



# Diagnostic Approach in Ambulatory Medicine

Verdon F\*

Department of Ambulatory Care and Community Medicine, University of Lausanne, Switzerland

## Abstract

**Objective:** Analyses on the spot the principal determinants of diagnostic process in primary care.

**Materials and Methods:** In a multicenter observational study, 59 experienced GP evaluated the potential threat of the clinical condition and their diagnostic hypotheses in 672 consecutive patients with chest pain during the initial consultation, after three months and after one year.

**Result:** The diagnostic procedure was consistent from a GP to another, and started immediately during the consultation. One or two min after the identification of chest pain, the GP proposed diagnostic hypotheses for 70% of the patients and offered an assessment of the potential danger for 85% of them. The clinical status assessed as potentially dangerous led to an aggressive diagnostic strategy. The initial impression was often modified subsequently so that the final diagnosis was reached in 51% of cases after one to two min, in 81% at the end of the consultation and in 97% after one year. The difficulty of diagnosis and the degree of anxiety of the patients and GPs delayed the diagnostic. Irrational factors such as personality, anxiety or gender of the physician and of the patient influenced the approach. This one seems linked to an intellectual endeavor appeared very early in the evolution.

**Conclusion:** In primary care, the diagnostic process quickly starts with the assessment of risk associated with the condition and the laying of first diagnostic hypothesis. This intuitive process is followed by an analytical activity based on clinical and, if necessary, paraclinical data. It is mainly founded on the clinic.

**Keywords:** Paraclinical; General practitioners; Ambulatory

## Introduction

In medical schools and in teaching hospitals or when complex cases are reported in medical journals the diagnostic approach is considered as an analytical (or hypothetical deductive) process using epidemiological, clinical and laboratory data [1]. Emergency medicine does often provide algorithms based largely on paraclinical data for definite clinical status [2]. In general practice, the process of making a diagnosis does follow other poorly understood pathways. General Practitioners (GPs) are required to identify serious conditions but must also face all problems, including benign conditions that may still be important for the patient. For GPs, there is very little useful data established on evidence based medicine [3,4]. GPs have acknowledged using non specific signs [5,6]. An early intuitive diagnostic impression could also play a role [7]. However the importance of these phenomena has never been quantified. We approached this diagnostic procedure in outpatients complaining of chest pain. Chest pain is a good subject for study because of its high prevalence but also the variable etiology ranging from harmless to potentially life threatening. This study evaluates the importance of intuitive, analytical, clinical and paraclinical elements.

## Materials and Methods

### Setting

GP researchers in family medicine associated with an academic primary care department chose chest pain as a research object. They opted for a no-invasive observational study through questionnaires, set up a network of family practitioners, and organized the study with three objectives:

- Defining the epidemiology of chest pain in an ambulatory setting
- Defining the clinical markers of the different clinical conditions causing chest pain
- Studying the diagnostic process. This later is considered here

Data collection took place in years 2001 to 2002 and the very large database was reviewed and

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### \*Correspondence:

Verdon F, Department of Ambulatory Care and Community Medicine, University of Lausanne, Switzerland,

Tel: 41 79 931 11 65;

E-mail: fverdon@net2000.ch

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**Table 1:** Categorization of retained diagnosis at one year for 672 office patients with chest pain studied in a general practitioners network in the French part of Switzerland, -years 2001-2005.

Categories of chest pain (% patients)	Specific diagnosis for chest pain		Complex diagnosis *
	Not life threatening	Potentially life threatening	
Musculoskeletal chest pain -49%	Chest wall syndrome, trauma, rib fracture, referred shoulder or spine pain	Costal metastasis and tumoral invasion	Costal metastasis and tumoral invasion
Cardio-vascular origin -16%	Arrhythmia without circulatory failure, acute hypertension, aortic stenosis, mitral prolapse, acute hypertension	Stable or unstable angina, myocardial infarcts, arrhythmia with instable circulatory state, pulmonary embolism	Cardiomyopathy, acute hypertension, arrhythmia
Psychogenic chest pain -11.5%	Anxious state, acute anxiety and panic attack, anxiety-depression, somatoform disorder	-	Somatoform disorder
Respiratory origin -10.5%	Bronchitis, asthma, COPD	Pneumonia, pleurisy, acute asthma	Pulmonary abscess, pulmonary cancer
Digestive origin -8%	Peptic affection: esophagitis, gastritis, gastric ulcer, oesophageal spasm	Oesophageal cancer, pancreatic cancer, acute cholecystitis	Oesophageal spasm, acute cholecystitis, digestive cancers
Miscellaneous -2%	Mastitis, mastalgia, herpes zoster, skin infection, chest wall keloid, sarcoidosis	Acute pyelonephritis	Sarcoidosis Acute pyelonephritis
Without diagnosis -3%	-	-	-

\*complex diagnoses are specific diagnoses with difficult clinical problem solving necessitating complementary investigation or diagnoses retained after a process of exclusion

analyzed until 2005.

## Design

The research network of 59 family practitioners evaluated the diagnostic process in 672 patients consulting their doctors for chest pain. They evaluate the approach 1) at the first encounter after each step of consultation: the initial appraisal, history, physical examination and at the end of the encounter 2) at three months, when the majority of even complex cases have found a solution and 3) at twelve months, in light of the evolution data and possible new investigations and new treatments.

## General practitioners

Fifty eight participating GPs working in private in the French part of Switzerland were included, as well as six residents of an academic primary care outpatient department counted globally as one additional GP. They were not randomized but joined after personal contacts and participated without remuneration. The practices were located in both urban (37 GPs) and non urban areas, relatively close to an emergency centre. Nine female and 49 male GPs took part to the study. Their average experience in private practices was 12 years following 7 years to 11 years of postgraduate hospital training. They received detailed information on the study and were trained to fill in the forms. GPs had to handle medical decision in their usual way, without external intervention. Most participants did practice in their office electrocardiograms and emergency laboratory tests. They were free to require more specific tests and to ask for specialist consultation.

## Patients

GPs consecutively enrolled all patients over sixteen years of age who reported any type of chest pain during their visits as a main or minor medical complaint over a three to nine week period (median, five weeks) from March to May 2001. Patients were seen by their physician at day one with a control planned for at three and at twelve months. Patients participated willingly and each patient gave informed consent.

## General data

Physicians recorded their observations and their first diagnostic hypothesis on questionnaires validated in a pilot study. All questionnaires were filled immediately after identifying a complaint of chest pain and after each step of consultation. This initial form reported general patient data and characteristics of chest pain.

Detailed history, physical examination, level of anxiety expressed by patients and physicians were reported with possible emergency tests results, comorbidities, medication and treatment decision at the end of the consultation, decision to refer the patient to a specialist or hospitalization. Questionnaires at 3 months evaluated investigations, treatment, and evolution. After twelve months, an ambulatory check up examination was performed or, by default, a telephone interview was made (13% patients).

## Specific data for diagnostic formation

The potentially serious nature of the condition and the suspected diagnosis were noted at the different steps of the consultation, and at three months. At twelve months, the evolution, new diagnosis if any, final diagnosis, and degree of certainty were recorded.

## Data processing

All completed forms were sent to the study coordination centre. A set of predefined criteria was used for data entry checks and double data entry was used to identify transcription errors. Inconsistencies or missing data were reported to the principle investigators, who contacted physicians for case resolution. Data cleaning and validation was performed by a group of physicians experienced in research.

We used the diagnosis retained after one year of follow up as the definite diagnosis. Forty three patients were lost to follow up. For the 25 patients deceased, the diagnosis at the time of death was used. For the 18 other patient lost to follow up, the three month diagnosis was considered the final diagnosis. When the diagnosis reported by the family practitioner was not consistent throughout the year of follow up, it was discussed and approved by a group of independent clinicians.

## Statistical methods

The test was used for continuous variables, and the chi-square test for data expressed as proportions. All statistical analyses were performed with Statview 5.0 or Stata 7.0 and CIA 2.1.3 for confidence intervals or predictive values calculation. Factors significantly implicated in the diagnosis process were identified in a univariate analysis. To determine independent indicators, these factors were introduced in a multivariate logistic regression and the influence of clinical factors was given by the pseudo R-squared of the logistic regression. Homogeneity of emergency identification and of diagnosis timing across GPs was verified by one-way ANOVA. Hastiness of

evaluation of the risk, early diagnostic guess, and retained diagnosis was compared between the diagnostic classes with the non parametric Mann-Whitney U test; significance level was set at  $p < 0.05$ .

## Result

Categories of chest pain, potentially life threatening condition and complex diagnosis are reported in Table 1.

### Identification of danger

The assessment of the potential risk of the disease was made in 85% of patients one to two min after the pain complaint. The condition was considered serious in 162 patients, benign in 409 and uncertain in 101 patients. The 162 patients suspected of a serious condition included 95 of the 134 patients confirmed as severe at one year (Positive Predictive Value 0.59; Negative Predictive Value 0.92). At the end of the consultation, a serious condition was considered in 142 patients including 113 of these 134 patients (PPV 0.80; NPV 0.96). The disquietude of physicians for 99 patients was correlated with a diagnosis of gravity ( $r=0.33$ ). In contrast, the anxiety expressed by 381 patients was not ( $r=0.03$ ).

### Timing of diagnosis hypothesis

Figure 1 reports the diagnosis guess (white columns) at different times of the first encounter, and at three months. One to two min after the description of pain, the physicians reported a specific early diagnosis guess for 472 patients (70.2%); they did not report a diagnostic guess in 200 patients. The diagnostic prevision improved after history, after physical examination and at the end of the first visit with a cumulative guess diagnosis for 97.5%, and 99.1% at three months. As for identification of danger, the first diagnostic hypothesis was made later when the patients were anxious, and more quickly by women physicians than by men.

### Timing of retained diagnosis

The initial assumptions have been changed up to one year 217 times in 178 of 672 patients (26.5%) ((Figure 1) columns grayed). In view of these changes the final confirmed diagnosis was made after the first min in 50.9% of patients. The diagnostic accuracy improved after history, after physical examination and at the end of the visit with a cumulative specific diagnosis for 80.9%, and 93.8% for up to three months ((Figure 1), black columns). At the end of the consultation, the diagnosis was less frequently made for complex diagnoses, for older age of the patient, for unknown patient, in the presence of psychiatric comorbidity and when the doctor felt anxiety.

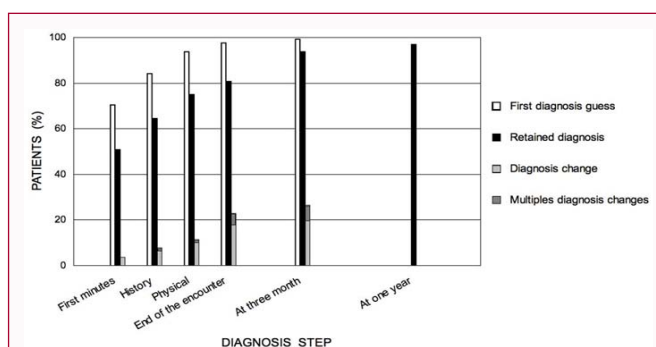
### Diagnosis consistency among GPs

There were no important discrepancies among the 59 participating doctors in evaluating the danger facing the patient. It was formulated within one minute in the five groups significantly faster, at the beginning of history in the forty average groups, and at the end of history in the six groups significantly slower.

There were similar differences in the timing of first diagnostic hypothesis. Clinical factors described above partially explain these differences whereas the examining physician factors such as age, gender, experience contributed little, suggesting that the personality and methodology of GP matter more.

### Importance of the laboratory tests, imaging and specialists

Diagnostic tests were made in 202 emergency patients (30%). After the consultation, physicians have asked for additional tests for 193 patients (29%), a specialized consultation was required for 111



**Figure 1:** First diagnosis guess and retained diagnosis during the first encounter, at three month and at one year for 672 office patients with chest pain studied in a General Practitioners Network in the French part of Switzerland, during the years 2001-2005. A first diagnosis guess is reported within one to two minutes for 70% of the patients and does progress during the first encounter and until the third month (white columns). Initial hypothesis can change once or several times for 26.5% of the patients at one year (greyed columns). Additional diagnosis guesses are made up to one year. At one year the first minute(s) diagnostic hypothesis is confirmed in 51% patients and at the end of first consultation hypothesis is confirmed in 81% (black columns). Correct diagnosis progress between the first consultation and the three months step and, less strikingly, between three months and one year.

patients (17%) (Table 2) and thirty three patients (5%) were sent to a hospital. A total of 341 patients (50.7%) did benefit from diagnostic tests.

Emergency tests were required more often when a serious condition was suspected, when a diagnosis could not be made and in patients previously unknown to the physician, in emergency consultation, and for anxious patients. They were very helpful: A diagnosis was made significantly more often for such patients by the end of the first consultation. In addition these tests changed the diagnosis of 9.9% compared to 2.3% in patients without tests.

Delayed tests were mostly required when a serious condition was suspected, when no diagnosis could be made, when the physician was a woman and/or when the practitioner had less than 3 years of experience. A change in diagnosis resulted respectively in 18.1% vs. 9.4% at three month. The degree of diagnostic confidence as assessed by the GP rose significantly too. The request for delayed test was not always diagnostic but often for patient or doctor reassurance particularly in psychogenic, parietal, and digestive aetiologies (Table 2).

Specialists (mainly cardiologists) were consulted more often in absence of a diagnosis. Male patients and patients treated by women doctors were more often referred. Female patients with a suspected cardiac condition were referred notably less frequently to a cardiologist than male patients [8]. After the specialist evaluation the degree of diagnostic confidence rose significantly.

### Aggressive vs. conservative diagnostic strategy

The diagnostic approach was affected by hypothetical etiology of pain. For example the clinical approach was more aggressive for recently appeared cardiocirculatory chest pain than for recently appeared psychogenic chest pain. Among 46 new cardiac patients, 61% were diagnosed in the first min and 89% at the end of the consultation. For the 48 new patients with psychogenic pain the diagnosis was suspected at the first min in only 33% and at the end of the consultation, in 67% cases. This contrasts strikingly with cardiac cases. Overall, the diagnosis of cardiac disease was wrongly suspected

**Table 2:** Emergency and delayed diagnostic tests and reference to specialists for 672 office patients with chest pain studied in a general practitioners network in the French part of Switzerland, -years 2001-2005.

Categories of chest pain	n	Emergency diagnostic tests n (%)	Delayed diagnostic tests n (%)	Most frequent mentioned goal	Specialists 1) and specialized tests 2) n (%)	Most frequent expectation from specialist
Musculoskeletal chest pain	331	87 (26)	88 (27)	Patient reassurance	31 (9)	Preclude an affection
Cardio-vascular origin	108	37 (34)	37 (34)	Diagnosis	37 (34)	Diagnosis
Psychogenic chest pain	77	21 (27)	14 (18)	Patient reassurance Preclude an affection	12 (16)	Preclude an affection
Respiratory origin	71	32 (45)	25 (35)	Diagnosis	7 (10)	Diagnosis Doctor reassurance
Digestive origin	55	16 (29)	17 (31)	Preclude an affection Patient reassurance	16 (29)	Diagnosis
Without diagnosis	21	8 (38)	10 (48)	Preclude an affection	7 (33)	Preclude an affection
Miscellaneous	9	1 (11)	2 (22)	-	0 (0)	-
Total	672	202 (30)	193 (29)	Preclude an affection	111 (17)	Diagnosis

1) 130 specialist references for 111 patients: Cardiology 79; gastroenterology 28; pneumology 11; rheumatology 8; psychiatry 2; neurology 1

2) Ergometry and stress echocardiography 51; coronaro-/scintigraphy 18; cardiac echography 15; Holter 5; gastroscopy 25; other 7

more often than for psychogenic pain.

Additional diagnostic tests were requested more often in patients suspected of having cardiac disease and the reasons for these exams were different. In the cardiac group, tests and referral to specialist were performed mostly for diagnostic purposes, and in the psychogenic group mostly for patient reassurance (Table 2).

### GPs' view

The GPs assessed at three months the decisive factors leading to their diagnosis. Six clinical key factors were: history (80% of patients), physical examination (69%), prior knowledge of the patient (64%), initial impression (50%), evolution (29%), and a therapeutic trial (21%). Additional information was obtained by a specialist consultation (15%), deferred exams (12%), emergency tests (9%), and hospital diagnosis (7%). In 67% of cases the primary physician made a diagnosis exclusively by history and physical examination, in 30% paraclinical tests were added to the clinical impression and in 3% of cases paraclinical information was the only diagnostic tool.

### Weakness and strength

There is a long period of time from field study to publication. Nevertheless one could hardly imagine a new very efficient diagnostic tool able to fundamentally change the process. Possible biases are the absence of randomization to select a representative sample of GPs. The way of doing could be different with a different selection process. Also no monitoring was possible to check that the GPs really enrolled consecutively all patients who reported chest pain, and that questionnaires were really filled in sequence "on the spot". Finally physicians possibly behaved differently during the initial patient encounter due to the additional paperwork and distraction. However, few studies examined the performance of the sense of danger, of the first diagnostic impression, or timing and diagnostic determinants for patients presenting with a medical problem. Study data were collected from multiple private practices, from a large patient sample size and from a variety of physicians showing a notable adherence quality to the study protocol.

### Discussion

The observation "on the spot" of the diagnostic process followed by experienced GPs facing patients with chest pain reveals the following facts: (1) the assessment of a critical case is made very quickly; (2) an early diagnostic guess is most often made after the first min of the patient's complaint; (3) an analytical process starts soon after the

initial hypothesis and can continue until the end of the consultation and beyond; (4) this diagnostic approach is common to all physicians.

The GPs face thoracic pain with an assessment of the danger it represents within the first min in the majority of patients. At this very early stage of the consultation, risk identification is necessarily based on very little objective data: a short history, physical examination limited to general signs, body language, etc. Others have recently described such a sense of danger in general practice as "an uneasy feeling perceived by a GP as he/she is concerned about a possible adverse outcome, even though specific indications are lacking" [9,10]. The GPs suspect more dangerous conditions that will finally be confirmed (the "precautionary principle"). Sensibility and specificity for the prediction of acuity at the first min are relatively high and comparable to the values reported in a department of emergency medicine [11].

The first diagnostic hypotheses are also made very quickly and are unchanged at one year in half of all patients. Thus the final diagnosis is obvious "at first glance" for one out of two patients [7]. This early diagnostic hypothesis is mostly based on weak non verbal signals [5,12]. The hazard assessment and early diagnostic hypothesis are dependent on intuition. Intuition can be defined as an ability to acquire knowledge without inference or the use of reason. Greenhalgh [13] best described the key feature of intuition in diagnosis as " - a rapid, unconscious process; - context-sensitive; - comes with practice; - involves selective attention to small details; - cannot be reduced to cause-and effect logic; - addresses, integrates, and makes sense of multiple complex pieces of data". The psychological anthropologists interested in the evolution of human thought suggests that at an early period, it was vital for mankind to develop systems for rapid and effective assessment of danger, to judge reliability and health status of clan members and non members by incomplete communication elements [14-17]. Thus intuitive medical diagnosis could be the heir to neocortical inference systems working unconsciously and very rapidly with the help of (hypothetical) mirror neurons [18,19]. Let us accept that the diagnostic process depends on a phylogenetic mechanism which appeared early in evolution. So it may be independent of ethnic, cultural, socioeconomic and medical considerations.

A high success rate shows the efficiency of the intuitive process, but the initial diagnostic hypothesis is corrected in one in four patients, showing its limits [1,20]. It is delayed when the diagnosis is complex, or new, or when the patient was previously unknown, and

mostly by emotional factors such as patient' or the physician's anxiety [17,21,22].

In the case of complex problem solving presented to an expert, Elstein [23] noted that 3 to 4 diagnostic hypotheses are discussed immediately followed by others related to tests [1]. The initial assumption is the starting point of an analytical process further refined by more complete data. Kassirer and Kopelman [24] suggest that a hypothetico-deductive approach is preferably chosen by less experienced doctors or when the early pattern recognition fails. Our observations agree with those of Elstein and of Kassirer. The GPs are aware of their intuitive approach and its limits and there is a cognitive continuity from what Croskerry [26] called informal/intuitive to computable/analytical process [25-27]. Which is shown in the present study by the process of rapid intuitive diagnostics either maintained, corrected, or abandoned later.

What is the contribution of laboratory tests and imaging [28,29]? Previous publications suggest that the majority of diagnoses in general practice is made without paraclinical data, even in an academic center [30-33]. However, these publications predate the impressive progresses of medical technology. Obviously the severity of diagnoses and complex diagnoses cannot dispense with today's reliable paraclinical investigations but such cases are not the most frequent in daily practice of most GPs. In our study, half of patients with chest pain did not require diagnostic tests. For cases that have provided such information, the gain in terms of diagnoses or diagnostic safety is significant and similar to what has been shown in previous studies [34,35]. The need to clarify the risk and the diagnosis does not explain, however, all of the examinations carried out: We also notice an emotional motivation such as patient anxiety, the desire to reassure him, physician's gender and style, as well as patient gender. Other characteristics such as other emotional problems, communication problems, the requirements of patients, legal protection, economic incentive etc. have been described [5,22,36-39]. For all these reasons it is difficult to evaluate the contribution of laboratory and imaging tests to the diagnosis. In any event, a revolutionary paraclinical examination or innovating clinical prediction rule could hardly change the diagnostic approach since it would be valuable after the initiation of diagnostic approach only. Ultimately, evaluating the danger of disease, starting diagnostic assumptions, deciding the need for tests, and integrating the whole into the global picture remains the ultimate clinical process that will benefit from further progress diagnostic tests without being supplanted by them. As the diagnostic approach in general practice is based on the clinic, the medical training has to enable the accumulation of clinical experience fundamental to develop intuitive approach. It also has to complete the skills in history taking, physical examination and communicating with a patient [40].

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