# Prevalence, clinical characteristics, resource utilization and outcome of patients with acute chest pain in the emergency department. A multicenter, prospective, observational study in North-Eastern Italy

Lucia Solinas, Rosa Raucci*, Sergio Terrazzino**, Francesco Moscariello, Franco Pertoldi*, Sergio Vajto**, Luigi P. Badano***

*Emergency Department, Civic Hospital, Tolmezzo (UD), *Emergency Department, Civic Hospital, San Daniele del Friuli (UD), **Emergency Department, Civic Hospital, Gemona del Friuli (UD), ***Department of Cardiovascular Sciences, S. Maria della Misericordia Hospital, Udine*

*Key words:*
**Chest pain; Costs; Epidemiology.**

*Background.* **The evaluation and triage of patients with suspected myocardial ischemia in the emergency department is challenging and costly. In Italy there are no prospective data neither about the prevalence, clinical characteristics, and outcome of patients with chest pain in the emergency room, nor about the costs of their triage. Therefore, this study was undertaken to evaluate the diagnostic accuracy and costs of the actual emergency department triage modalities of patients with acute chest pain.**

*Methods.* **We analyzed the clinical data from a multicenter, prospective study of all patients with chest pain who presented to the emergency department of three hospitals in North-Eastern Italy from April to October 1999.**

*Results.* **Of 12 375 new medical admissions at the three emergency departments during the study period, 495 (prevalence 4%, mean age 62 ± 16 years, 50% females) were for chest pain. Thirty-seven percent of the patients with chest pain were hospitalized with a suspected acute coronary syndrome, while 63% were directly discharged from the emergency department. The diagnosis of acute coronary syndrome was confirmed in 79% of hospitalized patients. Among the patients discharged directly from the emergency department 68% were immediately sent back home (69 ± 60 min from admission) and 32% required a brief clinical observation lasting 10 ± 6 hours and including serial electrocardiographic and myocardial injury marker assessment. The average cost of the emergency department triage was 189 ± 237 /patient. The 1-month follow-up of the patients directly discharged from the emergency department revealed a 2.5% incidence of acute coronary syndromes (3 acute myocardial infarctions), but no deaths.**

*Conclusions.* **Data obtained from our multicenter observational study suggest that present triage modalities for patients with chest pain in the emergency department based on patient history, clinical data, electrocardiography, and myocardial injury marker assessment could be improved in terms of accuracy and efficacy. Our data provide the clinical and economical framework for the designation of trials of new accelerated critical pathways for chest pain evaluation in the emergency department.**

(Ital Heart J 2003; 4 (5): 318-324)



Received October 17, 2002; revision received April 3, 2003; accepted April 17, 2003.

*Address:*

Dr.ssa Lucia Solinas

*Servizio di Cardiologia*
*Ospedale Civile*
*Via Morgagni, 18*
*33028 Tolmezzo (UD)*
*E-mail: lbadan@tin.it*

## Introduction

Cardiovascular disease still reigns as the leading cause of death in Italy accounting for 243 000 deaths annually, or almost one third of all-cause deaths (data from the National Health Service). Each year, thousands of persons have an acute myocardial infarction (AMI). The early restoration of the myocardial perfusion is the most effective treatment for patients with AMI. This heightened awareness in the medical community that "time is muscle" has prompted rapid referrals to the emergency department (ED) for essentially any complaint of chest pain. Likewise, the heightened community awareness of heart attack symptoms disseminated by the media has led to an increase in the number of patients who present to the ED with a complaint of chest discomfort.

Despite many insights and innovations over the past decade, the ED evaluation of patients with chest pain remains challenging, and a high percentage of these patients are admitted to hospital to avoid the increased mortality risk of patients with AMI mistakenly discharged from the ED (about twice what would have been expected if they were hospitalized)[1], and malpractice

suits. In 1999, 50 466 patients have been discharged from Italian hospitals with the symptom "chest pain" (DRG 143) as the principal discharge diagnosis. The average length-of-hospital stay to establish this non-diagnosis was 4.0 days with an estimated cost approximating 75 568 373,8. With the increasing economic pressure on health care, most physicians, health plans and hospitals are interested in improving the efficiency of care for patients with acute chest pain with the aim of reducing: 1) delays in therapy; 2) "soft" admissions; 3) inappropriate dispositions; and 4) costs. However, any program aimed at improving care should be developed taking into account some variables such as the prevalence of the condition object of the program, the patient characteristics, the effectiveness of present practice, physician training and risk tolerance. Reliable data about the prevalence of chest pain among patients coming to the ED for an urgent visit and about their clinical characteristics and outcome are lacking for the Italian population[2], and data coming from the United States or United Kingdom are not easily transposable to the Italian reality because of the profound differences among the respective health systems.

Therefore, as a first step of a program aimed at improving our management of patients with chest pain in the ED, we carried out a 6-month prospective, multicenter, observational study to assess the prevalence, demographics, clinical characteristics, resource utilization and outcome of these patients in our social setting. Since we wanted to assess the performance of current clinical practice, we purposely did not implement any specific protocol for the management of chest pain in the ED.

## Methods

This study examined the performance of current ED triage modalities in evaluating chest pain patients for possible acute coronary syndromes. Three EDs in Friuli Venezia Giulia participated in this study (Gemona del Friuli, San Daniele del Friuli and Tolmezzo). From April 20 through October 31, 1999, consecutive patients who presented to the study hospital EDs with non-traumatic or equivalent chest pain within the last 24 hours were enrolled into the study. Patients were included only once. Patients < 18 years of age as well as those who had a cardiac arrest in the ED or who left the ED against the physician's advice were excluded.

**Data collection.** A data collection form containing information on the presentation, risk factors, medical history, physical examinations, laboratory and ECG results, diagnostic procedures and dispositions (Appendix 1) was completed for each patient. Data were collected at the time of patient arrival and at the time of discharge from the ED or from the admission unit if hospitalized. The data collection forms were completed by the study site principal investigator (LS, RR, ST) and were sent to the data analysis center (Tolmezzo) on a monthly basis. The clinical characteristics that provided information pertinent to the potential diagnosis and risk stratification were collected. Coronary artery disease was defined as 1) the presence of a clinical diagnosis of coronary artery disease; 2) positive results of a stress test; 3) coronary angiography showing ≥ 1 vessel with stenosis > 50%; 4) a clinical history of myocardial infarction; and 5) ECG findings of a Q-wave myocardial infarction. A patient was considered as having hypertension if 1) this was a clinical diagnosis indicated in a previous medical record; 2) his arterial blood pressure was normal with ongoing antihypertensive therapy. A patient was considered as having diabetes if 1) this was a clinical diagnosis indicated in a previous medical record; 2) he was being treated with insulin or hypoglycemic agents. In each institution the diagnosis of AMI was made on the basis of the World Health Organization criteria[3] by an experienced observer who was blinded to all the study data.

Enrolled patients underwent serial ECG, cardiac injury marker measurement and any other diagnostic test at the discretion of the ED physician. Cardiac troponin levels were determined by means of a bedside rapid test (Cardiac Status Troponin I Test Kit, Spectral Diagnostic Inc., Princeton, NJ, USA). Creatine kinase levels were determined by means of the CK-NAC IL Test™ (Instrumentation Laboratory SpA, Milan, Italy). The physician who examined the patient in the ED and transcribed the pertinent data onto the study form did so at a time when he/she had no knowledge of the patient's subsequent course.

The protocol was approved by the Ethics Committee of the Azienda Servizi Sanitari "Alto Friuli".

**Follow-up.** Patients discharged directly from the EDs were followed-up by telephone interviews at 1 week and 1 month after discharge. The telephone interviews were performed by a registered nurse or a physician, and the results were recorded onto the study form (Appendix 2). The endpoints included death, AMI, a return to the ED with chest pain as the chief complaint, and hospitalization for chest pain. The medical records were reviewed to confirm the endpoints.

**Data analysis.** Data were entered into a custom designed database (Excel, Microsoft Systems, Seattle, WA, USA) and analyzed using the SPSS 10.0 statistical package (Chicago, IL, USA). Demographic and clinical data are presented as percentages or mean values ± SD. Chi-square for greater than two-by-two and Fisher exact for two-by-two contingency tables were computed to test for differences in nominal variables whereas for continuous variables a two-tailed Student's t-test was computed. A p value of $< 0.05$ was considered statistically significant.

## Results

A total of 495 ED patients presenting with chest pain as the chief complaint were enrolled in the study at the three EDs by the end of October 1999 (Table I). These patients ranged in age from 18 to 91 years, and represented 4% of the 12 375 ED visits across the study EDs. The number of patients enrolled by each ED was 188 from Gemona del Friuli, 118 from San Daniele del Friuli, and 189 from Tolmezzo. The demographics and clinical characteristics on the ED presentation of the study patients are summarized in table I and in figure 1. There was no difference in patient demographics and clinical characteristics among the three enrolling EDs.

At the time of presentation to the ED, most of the study patients complained of chest pain (Table I). Chest pain was typical in 35% of the study patients. The average chest pain duration was 4 hours (range 4 min-72 hours).

There were significant differences in the use of diagnostic procedures and practice dispositions among the three EDs (Table II). The San Daniele del Friuli ED performed chest X-ray in a significantly higher percentage of patients ($p < 0.0001$), and used cardiac troponin I assessment in a significantly lower percentage of patients ($p < 0.0001$) than the other two EDs. On the other hand, a higher percentage of the patients evaluated at Tolmezzo were sent home directly from the ED than at San Daniele del Friuli or at Gemona ($p < 0.009$). D-dimer dosage and pulmonary scanning were used in 1 patient with suspected pulmonary embolism. No patient underwent chest computed tomography.

One hundred and eighty-one of the 495 patients (36.5%) evaluated at the three EDs were subsequently hospitalized, 133 (76%) with a clinical diagnosis of an acute coronary syndrome (93 patients with unstable angina and 40 with AMI), after 66 ± 93 min from the time of admission to the ED. One hundred and five of the 133 patients (79%) in whom a diagnosis of an acute coronary syndrome was made at the ED had their diagnoses confirmed during hospitalization.

Three hundred and fourteen of the 495 patients (63%) were sent back home directly from the EDs. Two hundred and thirteen of the 314 patients (68%) were discharged immediately after the initial ED evaluation and remained in the ED for 69 ± 60 min from the time of admission. One hundred and eighteen of the 314 patients (38%) required an average observation period of 10.24 ± 6.1 hours (range 46 min-23.55 hours) in the ED before being discharged. During the observation period in the ED an average of 3.5 ECGs and 1.6 myocardial injury marker dosages were performed per patient. Chest X-ray was performed in 17% of these patients, and echocardiography in 15%.

**Table I.** Demographics and clinical characteristics of the patients with chest pain.

| | All patients (n = 495) | Gemona del Friuli (n = 188) | San Daniele del Friuli (n = 118) | Tolmezzo (n = 189) |
|---|---|---|---|---|
| Age (years) | 62 ± 16 | 62 ± 17 | 65 ± 15 | 59 ± 16 |
| 18-55 years (%) | 33 | 30 | 31 | 39 |
| 56-75 years (%) | 43 | 47 | 38 | 42 |
| > 75 years (%) | 24 | 23 | 31 | 19 |
| Females (%) | 50 | | | |
| 18-60 years | 34 | 37 | 27 | 40 |
| > 60 years | 66 | 63 | 73 | 60 |
| Males (%) | 50 | | | |
| 18-55 years | 42 | 34 | 40 | 48 |
| > 55 years | 58 | 66 | 60 | 52 |
| Risk factors (%) | | | | |
| Hypertension | 38 | 35 | 52 | 32 |
| Smoking | 22 | 28 | 22 | 17 |
| Family history of CAD | 14 | 12 | 15 | 14 |
| Hypercholesterolemia | 17 | 17 | 19 | 17 |
| Diabetes | 6 | 6 | 4 | 9 |
| ≥ 2 risk factors | 26 | 25 | 23 | 31 |
| Known CAD (%) | 30 | 30 | 36 | 26 |
| Pain at the time of presentation (%) | 59 | 59 | 49 | 65 |
| Pain duration (hours) | 4.13 ± 8.28 | 4.25 ± 9.13 | 3.13 ± 6.3 | 4.44 ± 9.5 |
| Typical pain (%) | 35 | 36 | 38 | 33 |
| Electrocardiogram (%) | | | | |
| Normal | 57 | | | |
| Atypical | 33 | | | |
| Ischemic ST elevation | 4 | | | |
| Ischemic non-ST elevation | 3 | | | |
| ST not assessable | 3 | | | |

CAD = coronary artery disease.

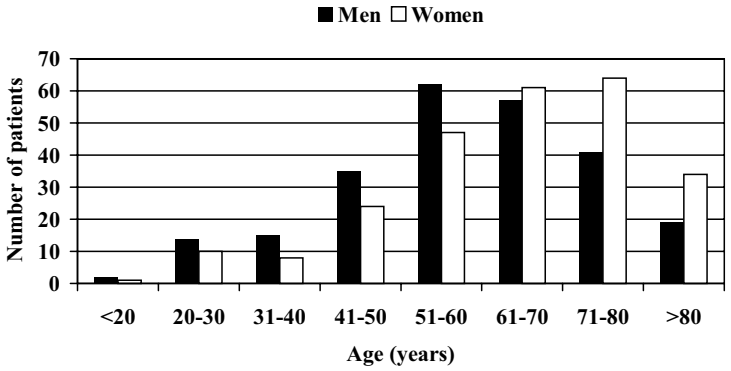


**Figure 1.** *Age distribution by gender of the patients admitted to the emergency department with acute chest pain.*

**Table II.** Percent of chest pain patients by selected diagnostic procedures, treatment, disposition practice patterns and costs of emergency department (ED) management of each individual site.

| | All patients (n = 495) | Gemona del Friuli (n = 188) | San Daniele del Friuli (n = 118) | Tolmezzo (n =189) | p |
|---|---|---|---|---|---|
| Electrocardiogram (%) | 97 | 99 | 97 | 97 | 0.39 |
| Chest X-ray (%) | 17 | 13 | 29 | 12 | < 0.0001 |
| Echocardiogram (%) | 15 | 16 | 8 | 18 | 0.086 |
| Cardiac injury markers (%) | | | | | |
| Creatine kinase-MB mass | 37 | 33 | 64 | 25 | 0.41 |
| Troponin I | 13 | 7 | 27 | 10 | < 0.0001 |
| Disposition (%) | | | | | |
| Initially home | 43 | 39 | 33 | 54 | |
| Initially observed | 27 | 32 | 31 | 20 | 0.009 |
| Initially admitted | 30 | 29 | 36 | 26 | |
| Observation duration (hours) | 10.21 ± 6.12 | 11.26 ± 6.9 | 9.53 ± 5.54 | 9.20 ± 6.22 | 0.83 |
| Costs of ED management ( ) | 89 ± 237 | 214 ± 255 | 201 ± 245 | 158 ± 210 | 0.0081 |

**Patients with chest pain and a non-diagnostic electrocardiogram.** Four hundred and nine patients (51% females, age 60 ± 16 years) with chest pain had an initially non-diagnostic 12-lead ECG (Table III). At the time of admission, pain was present in 237 of the 409 patients (58%) with chest pain and a non-diagnostic ECG. One hundred and three of the 409 patients (25%) had at least two cardiovascular risk factors. Ninety-five of the 409 patients (23%) with a non-diagnostic ECG were subsequently hospitalized with a clinical diagnosis of an acute coronary syndrome (86 patients with unstable angina and 9 with AMI). Sixty-seven of the 95 patients (71%) in whom a diagnosis of an acute coronary syndrome was made had their diagnoses confirmed during hospitalization.

Three hundred and fourteen of the 409 patients (77%) were discharged directly from the EDs. One hun-

**Table III.** Management of chest pain patients by electrocardiographic and clinical characteristics at the time of presentation to the emergency department.

| Subgroups | No. | Pain (%) | Admitted | Confirmed ACS | Discharged | Time of discharge (hours) |
|---|---|---|---|---|---|---|
| Overall | 495 | 59 | 181 | 105 | 331 | |
| | | | 93 UA, 40 AMI | | 213 | Immediately |
| | | | | | 118 | 10.24 ± 6.1 |
| ECG- | 409 | 58 | 95 | 67 | 314 | |
| | | | 86 UA, 9 AMI | | 181 | Immediately |
| | | | | | 133 | 10.4 ± 6.12 |
| ECG-, no CVRF | 89 | 59 | 5 | 4 | 94 | |
| | | | 4 UA, 1 AMI | | 23 | Immediately |
| | | | | | 71 | 3.6 ± 5.19 |

ACS = acute coronary syndrome; AMI = acute myocardial infarction; CVRF = cardiovascular risk factors; ECG- = negative electrocardiogram; UA = unstable angina.

dred and eighty-one of the 314 patients (58%) were discharged immediately after the ED visit and remained in the ED for an average of 70 ± 62 min. One hundred and thirty-three of the 314 patients with chest pain and a non-diagnostic ECG (42%) required an average observation period of 10.4 ± 6.12 hours (range 85 min-23.55 hours) in the ED before being discharged.

**Patients with a low probability of a cardiac etiology for their chest pain.** Eighty-nine (17.9% of our study population) patients (57% females, mean age 51 ± 18 years) with chest pain showed no cardiovascular risk factor and an initially normal 12-lead ECG (Table III). Pain on admission was present in 52 of the 89 patients (59%) with chest pain, no risk factor and a normal ECG. They required an average observation period of 3.6 ± 5.19 hours (range 2 min-23.50 hours) in the ED. Five of 89 patients (6%) with no cardiovascular risk factor and a normal ECG were subsequently hospitalized with a clinical diagnosis of an acute coronary syndrome (4 patients with unstable angina, and 1 with AMI). The clinical diagnosis of unstable angina was not confirmed in 1 of the 4 patients during hospitalization. One AMI was missed during triage in the ED.

**Follow-up results.** Because the principal investigator left her post and moved from San Daniele del Friuli, complete follow-up data were available only for patients recruited in the Tolmezzo and Gemona del Friuli EDs. Of these 240 patients, 6 (2.5%) had an adverse outcome (3 AMI, 3 admissions for unstable angina, and 1 pulmonary edema) within 30 days of ED discharge. Three adverse events (1 AMI, 1 unstable angina, and pulmonary edema) occurred within 7 days of ED discharge. The average age of those patients having an adverse outcome was approximately 12 years greater than that of those without. Two of the 6 patients with an adverse outcome were male (33%). Neither age ($p = 0.078$) nor gender were found to be statistically significant predictors of an adverse outcome.

## Discussion

The results of this prospective multicenter observational study can be summarized as follows: 1) in North-Eastern Italy chest pain accounts for 4% of all new admissions to the ED; 2) presently, around 37% of patients with chest pain are hospitalized whereas 63% are discharged directly from the ED; and 3) the rate of inadvertent discharge of patients with acute coronary syndromes is 2.5%.

There is a lack of prospective data regarding the demographics, clinical characteristics, as well as the resource use and outcome of patients presenting to Italian ED with acute non-traumatic chest pain. Our study was a prospective one which included all consecutive patients presenting to the ED with chest pain during the study period, and in which patients who were deemed as not having chest pain of cardiac origin were actually discharged at the end of the triage. Our data may be useful to plan protocols or trials with the aim of improving the efficacy and effectiveness of the triage of these patients. The management of chest pain in the ED may become an even more important issue in the future since the number of patients presenting to the ED with acute chest pain is likely to increase progressively due to a greater awareness of the symptoms of heart attack and due to the aging of the Italian population.

**Prevalence of chest pain among patients admitted to the emergency department.** Chest pain accounts for 2.4% of all new presentations at the ED in the United Kingdom[4,5], and for 5-6% in the United States[6]. Current practice requires that all patients with a possible cardiac problem be hospitalized for at least 24-48 hours for clinical monitoring and further tests. In the United Kingdom, about 30% of such patients are hospitalized for this period of time[7] whereas in the United States around 60% are hospitalized[4]. Our data show that the prevalence of acute chest pain as the main complaint of patients presenting to the ED in Friuli Venezia Giulia (4%) is higher than that reported in the United Kingdom and lower than that reported in the United States. This prevalence confirms the figures reported in previous retrospective studies[8], whereas it is lower than the 5.6% prevalence found in a recent prospective study[2]. However, the latter was a study in which a test of a management protocol of patients with chest pain was performed, and therefore an increased sensitivity of the physicians to the problem may have influenced the final results. The differences from data coming from the United Kingdom and United States may be explained by the differences in the health systems (particularly in the role of the general physician in the United Kingdom), the lower prevalence of coronary artery disease in our country and the lower mean pressure on the general population about acute heart attack symptoms.

**Effectiveness of current triage modalities.** The percentage of hospitalizations (37%) compares well with the rates reported for the United Kingdom and United States. However, the most important datum is the rate of a definite diagnosis of an acute coronary syndrome in patients who were hospitalized (79%) that is consistently greater than the rates found in the United Kingdom and United States. This translates in a reduced wastage of resources, in the avoidance of many unnecessary admissions and in an improved patients' quality of life. The sensitivity of the protocols employed to rule out acute coronary syndromes in patients with acute chest pain is an important issue. Although many interventions, including drugs and surgery, can significantly reduce the mortality due to acute coronary syndromes, patients benefit only if they can be correctly identified. The mortality in patients who are discharged with a missed diagnosis of an acute coronary syndrome is twice higher than in those who are hospitalized[1].

Among our patients discharged from the ED, the incidence of an AMI and that of the overall adverse cardiac events during the 30-day follow-up were 1.3 and 2.5% respectively. No patient discharged from the ED died during the follow-up. In the United States, 2.2% of the patients discharged from the ED actually have an acute coronary syndrome[1] whereas in the United Kingdom the figure is about 6%[9].

**Study limitations.** Our study did not evaluate a prespecified protocol but it was a 1998 registry of current practice in the three EDs. Therefore, the study is burdened by all the limitations of registries, and, above all the significant differences in practice among the three EDs. However, we think that to have a picture of the actual clinical practice is useful when a formal protocol is to be implemented.

Another important limitation of our study is the fact that only a few of the patients directly discharged from the EDs (7%) underwent the stress test during follow-up. Therefore, the incidence of ischemic heart disease in our study population may have been underestimated.

Finally, in our study AMI was defined according to the 1994 World Health Organization criteria. This was due to the fact that the study was carried out in 1998. Had we used the 2000 American College of Cardiology/European Society of Cardiology consensus conference criteria, the number of AMIs could have increased significantly.

In conclusion, the results of our study confirm that the majority of patients presenting to the ED with chest pain are at a relatively low risk for an acute coronary syndrome and that those patients with an ongoing acute coronary event can be identified by initial clinical assessment at the time of presentation. However, because 2.5% of the patients with a coronary event were inadvertently discharged from the ED, and since in 21% of the patients who were admitted for a possible acute coronary syndrome a cardiac etiology of their chest pain was not found, there is room for the development of new approaches with the aim of achieving an even more accurate evaluation of low-risk patients presenting with chest pain[2,10]. Our data may be used to accurately plan the cost-effectiveness evaluation of specific protocols aimed at improving our management of these patients.

**Appendix 1**

**Patient # ....** **Date** __-__-___ **Time** __-__

Name and surname Date of birth __-__-__

Address City

Tel. ___-_____ Age Years Gender: M☐ F☐

- **Arrival to the Emergency Department**
  - ☐ own transport ☐ 118
  - ☐ own initiative ☐ referred by ambulance personnel ☐ by general practitioner
- **Risk factors for ischemic heart disease**
  - ☐ Hypercholesterolemia Diabetes mellitus: ☐ IDDM
  - ☐ Arterial hypertension ☐ NIDDM
  - ☐ Cigarette smoking ☐ Family history (myocardial infarction or sudden death in first degree relatives aged < 55 years if male and < 60 years if female)
- **Predisposing factors for deep vein thrombosis:**
  - ☐ No ☐ Yes .....
- **Cardiac history:**
  - ☐ Previous diagnosis of ischemic heart disease ☐ Previous AMI
  - ☐ Previous bypass surgery ☐ Previous PTCA
  - ☐ Previous vasculopathies (aorta, peripheral or cerebral vessels) ☐ Gastritis, Duodenal ulcer
- **Chest pain:** Onset date ___-___-___ __hrs ___ min
  - ☐ Present ☐ at rest ☐ Typical
  - ☐ Absent. Lasting __ hrs __min ☐ effort ☐ Atypical
  - ☐ Doubtful
- **Electrocardiogram:**
  - ☐ ST elevation > 0.10 mV
  - ☐ ST depression > 0.10 mV ☐ with inverted T waves
  - ☐ with normal T waves
  - ☐ isolated T wave inversion
  - ☐ aspecific abnormalities ☐ S1, Q3, right branch block
  - ☐ non-interpretable tracing (PM rhythm, left branch block)
  - ☐ normal recording
- **Utilized procedures** (refer number of utilized procedures)
  - Biohumoral markers: ☐ CK ☐ CK-MB ☐ cTnI ☐ D-dimer
  - ☐ Chest X-ray ☐ CT ☐ Echocardiography ☐ Pulmonary scintigraphy
- **Clinical and instrumental outcome**
  - Hospitalization: ☐ Emergency ☐ Medicine ward ☐ Transferred to the ICU ☐ Sent home ☐ Observation
  - Diagnosis: .....

Date __-__-___ Time __-__

**Appendix 2.** Follow-up and efficiency and efficacy control of the present day protocol.

**1. Hospitalized patients:**

Chart no. _____/___

Main diagnosis at the time of discharge: .....

**2. Discharged patients:**

***2a. Clinical and instrumental evaluation within 1 week***

Procedures performed: ☐ Echocardiography
☐ Exercise testing
☐ Holter ECG
Stress imaging ☐ Scintigraphic ☐ Echocardiographic

Diagnostic conclusions: Ischemic heart disease ☐ Yes ☐ No
Other .....

Events: ☐ Death
☐ Acute myocardial infarction
☐ Hospitalization for unstable angina
☐ Other .....

***2b. Evaluation at 1 month***

Events: ☐ Death
☐ Acute myocardial infarction
☐ Hospitalization for unstable angina
☐ Other .....

## Acknowledgments

The authors would like to thank the emergency department staff members for their invaluable help in collecting data: Chiara Rocco, Gabriele Secoli, Giovanna Cozzi, Sandra Grego and Isabella Pegoraro in Tolmezzo; Franco Arteni, Ermes Comisini, Paola Bortolotti, Stefano Martina and Sabrina Rieppi in San Daniele del Friuli; and Guy Zur, Gian Paolo Mattei, Alessandro Cigalotto, Francesco Comelli, and Francesca Pezzetta in Gemona del Friuli.

## References

1. Pope JH, Aufderheide TP, Ruthazer R, et al. Missed diagnoses of acute cardiac ischemia in the emergency department. N Engl J Med 2000; 342: 1163-70.
2. Cassin M, Macor F, Cappelletti P, et al. Management of patients with low-risk chest pain at the time of admission: a prospective study on a non-selected population from the emergency department. Ital Heart J 2002; 3: 399-405.
3. Tunstall-Pedoe H, Kuulasmaa K, Amaouyel P, Arveiler D, Rajakangas AM, Pajak A. Myocardial infarction and coronary deaths in the World Health Organization MONICA Project. Registration procedures, event rates, and case-fatality rates in 38 populations from 21 countries in four continents. Circulation 1994; 90: 583-612.
4. Fothergill NJ, Hunt MT, Touquet R. Audit of patients with chest pain presenting to an accident and emergency department over a 6-month period. Arch Emerg Med 1993; 10: 155-60.
5. Emerson PA, Russell NJ, Wyatt J, et al. An audit of doctor's management of patients with chest pain in the accident and emergency department. QJM 1989; 70: 213-20.
6. Schappert SM. National hospital ambulatory medical care survey: 1992 emergency department summary. Vital Health Stat 13 1997; 125: 1-108.
7. Herren KR, Mackway-Jones K, Richards CR, Seneviratne CJ, France MW, Cotter L. Is it possible to exclude a diagnosis of myocardial damage within six hours of admission to an emergency department? Diagnostic cohort study. BMJ 2001; 323: 372-4.
8. Cassin M, Badano L, Solinas L, et al. È realizzabile una strategia operativa più efficace per la gestione in urgenza del paziente con dolore toracico acuto? Ital Heart J Suppl 2000; 1: 186-201.
9. Collinson PO, Premachandram S, Hashemi K. Prospective audit of incidence of prognostically important myocardial damage in patients discharged from emergency department. BMJ 2000; 320: 1702-5.
10. Mauri F, Mafrici A, Pirelli S, Doneda R. Riduzione dei costi nella valutazione del dolore toracico con la "chest pain unit" in Pronto Soccorso. Ital Heart J Suppl 2002; 3: 518-25.