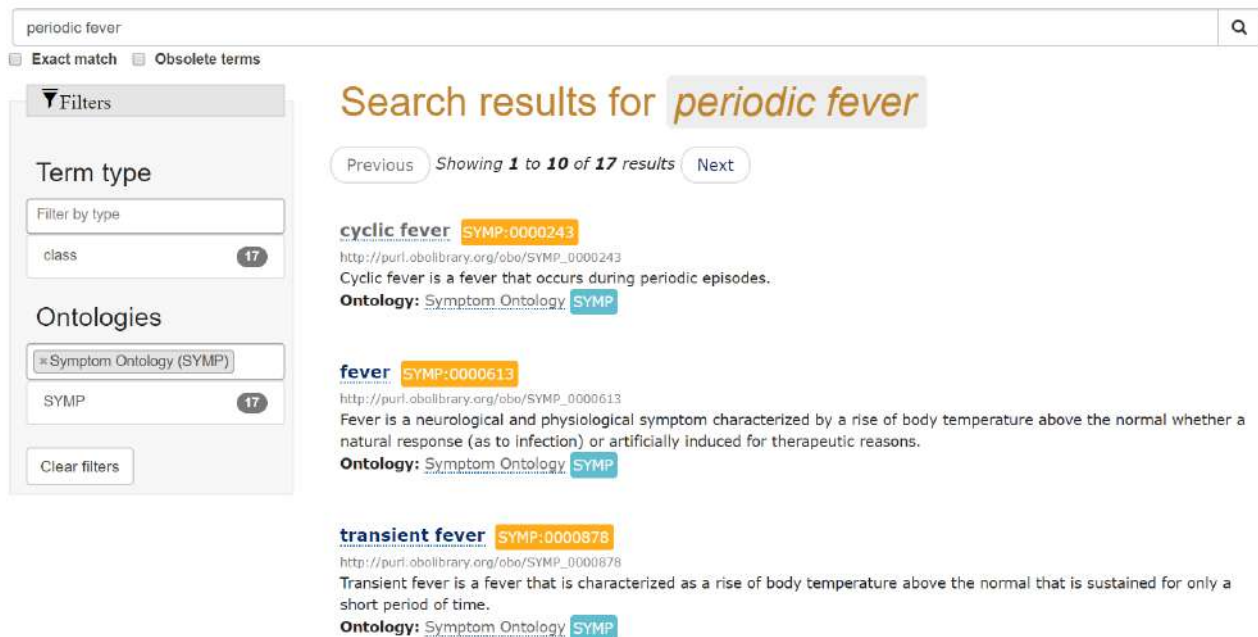


Figure 1: Signs and symptoms are close relatives and often viewed as synonyms. In veterinary medicine we [mostly](#) find the mention of signs only, in human medicine the [signs and symptoms](#) are grouped together. [↗](#)

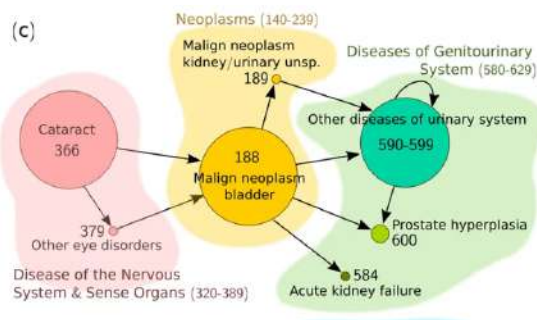
**Time patterned symptoms** Always, ask if the patient has ever had [similar symptoms before](#). Fever may come and go in [patterns](#), such as [intermittent](#), [remittent](#), [continuous or sustained](#), [hectic](#), [relapsing](#), or [periodic](#). On other diseases, symptoms may come and go, like in relapsing-remitting [Multiple Sclerosis](#). Infamous is the recurrence of cancer after surgical removing for example of a missed [sebaceous carcinoma](#), resembling a simple [chalazion](#), or at a later stage, a skin lesion turning out [melanoma](#). [Time patterns of diseases](#) have great significance, epidemiologists often make use of those.

**Mnemonics** [Mnemonics](#) can be handy, think about the ABC of resuscitation. However, only 20% of doctors continue using them after leaving medical school. Mnemonics cause a degree of [cognitive load](#). For some doctors, [visual mnemonics](#) may improve retention and use. Others would use them if readily available, which is the case in [apps](#).

**Red Flags** [Red Flags](#) are those symptoms, which if placed in the right context, play an essential role in diagnosing serious diseases, such as [fever with skin](#)



**Figure 2:** Symptom Ontology is a very informative ontology to start exploring symptom domains. However, unfortunately, for clinical purposes *ontologies* have limited use; their technologies need further development, *EMBL-EBI*



**Figure 3:** New technologies explore relations of symptom clusters in disease trajectories using dynamic time warping. Medicine is and will remain an exciting and dynamic domain for a long time. *Guinnaloula et al.*

**rash.** Sometimes, these visual clues on the skin or mucosa literally are alarming sign, like in *erysipelas* and *scarlet fever*.

**Visual cues Red Flags** are those symptoms, if placed in the right context, play an essential role in diagnosing severe diseases. *Visual cues* provide welcome shortcuts to diagnosis of diseases in general. Their most significant value is that they limit appointment time. The best example is the *gait speed*, used as the *6th vital sign*. Walking speed, like blood pressure, may be a general indicator that can predict future events and reflect various underlying physiological processes. *Stacy et al.* *Parkinsonian gait* is famous for recognising it makes the diagnosis of Parkinson a matter of milliseconds. The use of visual cues is part of our *evolutionary armamentarium*.

**Pathognomics Pathognomic signs and symptoms** indicate that a particular disease is present beyond any doubt. Therefore, knowing and finding them is a very

helpful shortcut. indicate that a particular disease is present beyond any doubt. Therefore, to know, and find, them is a very helpful shortcut.


**Cluster of signs and symptoms** Syndromes are a cluster of symptoms. Within the group of *congenital anomalies* disease names with syndrome are very common.

**Major associated symptoms** Clusters, or major associated symptoms have been discussed before - see our previous blogs 4 figure 2 and 4 -. *Professional Guide to Signs and Symptoms* has published a large collection of tables with major associated symptoms. *Visirule* provides a prolog based app to create medical tables like this.

## How programmers could help

Many of the described medical cue systems result from quarrying diverse databases. The problems doctors encounter are that they are in print only, incomplete and organised in specialty domains, and if online they are not open source, and means to access by non-programmers are *very limited*. Over more than 25 years *theBrain* has created tools to visually fly through a 'brain' and access linked information quickly. However they do not support or facilitate projects needed in medicine.

**MPOSP** envisions a world where patients create and share their own professionalized Casebook. They become true healthcare-team members.

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## How Doctors Think

### Part 11. Current Complaint Diagnostic Cues

#### Screenshots iPhone iPad

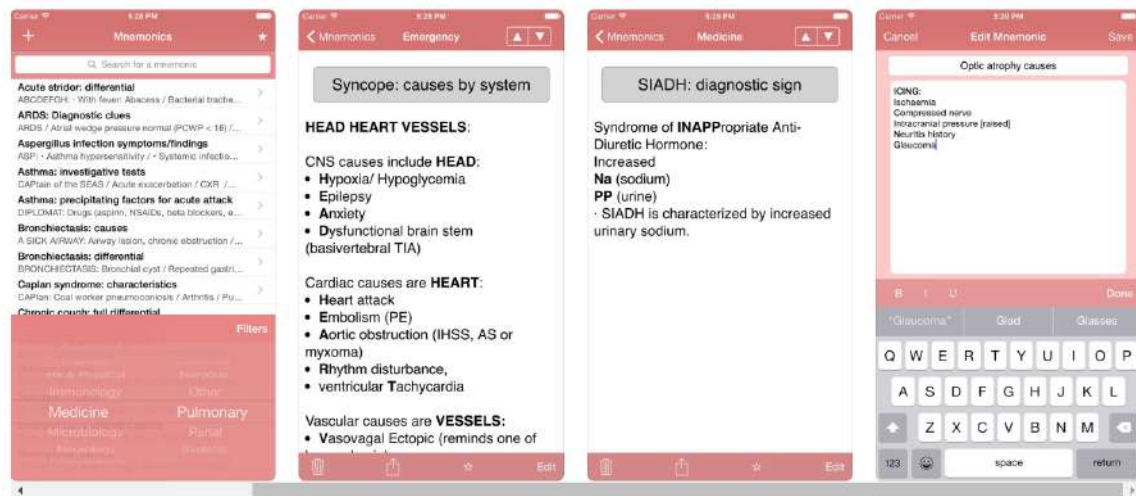


Figure 4: Mnemonics, a small riddle contains cues for diagnosis, are available in apps. [Schoenberg](#)

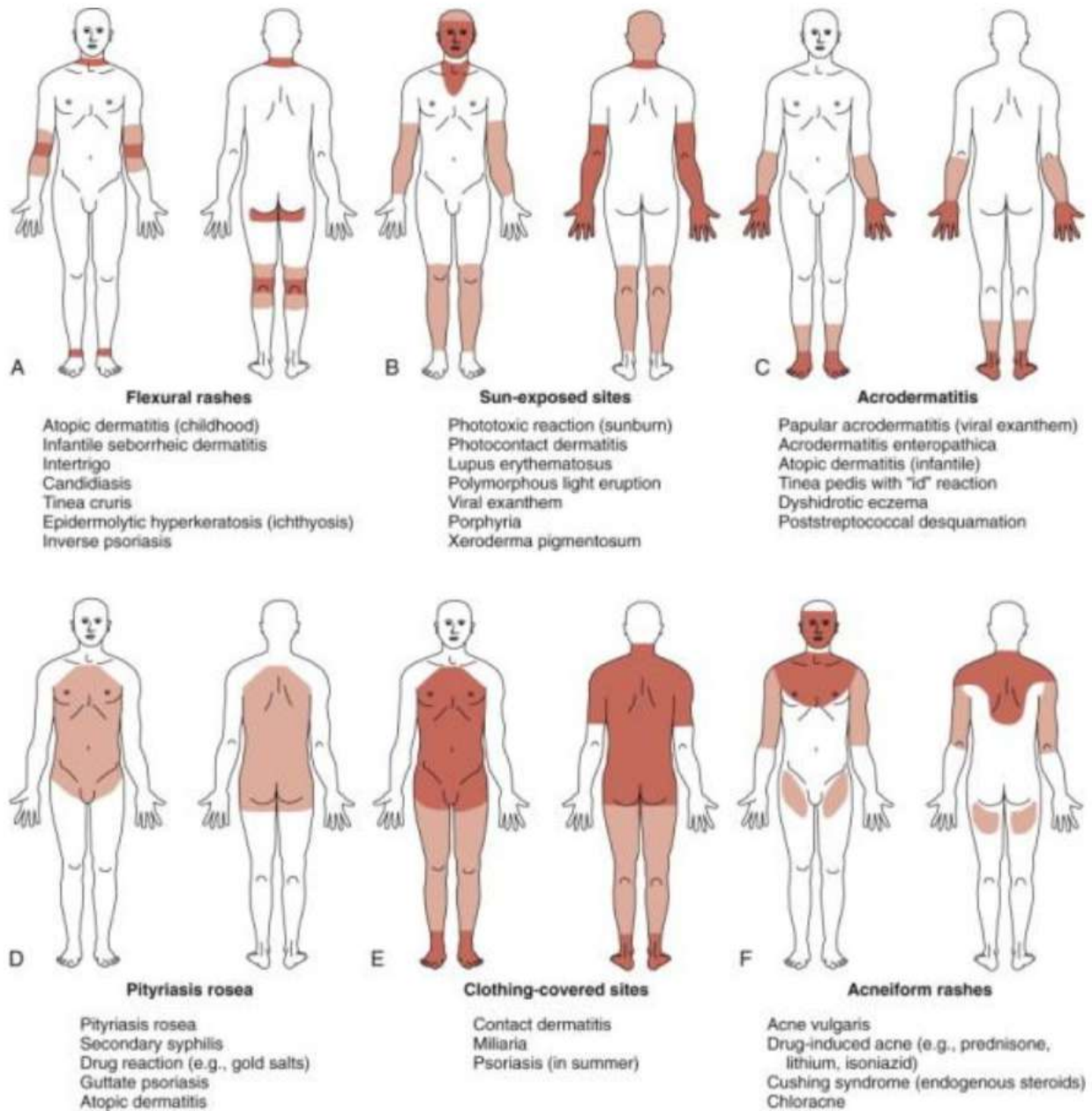
Disease	Sign
Cytomegalovirus infection	Owl's eye appearance of inclusion bodies <sup>[4][5]</sup>
Hodgkin's lymphoma	Reed-Sternberg cells (giant mono- and multinucleated cells) upon microscopy
Lyme disease	Erythema chronicum migrans <sup>[6]</sup>
Inclusion body myositis	Filamentous material seen in inclusion bodies under electron microscopy
Hypocalcemia	Trousseau sign and Chvostek sign
Tetanus or Strychnine poisoning	Opisthotonus sardonicus
Measles	Koplik's spots
Wilson's disease	Kayser
Diphtheria	Pseud
Chronic hemorrhagic pancreatitis	Grey-T
Cholera	Rice-v
Enteric fever	Rose
Meningitis	Kernig
Angina pectoris	Levine
Patent ductus arteriosus	Machi
Parkinson's disease <sup>[citation needed]</sup>	Pill-rol
Whipple's disease	Oculo
Acute myeloid leukemia	Auer r
Multiple sclerosis	Bilater
Pericarditis	Perica
Rheumatic fever	Ascho
Rabies	Hydrophobia and negri bodies



**Koplik's spots** are a prodromic viral enanthem of measles manifesting two to three days before the measles rash itself. They are characterized as clustered, white lesions on the buccal mucosa and are pathognomonic for measles. The textbook description of Koplik spots is ulcerated mucosal lesions mark

Figure 5: Pathognomic symptoms and signs direct towards a specific disease. [Wikipedia](#)





**Figure 6:** *Pattern recognition is an important tool.* As longer doctors have experience, the more they can rely on this skill. *Atlas of common Pain Syndromes, Waldman*