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Impact of medical practice guidelines on the assessment of patients with acute coronary syndrome without persistent ST segment elevation

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Abstract

Objective. To assess the impact of introducing clinical practice guidelines on acute coronary syndrome without persistent ST segment elevation (ACS) on patient initial assessment.

Design. Prospective before–after evaluation over a 3-month period.

Setting. The emergency ward of a tertiary teaching hospital.

Patients. All consecutive patients with ACS evaluated in the emergency ward over the two 3-month periods.

Intervention. Implementation of the practice guidelines, and the addition of a cardiology consultant to the emergency team.

Main outcome measures. Diagnosis, electrocardiogram interpretation, and risk stratification after the initial evaluation.

Results. The clinical characteristics of the 328 and 364 patients evaluated in the emergency ward for suspicion of ACS before and after guideline implementation were similar. Significantly more patients were classified as suffering from atypical chest pain (39.6% versus 47.0%; $P = 0.006$) after guideline implementation. Guidelines availability was associated with significantly more formal diagnoses (79.9% versus 92.9%; $P < 0.0001$) and risk stratification (53.7% versus 65.4%, $P < 0.0001$) at the end of initial assessment.

Conclusion. Guidelines implementation, along with availability of a cardiology consultant in the emergency room had a positive impact on initial assessment of patients evaluated for suspicion of ACS. It led to increased confidence in diagnosis and stratification by risk, which are the first steps in initiating effective treatment for this common condition.

Keywords: acute coronary syndrome, chest pain, clinical practice guidelines, emergency, risk

Among people with acute chest pain presenting to the emergency departments of hospitals, 15% suffer from acute coronary syndrome with persistent ST segment elevation on the electrocardiogram (ECG) [acute myocardial infarction (AMI)], 35% from acute coronary syndrome without persistent ST segment elevation (ACS) (non-ST elevation AMI and unstable angina), and 50% from other diseases [1]. The 1-year mortality of ACS is ~12%, mainly during the acute phase of the disease [2,3]. ACS is characterized by the rupture of an atheromatous plaque in a coronary artery, leading to thrombus formation [4,5], and can induce occlusion of the artery or distal embolization. Aggressive treatment is able to stop this process and consequently salvage some cardiac muscle cells.

Diagnosis rests on clinical history, physical examination, and ECG, which together allow the correct identification of patients suffering from an acute ischemic event in 90% of cases [6]. Stratification into different risk categories [7,8] is useful, as prognosis is directly linked with risk categories [9] and treatment intensity.

Blood level determination of troponin is an important diagnostic aid in identifying low-risk patients [10] who can be discharged early, and high-risk patients [11] who have to be aggressively treated [12]. This test was recently introduced in

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the decision algorithm, in addition to clinical history, physical examination, and ECG.

Practice guidelines dedicated to the assessment of patients with ACS have existed in the United States since 1994 [13], and have recently been published in Europe [14] and revised in the US [15]. We designed this study to assess prospectively the impact of introducing practice guidelines on patient initial assessment in our institution.

Patients and methods

After a systematic review of the literature, expert physicians from the cardiology, critical care medicine, and general internal medicine staff met on several occasions to review current evidence from published randomized trials and meta-analysis of the diagnosis and treatment of ACS, as defined above. Evidence was graded according to the recommendations of evidence-based medicine. A clinical practice guideline was then drafted by one of us (A.B.), and validated by internal reviewers. External reviewers, including one of the authors of the European guidelines, provided final validation.

Before guideline implementation, all patients evaluated at the emergency department of our institution over a 3-month period (1 October 2000 to 31 December 2000) with acute chest pain of <12 hours duration were considered eligible for this study. Patients suffering from chest pain of non-cardiac origin and AMI with permanent ST segment elevation were registered, but excluded from the ACS group. The medical staff at the emergency department included nine full-time resident positions, three senior registrars, and additional residents or students on occasion.

For ACS patients, a research assistant (D.G.) reviewed medical charts and collected medical history, clinical characteristics, laboratory test results (including troponin I blood levels, measured twice, 6 hours apart), and ECG interpretation on the day following admission. Risk stratification into four categories according to the forthcoming practice guideline [16] was actively retrieved from emergency physicians, without providing them with the following precise definitions:

1. Low-risk patients: acute chest pain without modification of the ECG or laboratory tests (troponin I blood level <0.1 μg/ml).
2. Intermediate-risk patients: acute chest pain with modifications of the ECG (down-sloped ST segment <1 mm or negative T-wave) and negative troponin I blood level (<0.1 μg/ml).
3. High-risk patients: prolonged chest pain (>20 minutes) or modification of the ECG (down-sloped ST segment >1 mm) or at least one positive troponin I blood level.
4. Very high-risk patients: acute recurrent or refractory chest pain, or hemodynamic instability (cardiogenic shock) or rhythmic instability, and transient ST segment elevation.

The high-risk group described in the European Society of Cardiology (ESC) and American Heart Association (AHA) guidelines was split into high risk and very high risk groups because different treatment strategies, which are not available in all hospitals, are used in our institution to treat these specific conditions.

The practice guidelines were introduced in January 2001. Implementation strategy included presentation and distribution of the guidelines to all internal medicine and cardiology physicians, including interns, residents, fellows, and staff physicians, and educational interventions by experts in the field during weekly seminars (small group meetings) and grand rounds (large group meetings). During these meetings, detailed presentation of the guidelines was carried out and all questions related to the topic were answered. A comprehensive document summarizing the evidence was handed out [16], as well as a one-page algorithm (Figure 1). Both documents were also available on the intranet network. In addition, we placed reminders in the charts of all patients diagnosed with chest pain while in the emergency room, and posted general reminders on the emergency residents' office walls. At the same time, a cardiology consultant, who was available during working hours 5 days a week, was added to the emergency medical staff.

For the second part of the study, conducted after introduction of the guidelines, several strategies were used to minimize the change in the residents' professional behaviour induced by the study itself (Hawthorne effect). Residents were blind to the actual aim of the trial and were only informed that a survey on cardiovascular medicine would be conducted among clinical patients. Furthermore, we simply announced a training program in evidence-based medicine including sessions on several clinical topics, such as deep venous thrombosis or community-acquired pneumonia for example.

Impact on patient initial assessment was measured following the same methodology as described above, over a 3-month period, extending from 1 February 2001 to 30 April 2001. Analysis compared patient characteristics, initial assessment characteristics, laboratory test results, ECG interpretation, and risk stratification in the two parts of the study.

Two reviewers (A.B. and J.B.W.) separately carried out independent risk assessments based on laboratory tests results and ECG interpretation for all patients. The ECG interpretation was based upon an independent assessment of all ECGs by two other reviewers (P.E. and J.C.S.), blinded to the clinical and patient's characteristics, and ECG interpretation by emergency residents, who classified them, as did the residents, into the following categories: normal, negative T-wave; down-sloped ST segment 0.5–1.0 mm; down-sloped ST segment >1.0 mm; and transient ST segment elevation, corresponding to the four categories of risk mentioned above. Disagreement between the two reviewers was resolved by a third reviewer (J.S.). We used this final ECG analysis for the independent risk assessment. Concordance analysis was carried out only for patients with available risk stratification data and diagnosed with ACS at the end of the initial assessment.

Comparisons between the two groups were carried out using the Student's *t*-test for continuous variables (after assessment of distribution normality), the Mann–Whitney U-test for ordinal variables or non-normally distributed data, and the χ^2 test for distributions, as appropriate. Distribution analyses were carried out after exclusion of missing data, and opposing missing data to available ones. All analyses were carried out with SPSS 12.0 for Windows. Statistical significance was assumed at a *P*-value of <0.05.

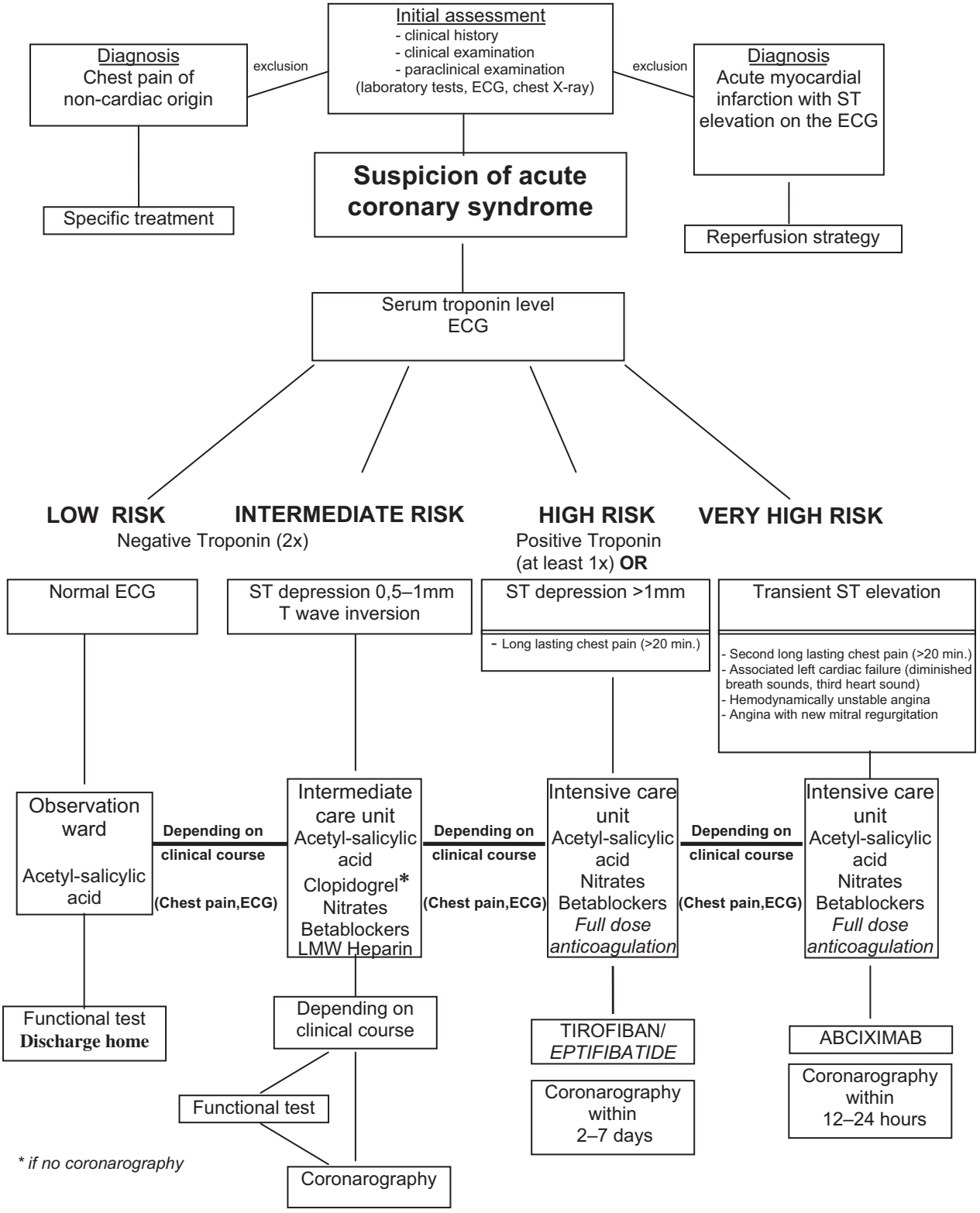

Figure 1 Clinical pathway for acute coronary syndrome.

Results

During the two study periods, 3284 and 3260 patients, respectively, were evaluated at the Medical Emergency Department of our institution. Among them, 497 (15.1%) and 498 (15.3%) were evaluated for chest pain, by 33 and 32 different physicians, respectively. Residents contributed to 95% and 97% of the assessments, and only four of them treated patients during both study periods, with the majority of assessments carried out during one period.

Non-cardiac origin was diagnosed in 143 (28.8%) and 109 (21.9%) patients, pre- and post-guidline implementation, respectively. Clinical characteristics of these patients were not statistically significantly different between the two study periods. One hundred and sixteen were women and 136 were men (mean age 47 ± 20 years). Fifty per cent of them suffered from osteo-articular problems, 21% from pulmonary diseases, 10% from psychological disturbances, 5% from pericarditis and myocarditis, and 2% from gastro-intestinal disorders. Finally, unknown origin for chest pain was ascribed to 12% of them.

AMI with persistent ST elevation was diagnosed in 26 (5.2%) and 25 (5.0%) patients in the two groups, respectively. Clinical characteristics of these patients were again not different between the two study periods. Of these 51 patients (13 women and 38 men, mean age 47 ± 20 years), 42% of them suffered from anterior wall infarction, and 48% from inferior or posterior wall infarction, while 4% were located on the right ventricle only and 6% could not be located at all.

The remaining 328 (10.0% of all admissions in the first period) and 364 (11.2% of all admissions in the second period) patients were included in this study. Their main characteristics are summarized in Table 1. The two groups were not statistically significantly different.

Table 1 ACS patients' characteristics

	Before guidelines	After guidelines	*P*-value
Total patient number	328	364	
Women, *n* (%)	142 (43.3)	149 (40.9)	0.531
Men, *n* (%)	186 (56.7)	215 (59.1)	
Mean age (SD)	61.7 (17.8)	63.0 (17.0)	0.313
Cardiac history, *n* (%)	131 (39.9)	135 (37.1)	0.365
Risk factors, *n* (%)			0.685
Family history	89 (27.1)	57 (15.7)	
Hypercholesterolemia	156 (47.6)	162 (44.5)	
Diabetes mellitus	41 (12.5)	46 (12.6)	
Hypertension	176 (53.7)	173 (47.5)	
Smoking	92 (28.0)	111 (30.5)	
Pain characteristics, *n* (%)			0.193
Thoracic oppression	183 (55.8)	183 (50.3)	
Atypical	130 (39.6)	171 (47.0)	
Not specified	15 (4.6)	10 (2.7)	
Duration in minutes			
Mean (SD)	81.7 (86.8)	100.5 (100.5)	0.074
Median (25, 75 percentiles)	60.0 (30.0, 120.0)	60.0 (25.0, 120.0)	
Intensity upon admission			
Mean (SD)	4.7 (2.1)	4.8 (2.3)	0.916
Median (25, 75 percentiles)	5.0 (3.0, 6.0)	5.0 (3.0, 6.0)	
Maximal intensity			
Mean (SD)	6.7 (2.1)	6.3 (2.2)	0.107
Median (25, 75 percentiles)	7.0 (5.0, 8.0)	6.0 (5.0, 8.0)	
Vital signs (SD)			
Systolic blood pressure			
Mean (SD)	147.2 (25.7)	145.3 (24.8)	0.310
Median (25, 75 percentiles)	147.0 (130.0, 161.0)	146.0 (126.2, 160.0)	
Diastolic blood pressure			
Mean (SD)	86.1 (14.7)	85.6 (15.6)	0.710
Median (25, 75 percentiles)	86.0 (76.0, 96.0)	86.0 (75.0, 95.0)	
Heart rate			
Mean (SD)	82.0 (21.7)	83.2 (21.6)	0.484
Median (25, 75 percentiles)	78.5 (67.0, 93.0)	79.5 (69.0, 94.7)	

Table 2 Results of the initial assessment

	Before guidelines, *n* (%)	After guidelines, *n* (%)	*P*-value
Total *n*	328	364	
Electrocardiogram			0.971
Normal	149 (45.4)	173 (47.5)	
Abnormal	149 (45.4)	172 (47.4)	
Assessment not available	30 (9.2)	26 (7.1)	
Troponine T blood level			0.003
<0.03 μg/ml	265 (80.8)	254 (69.8)	
0.03–0.09 μg/ml	28 (8.5)	67 (18.4)	
>0.1 μg/ml	35 (10.7)	43 (11.8)	
Presence of coronary heart disease			0.356
Yes	163 (49.7)	194 (53.3)	
No	109 (33.2)	151 (41.5)	
Assessment not available	56 (17.1)	19 (5.2)	<0.0001
Risk of coronary event			<0.0001
Small	40 (12.2)	106 (29.1)	
Intermediate	50 (15.2)	55 (15.1)	
High	64 (19.5)	51 (14.0)	
Very high	22 (6.7)	26 (7.1)	
Assessment not available	152 (46.3)	126 (34.6)	0.002
Diagnosis			0.646
Atypical chest pain	120 (36.6)	154 (42.3)	
Probable unstable angina	98 (29.9)	118 (32.4)	
Unstable angina	17 (5.2)	24 (6.6)	
Myocardial infarction	14 (4.3)	16 (4.4)	
Other diagnosis	13 (4.0)	26 (7.1)	
Assessment not available	66 (20.1)	26 (7.1)	<0.0001

Results of the initial assessment are shown in Table 2. Although vital signs, mean duration, and maximal intensity of chest pain did not change significantly, significantly more patients were considered as having atypical chest pain at the end of the initial assessment after implementation of the guidelines [120 patients (47.0%) compared with 154 patients (39.6%); $P = 0.002$). In addition, ECG description was more often classified as abnormal. Troponin I blood level results were less often under the detection limit. These findings suggest a lower diagnostic threshold, but a better targeting of the use of diagnostic tests after guideline implementation than before.

The most important changes after guideline implementation were the clinician's commitment in assessing the probability of coronary heart disease (94.8% compared with 82.9% pre-implementation), in stratifying patients by risk of coronary event (65.4% versus 53.7%), and in making a diagnosis at the end of the initial assessment (92.9% versus 79.9%). The number of missing values dropped significantly in these three variables ($P < 0.0001$).

Comparison of the risk stratification of patients performed by the clinicians and the reviewers at the end of the initial assessment showed significantly less differences after guideline implementation than before (Table 3). Data were available for 87.8% of the patients before and 97.2% after guideline implementation. Concordance was observed in 20.8% and 42.0% of cases, respectively. Discrepancies were limited to one level of risk in 59.4% of cases before and 44.2% after guideline implementation, with overestimation of risk by clinicians in 64.4% and 43.4% of cases, respectively. Conversely, underestimation of risk by clinicians was recorded in 14.8% and 14.5% of cases, respectively.

Discussion

This prospective study showed that clinical practice guidelines for evaluation and treatment of ACS had a partial but positive impact on patient assessment. The study populations before and after guideline implementation were not statistically significantly different, but their assessment at the emergency department was quite different. Particularly striking were the apparent decrease in relative importance of history characteristics in favour of ECG and troponin blood level results in attributing a patient to a specific risk category. This might be ascribed to the impact of the decision algorithm that summarized the clinical practice pathway.

Also striking was the increased commitment of physicians in the assessment of the probability of underlying coronary artery disease, patient risk stratification, and diagnosis at the

Table 3 Concordance of risk stratification between emergency room physicians and reviewers

	ER physician									
	Risk before guideline implementation (*n*)					Risk after guideline implementation (*n*)				
	Low	Moderate	High	Very high	Total	Low	Moderate	High	Very high	Total
Reviewer Risk (*n*)										
Low	0	23	17	2	42	25	25	13	1	64
Moderate	1	8	15	2	26	6	10	9	0	25
High	1	7	13	6	27	1	4	17	12	34
Very high	0	0	6	0	6	0	4	5	6	15
Total	2	38	51	10	101	32	43	44	19	138
Kappa					−0.05					0.219
Statistical significance					0.301					<0.001

time of the initial evaluation. This influence is likely to be ascribed to the availability of risk classification for immediate use at the bedside.

Moreover, the ACS guidelines' positive impact on diminishing diagnostic uncertainty must be emphasized, as initial assessment is the cornerstone for allocating patients to specific treatment and monitoring. Any intervention conducted to decrease the delay in reaching the appropriate diagnosis and starting treatment is likely to have a positive impact on patient outcome. On the other hand, it should also result in a better use of scarce resources, such as expensive treatment procedures or intensive monitoring facilities, by reducing both over- and under-treatment, which both might negatively affect patient outcome.

This study did, however, show important limits in compliance with the guidelines' recommendations. The first one was related to the use of troponin blood level determination. Although results of the test during the second part of the study were more often located above the detection threshold, or positive, suggesting a better targeting of patients, its use was not optimal. In particular, the recommended second troponin blood level determination in case of a negative first one was seldom carried out (35%). This might be explained by the fact that this kind of test had just been introduced in our institution, and that physicians still lacked expertise in using it. The second limit is the relatively small improvement in accurate risk stratification in these patients, as demonstrated by a low level of agreement between clinicians and experts. This is possibly due to the fact that the concept of risk stratification was new for most of them. The finding that risk was overestimated in most discrepant assessments suggests that emergency room physicians might be overcautious in taking care of these patients, and might prefer over-treatment and unnecessary monitoring to under-treatment and overlooking monitoring. Further intervention is clearly needed to improve the routine use of risk stratification and its confident assessment, and longer follow-up necessary to assess the impact of the learning curve effect linked with the residency program.

This study provided yet another example of the difficulty of improving clinical care, even when evidence is brought to the bedside. This had already been demonstrated with the first version of the US guidelines: their introduction increased the percentage of patients treated with the recommended drugs such as aspirin or beta-blockers, and decreased the number of patients on calcium antagonists [17,18]. Another study carried out in Australia failed to show such a clear impact on drug use [19]. Altogether, a single study showed that patients' survival improved after guideline implementation [20]. On the other hand, such guidelines were designed to ease the orientation of low-risk patients to outpatient care, and high-risk patients to intensive care units. With respect to this, they partly missed their goals: low-risk patients were not treated as outpatients, and hospitalizations did not decrease, but at the same time an increased demand for intensive care beds was noted, which would require additional resources for no proven survival benefit [21]. Finally, guidelines were incompletely applied to elderly patients, and quality of care varied widely between hospitals [22]. Cardiologists were more likely to apply them than general internal medicine specialists, with no differences in patient outcome [23].

These findings points out the necessity of careful assessment of both processes of care and patient outcomes when an intervention is implemented in the health care system, in particular the introduction of clinical practice guidelines. In addition, local adaptation of international guidelines is expensive, and not in itself a guarantee that they will be applied [24].

This study has obvious limitations: firstly, it involved only one centre; secondly, it did not extend to assessing patient outcome; thirdly, the impact of the practice guidelines was assessed shortly after their implementation, and was not repeated later; and fourthly, the emergency room teams at the times of the two study periods were different. However, the study's findings are in perfect agreement with those described in the medical literature [17,22]. They will serve as a basis for additional interventions aimed at continuous quality improvement in our setting. These findings underline the importance of pre-testing guidelines by explicitly quantifying the risks and benefits of standardizing care in ACS, which has been shown to exhibit wide practice variations between hospitals and

between countries [1,25]. These findings will also be used to model the costs and thus the resources needed to anticipate improved compliance with the guidelines, once barriers to their implementation are addressed [26], so that patient safety can be guaranteed by appropriate monitoring when high-risk drugs and procedures are used to treat them.

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