Evaluation of the prescription of additional examinations in emergency departments

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Abstract

Objectives: This study aimed to describe the state of play of the prescription of additional examinations in the emergency department and to analyze the contribution of additional examinations in the treatment of acute pathologies, as well as the benefit of their prescription.

Methods: Prospective study including patients in the emergency department. A standardized questionnaire was completed by the clinician (resident, resident, or senior doctor) responsible for the initial management of the patient.

Results: 179 patients including 42.4% men and 57.6% women were included in our study, additional examinations were carried out on 144 patients; 80.4% of the population; 728 examinations. 494 examinations were biological (67.85%), 105 radiological examinations (14.42%) and 129 other types (17.73%). 68.7% of these exams were prescribed by interns, 29.6% by residents, and only 1.7% by seniors who were only notified in 48% of cases.

Among the additional examinations requested, 61.03% of the biological examinations were of little or no contribution to the diagnosis and therefore inappropriate.

We found that 30.8% of the radiological examinations requested were of little or no contribution to the diagnosis and therefore inappropriate, among the most incriminated are Abdominal X-rays in 100% of cases and X-rays of the urinary tract.

78.8% of the diagnoses made after the complementary examinations agree with the initial hypothesis diagnosis at the end of the clinical examination. To improve the behavior of the doctors prescribing these additional examinations and to reduce abuse, it is necessary to have good training of the doctors on the recommendations and the diagnostic value added by the additional examinations as well as the establishment of the protocol of prescriptions.

Overall residence time is also considered to be the key parameter for clinical progress and operational efficiency and explains the congestion in the emergency department. During our study, the ORT was 10 min to 1540 min with an average length of stay (ALS) estimated at 61 min without additional examinations and 3 h 33 min with a request for additional examinations.

One of the main causes of the delay in recovering additional examinations is the lack of coordination and management of the various health personnel, doctors, nurses, and stretcher-bearers.

Conclusion: Despite the existence of recommendations, a large number of additional examinations are unnecessarily prescribed to emergency departments. These prescriptions are responsible for an increase in the time and cost of treatment.

Keywords: Complimentary tests; Blood tests; Imaging; Evaluation; Emergency department; Management.

INTRODUCTION

Emergency physicians must deal with various and often complex pathologies. The clinician's main role towards his patient is to make a precise diagnosis essential for appropriate therapeutic management. Medicine today allows us to use an infinite number of biological and radiological examinations used in addition to the clinical examination in the diagnostic process, but a large number of doctors have become very fond of these complementary examinations.

Although some clinical situations require little or no further investigation, unjustified prescriptions are common observation, resulting in unnecessary work for caregivers, laboratory and radiology technicians, not to mention the time lost for parents, the cost generated, the pain inflicted and the risks of error inherent in any investigation, therefore as with any medical decision, the benefits and risks must be carefully weighed and in particular the question of the usefulness for the patient.

METHODS

This is a prospective mono-center study carried out at the Emergency Department of the Farhat Hached University Hospital Center in Sousse. The main objectives were to describe the state of play of the prescription of additional examinations in the emergency department (ED), to analyze the contribution of additional examinations in the treatment of acute pathologies, as well as the relevance of their prescription.

All patients were recruited randomly from 8 p.m. to 11 p.m. during three months, with exclusion criteria as follows: patients under 15 years, presenting for non-traumatic pathology, patients in arrest, or early death (before the establishment of the examination), outgoing patients against medical advice, escaped patients, patients referred with a pre-established diagnosis and patients with immediate orientation to the emergency room

Data collection was carried out using a standardized paper questionnaire completed by the clinician (resident, resident, or senior doctor) responsible for the initial management of the patient.

The data collected were as follows:

- Administrative and demographic data: file number, date and time of consultation, sex, age
- Triage data: history, the main complaint, triage score, and destination of the patient according to the score (box, sitting area, or in the breakout room)
- Data from the physical examination: diagnoses mentioned request or not for additional examinations, the grade of the prescriber (residents, internal or senior), and senior informed or not.

The nature of the additional examinations requested and carried out in the ED among blood tests analyses, imaging, and other exams: ECG, blood sugar test…

The diagnosis is retained and the orientation of the patient is. Finally, the prescriber must specify whether he has an idea of the cost of the balance sheets requested.

The relevance of an additional examination is the effect of this examination on the improvement of the patient's state of health, during our study this relevance was judged by:

- The contribution to making the final diagnosis by measuring the agreement between the final diagnosis and the diagnostic hypotheses at the start.
- The contribution to establishing a prognosis or a decision to hospitalize the patient.

RESULTS

A total of 179 patients were included in our study (42.4% men and 57.6% women). The average age of the patients included is 49.5 years, with extremes of 5 to 87 years. The age group older than 70 years was 20.5% of patients.

Additional examinations were carried out on 144 patients (80.4%); they had 728 examinations. 494 examinations were biological (67.85%), 105 radiological examinations (14.42%), and 129 other types (17.73%).

68.7% of these exams were prescribed by interns, 29.6% by residents, and only 1.7% by seniors who were only notified in 48% of cases.

The biological assessment was carried out on 110 patients, or 61.5% of the study population. The complete blood count (CBC) seems to be the most requested test among biological assessments with a percentage of 52% followed by the blood ionogram, urea, creatine level, and blood sugar with percentages around 40% of cases (Table 1).

The demand for CPK, LDH, Troponins, amylasemia, and transaminases tests was less commonly prescribed but not negligible with a percentage of around 10% of the cases.

Table 1: Distribution of biological assessments

Test nature	Number of cases	Percentage (%)
CBC	93	52
Ionogram	79	44,1
Creatine level	77	43
Urea	76	42,5
Glycaemia	54	30,2
Troponin	26	14,5
Lipase	23	12,8
CPK, LDH	15	8,4
Liver tests	15	8,4
GDS	14	7,8
level of amylase	10	5,6
TP, INR, TCK	3	1,7
BNP	3	1,7
CRP	3	1,7
Lactate	1	0,6
Myoglobin	1	0,6
Toxicological test	0	0

The average time recovery (ATR) of the biological exams was between 1h30 to 2h00 with extremes of 20 min and 5H (Table 2).

Table 2 : Distribution of the ATR

Test	Distribution of the ATR		
	≤ 30 min	] 30 min-1 h]	> 1 h
	Percentage (%)		
CBC	7,5	31,2	61,3
Ionogram	3,9	22,1	74
Urea	4	20	76
Creatine	5,3	18,7	76
Glycemia	5,7	13,2	81,1
CPK, LDH	0	6,7	93,3
Troponin	0	15,4	84,6
Liver tests	6,7	26,7	66,7
Amylase	10	30	60
Lipase	5	40	55
Blood gases	21,4	28,6	50

Among the additional examinations requested, 61.03% of the biological examinations were of little or no contribution to the diagnosis and therefore inappropriate (Table 3).

Other examinations were very appropriate, thus contributing to the diagnosis in the majority of cases, such as arterial blood gases in 69.2% of

cases and BNP in all cases. 14.5% of patients had useful but not done blood tests.

Table 3: Contribution of biological tests to the diagnosis

Test	Contribution to the diagnosis		
	high	low	absent
	Percentage (%)		
CBC	33	54,9	12,1
Ionogram	16,9	67,5	15,5
Urea	10,8	70,3	18,9
Creatine	12,2	71,6	16,2
Glycemia	20,8	62,3	17
CPK, LDH	0	71,4	28,6
Troponin	64	16	20
TP, INR, TCK	33,3	66,7	0
Liver test	33,3	60	6,7
Amylase	30	40	30
Lipase	39,1	39,1	21,7
Blood gases	69,2	23,1	7,7
BNP	100	0	0
CRP	0	66,7	33,3
Lactate	100	0	0
Proteinemia	0	0	100
Myoglobin	100	0	0

Radiological assessments were requested in 49.2% of the patients (Table 4).

Table 4: Distribution of radiological assessments

Imaging	Case numbers	Percentage (%)
Chest x-ray	29	16,2
Abdominal ultrasound	14	7,8
Abdominal CT scan	9	5,0
Echography	7	3,9
Wrist X-ray	6	3,4
Feet X-ray	5	2,8
Radio du Genou	5	2,8
Abdomen X-ray	5	2,8
Ankle X-ray	3	1,7
Hands' X-ray	3	1,7
Deep vein doppler	3	1,7
Radio du coude	3	1,7
Shoulder X-ray	1	0,6

In 34.3% of cases, the requested assessments were standard x-rays within the foreground chest x-rays with a percentage of 16.2%. CT represents 11.1% of radiological assessments followed by abdominal ultrasound with a percentage of 7.8% of cases.

The average recovery time (ART) for standard radiography is around 30 minutes with extremes of 15 minutes and 1 hour 20 minutes. The ART of ultrasound varies between 1 hour and 09 minutes for the abdominal ultrasound and 2 hours and 45 minutes for the cardiac ultrasound. The average DRR of CT is around 1 hour 35 minutes with extremes of 40 minutes and 4 hours.

Table 5: ART of the radiological assessments

Exam Test	Minimal time	Maximum time	Average time
	Hours	*Minutes*	
Chest X-ray	00:15	01:20	00:37
Abdomen X-ray	00:05	01:00	00:37
Wrist x-ray	00:15	00:50	00:32
Hand x-ray	00:20	00:30	00:25
Foot x-ray	00:18	00:40	00:29
Elbow x-ray	00:20	00:35	00:27
Shoulder x-ray	00:30	1:00	00:45
Brain CT scan	00:40	03:20	01:36
Abdominal CT scan	01:00	04:00	01:45
Doppler ultrasound	00:30	02:00	01:15
Echocardiography	1:00	4:30	2:45

It was found that 30.8% of the radiological examinations requested were of little or no contribution to the diagnosis and therefore inappropriate, among the most incriminated are Abdominal X-rays in 100% of cases and Urinary tract X-rays. 9.5% of patients had useful but not done radiological examinations (Table 6).

For the concordance of the diagnoses, 78.8% of the diagnoses made after the realization of the assessments agree with the initial diagnosis at the end of the clinical examination. Patients stayed on average 178 minutes (approximately 3 hours) with extremes of 10 min to 1540 minutes (25 hours and 35 minutes). Patients who did not have additional exams spent an average of 74 minutes in the emergency room, compared to an average

of 209 minutes for patients who had additional exams.

Table 6: contribution of radiological assessments to diagnosis

Test	Contribution to diagnosis		
	High	Low	Absent
	Percentage (%)		
Chest x-ray	44,8	44,8	10,3
Abdominal x-ray	0	100	0
Ankle x-ray	66,7	33,3	0
Wrist	100	0	0
Hand	50	50	0
Foot	60	20	20
Knee	80	20	0
Elbow	100	-	-
Shoulder	100	-	-
Abdominal CT	77,8	11,1	11,1
Urinary tract x-ray	-	-	100
Deep vein doppler	100	-	-
Echocardiography	100	-	-

In 41.8% of cases, patients who carried out radiological or blood tests were hospitalized versus 93.9% of the patients who did not carry out tests were discharged.

Table 7: Average length of stay (ALS) of patients at the ED with or without complementary assessments (N=110).

ALS	Without complimentary assessments	With complimentary assessments	P
	Minutes		
Average (±SD)	74,2 (60,83)	209 (213,47)	**0,002***
Minimum	10	15	
Maximum	220	1540	

During our study, the questionnaire made it possible to show that 172 prescribers, or 96.1%, had no idea about the real cost of the examination requested.

The total cost of the additional examinations among the 144 patients amounted to 8,798 Tunisian dinars (DNT) of which 44% (3,927 DNT) were spent on inappropriate examinations.

DISCUSSION

Although a large number of diagnoses were made based on clinical examination alone, the remaining two-thirds were obtained through the combination of clinical examination and the results of additional examinations.

To better assess the relevance of these prescriptions, we will focus below on their analysis and try to find solutions to better rationalize it in an environment of the economy of health expenditure.

At the end of our study, we identified 728 requests for examinations, including 494 requests for biological examinations and 105 requests for medical imaging examinations.

1- Analysis of blood tests request

Biological examinations represent 67.8% of all requested examinations, prescribed for 61.5% of patients. Concerning the frequency of requests for these exams: the blood count was the most requested exam with 52% of cases, followed by the blood ionogram. These results are similar to other studies carried out in Tunisia which showed a percentage of 51% (2) (3).

Indeed, these two complementary examinations, the results of which have a very low discriminating impact seem to be requested in an almost systematic way and are integrated into an irrelevant diagnostic approach. (4)

Out of all the prescriptions, elementary biology only modifies 5% of diagnoses or treatments in primary care (4) (5).

These results observed in our study are favored by easy access to the emergency department for complementary routine examinations and the

motivations of prescribers are often questionable: assessment of unscrambling, prescription ritual, preparation of the file for a senior or a potential specialist referent, patient's insistent request, forensic aspect (6--8).

Several studies have clearly shown, in the diagnostic process in primary care, the limited value of routine biological examinations and the tendency to minimize the importance of a good history and a rigorous physical examination behind the justification of a more scientific (4) (5)(9)(10). It is the clinical data at the presentation of the patient which must guide the choice of additional examinations in the event of diagnostic doubt. It is in this situation that their contribution will be most beneficial (11) (12).

A Brazilian study published recently in the "American Journal of clinical pathology" highlighted the systematic nature of certain requests for additional examinations in a university hospital, especially by residents and residents, and the redundant nature of these requests without even taking into consideration subsequent results. (13)

The demand for insensitive and unspecific exams (such as CRP, CPK, and LDH) remains fairly frequent: the CPK, and LDH represent 8.4% of the examinations requested, which is important and often irrelevant.

Indeed, for diagnostic hypotheses, the contribution of a specific examination depends on its predictive value which is determined by its sensitivity and specificity. Furthermore, the prescription of additional examinations can only be conceived in a reasonable diagnostic approach and the result of a diagnostic examination will be all the more helpful if the prevalence of the disease is very low or, on the contrary, very high. It is therefore always necessary to combine the test result with the prevalence of the disease and if possible, with the probability of the pre-test being evaluated more precisely by the clinician and the clinic.

2- Analysis of the demand for imaging

Imaging tests in our study represent 14.4% of all tests requested and performed in more than 49% of patients. The chest radiography is the most requested examination with 16.2%, it is legitimate because this radiological examination is essential and constitutes a mine of information on various pathologies, it is the imaging examination of the first intention of the chest, whose indications are very broad in front of any clinical thoracic sign (14) (15).

The chest x-ray is followed by abdominal ultrasound with 7.8%, then a brain scan with 6.1%. Indeed, today, sophisticated imaging techniques such as ultrasound or CT-scan are easily prescribed during the diagnostic process to refine diagnostic certainty and guide therapeutic decisions, while certain diagnoses such as appendicitis have long been purely clinical diagnoses, it is rare today that an appendectomy intervention is scheduled without supporting imaging.

Modern imaging techniques when used appropriately allow for faster and more accurate diagnosis and management. However, they are sometimes used improperly to reassure the prescriber or even as a defensive measure against

an allegation of professional misconduct (16). In addition, the result of an examination can be a false negative, contrary to what the patients think, and reassure them false, or on the contrary a false positive, and lead to abusive treatments.

Although these imaging techniques are generally benign for occasional use, they increase the cost of medical care significantly at a time when healthcare costs need to be controlled more than ever. Only when the added value in establishing an accurate diagnosis or in modifying therapeutic management is demonstrated (14). They should not, in any case, replace a good clinical examination, for example in the case of cardiac ultrasound, careful auscultation must be the essential clinical step for the diagnostic approach.

3. Analysis of deadlines

3.1. Overall residence time (ORT) and request for additional examinations

One of the most critical issues that doctors, nurses, and patients face every day is the overcrowding of emergency departments. It is associated with the increase in the risk of disruption of the care system with the departure of patients without being seen, and the increase in stress within the nursing staff (18). Apart from these problems, overall residence time represents an important measure of the quality of care in the emergency department. Several studies have found that overload is associated with an increase in this ORT (19) (20).

Overall residence time is also considered to be the key parameter for clinical progress and operational efficiency and explains the congestion in the emergency department. During our study, the TSG was 10 min to 1540 min with an average length of stay (ALS) estimated at 61 min without additional examinations and 3 h 33 min with a request for additional examinations. Compared to a similar study conducted within the same emergency department at the Farhat Hached CHU and published in the Maghreb Medical Journal in 2003 where the average length of stay for patients was 62.31 ± 143.9 min (range: 4 min - 2 days and 15 min). The overall length of stay has decreased significantly since then but remains high. This is due to the excessive demand for additional examinations, hence a more rational demand with a faster recovery of the results is essential to decrease the TSG and therefore to the improvement of the quality of the management in the emergency department.

3.2. Deadlines for recovery from biological exams

Each doctor wishes to have the results of additional examinations available without delay, but the reality is very different. Given the successive procedures in our structure, between prescription and the results, an average recovery time (ART) of 1h46min with a median estimated time of 1h30 min does not seem to us so important. It is comparable to the delays that we have found in the literature. Our feeling, like that of many emergency physicians, is that this period should be shorter, the extreme values, oscillating between 20 minutes and 5 hours, are the reflection of a very great heterogeneity of the results, which is valid for all ART studied. They

raise two questions: the relevance of the additional examinations requested on one hand, and the availability of the prescriber when the results arrive on the other. The crucial question of the impact of these prescriptions on the care of the patient was already highlighted by Holland et al in 2005. One might think that taking cognizance of a biological result 5 hours after its prescription has little impact on treatment. These extreme delays also come from poor coordination between the hospital structures which employ a lot of staff, namely the emergency service and the analysis laboratories. We can already hypothesize that the relevance of additional examinations and the organization of staff seem to be inseparable from the problem of reducing delays.

Abnormally long delays can have several causes:

***1* At the Emergency Department**

We can mention a lack of information transmission between the different actors: doctor, nurse, and stretcher-bearer, or a lack of availability of the nurse and stretcher-bearer. Conversely, one wonders if the immediate action of the doctor-nurse-stretcher chain can explain the very short deadlines.

The solution would *be to:*

• Streamline prescriptions, so as not to unnecessarily monopolize paramedical staff, and communication between caregivers: need to inform the nurse as soon as possible of the prescriptions requested. Emphasize the need to bring extremely urgent specimens to the laboratory without delay. We can also offer a solution that involves a major change in the current organization: the training of doctor-nurse-caregiver trinomials. This organization would require constant communication within the healthcare team, allow adaptation in real-time and avoid the digital imbalance between doctor and nurse. It would also require harmonization of the hours of the presence of the different categories of staff. One could imagine the formation of trinomials from 8h to 20h to absorb the peak attendance of 11h and teams from 20h to 8h to absorb that of 18h but current human resources do not allow the implementation of such proposals.

• The installation of a pneumatic circuit between emergencies and the laboratory, to improve transport times. This hypothesis has already been considered and carried out in other emergencies but the technical constraints of our structure do not allow it.

***2* At the laboratory**

This period includes all the successive stages between the deposit of the sample in the laboratory and its availability in full: recording, centrifugation, processing of the sample, and analytical validation.

We are often confronted with significant heterogeneity of deadlines. The analytical validation step seems to be the cause. But also, the lack of technicians especially during the guard and the periods of shift change.

For this, we think that different management of human resources in the analysis laboratories could improve the biological DRR. To do this, we can provide two proposals: the first would be to increase the number of laboratory technicians,

for biochemistry analyses at first; however, this proposal is subject to the economic constraints of the hospital. The second would be to adapt the number of laboratory technicians according to demand. We believe it is lawful to increase the number of technicians during peak periods, as well as during laboratory duty periods, that is to say from 7 p.m. This increase can be obtained by reorganizing timetables without being subject to budgetary constraints linked to the increase in the number of staff.

• Implement an IT system via an intranet network between the emergency department and the laboratories allowing them to receive the analysis results instantly in the emergency room, once available. This electronic transmission of biological results is widely used in European hospitals thanks to "ad hoc" software

• Promote analyzes of localized biology enabling certain analyzes to be carried out in the emergency department itself, which we hope to have soon.

Based on several recent studies which have shown proof of their effectiveness, we think that these analyzes are interesting in terms of saving time, as we have just seen. More recent studies also encourage their use to improve the waiting time for results (21) (22).

Offshored biology is currently a booming sector in certain developed countries and currently allows the determination of several parameters such as blood sugar, HbA1c, NT-pro BNP, INR, D-dimers, blood gases with pH, blood ionogram, lactates, and hemoglobin (25).

It would be useful to evaluate in the future if this means does not push the practitioner to over-prescription too.

The development of this type of analysis will raise the question of responsibility in terms of the sampling route and confidence in the results. At present, it is up to the biologist to ensure the quality of the sample, its transport, and its registration.

It will therefore be necessary to attach importance to the personnel who process the samples and to train them in the correct methods.

3.3. Time to recover the radiological assessment:

According to our study, the DRR of conventional radiographs was on average 35 minutes with a maximum of 1 hour 30 minutes, for ultrasound scans an average DRR of 1 hour with a maximum of 2 hours 30 minutes; for CT, the average DRR is estimated at 1 hour 30 minutes with a maximum of 4 hours.

- For imaging, following the radiologists' proposals: access to conventional imaging examinations must be in real-time, using radiology stations dedicated to emergencies, with access to specialized imaging examinations in real-time for the scanner (priority access in the absence of a scanner dedicated to the emergency department or immediate access to the scanner dedicated to the emergency department depending on the volume of patients treated daily in the emergency department); priority access to the MRI in case of indication retained.

- For ultrasound, its use in emergency medicine is essential. The emergency room physician must

be able to detect a large abundance of pericardial effusion, fluid or gas pleural effusion ... or detect an abdominal emergency

A generation of doctors will need to be trained to own this technology. This development will require that faculty education integrate this technology throughout the university curriculum (25).

4. Usefulness of additional exams

4.1. Relevance of the request for additional examinations

During our study, we found that the examinations carried out influenced the final diagnosis in 21.2% of the cases. 52.4% of the assessments carried out participated in the patient's decision to hospitalize. Our results are comparable with those of the literature. Elatrous et al. have shown that the additional examinations influenced the diagnosis in 30% of the cases (3).

Indeed, the principle of relevance comes down to choosing the right test, at the right time, and for the right patient. The relevance of analysis is inherent to his diagnostic performance and the understanding of the patient's clinical state, but also to the use that the prescriber will make of the information obtained by the prescribed analysis and, ultimately, to his clinical utility defined as the effect on improving the patient's state of health (1)(17). Although these results demonstrate the need for additional examinations to diagnose a certain number of potentially serious pathologies, they nevertheless suggest a rational use of the battery of diagnostic tests available in an emergency department.

This use would be appropriate if it allowed making the diagnosis, choosing the appropriate treatment and will establish the prognosis of the pathology, and will then guide in the management.

CONCLUSION

Despite the existence of recommendations, a large number of additional examinations are unnecessarily prescribed to emergency services. These prescriptions are responsible for an increase in the time and cost of treatment.

To improve the behavior of the doctors prescribing these additional examinations and therefore reduce abuse, it is necessary to have good training of the doctors on the recommendations and the diagnostic value added by the additional examinations as well as the establishment of the protocol of prescriptions. In addition, the completion of additional examinations requires rigorous organization and complementarity of stakeholders in this area.

That said, the doctor who writes the application form is not the only protagonist. We should therefore remember the role of the nurse who takes the sample or the technician, without forgetting the conditioned transport of the samples and the speed of obtaining the results. This human chain must work in synergy to avoid wasting time, which means delayed treatment.

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