

# Arrival mode and triage evaluation in an emergency department cohort of patients with syncope: the ADDRESS study

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## Abstract

In a cohort of 378 Emergency Department (ED) syncopal patients, we evaluated the arrival mode and the efficacy of triage evaluation in predicting cardiac syncope, acute underlying diseases, and the need for admission. Less than half of patients (48.4%) arrived in the ED with Emergency Medical Services (EMS), and in a small minority of cases (12.4%), an Electrocardiogram (ECG) was performed at the triage, even in cases of cardiac syncope (44% and

8%, respectively). Most patients (67.4%) received a white, green, or blue code; the triage priority code was associated with the presence of cardiac syncope and acute underlying diseases when indicative of high severity (*i.e.*, red or orange), with a high negative predictive value (95% and 81%, respectively) if lower. Triage priority was also associated with the need for admission when indicative of a high care complexity (*i.e.*, orange, red, or blue), with a high negative predictive value if lower. To ensure a rapid evaluation of cases at higher risk, it would be appropriate to increase the number of patients transferred to ED by EMS and the execution of the ECG at triage. To reduce unnecessary admissions, the role of ED triage should be valued, as it is able to identify patients without cardiac syncope or acute underlying diseases, especially in the case of a high care complexity but a low severity code (blue).

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Ethics approval and consent to participate: the study was carried out in agreement with the ethical guidelines of the Declaration of Helsinki and under the terms of all relevant local legislation. The study also received regulatory approval from the local ethical committee (reference No. 632/2022; amendments protocol No. 35100, 6/9/23, and No. 15658, 8/4/2024). Each patient provided informed consent for inclusion in the study.

Informed consent: informed consent was obtained from the patients included in this study.

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## Introduction

In the Emergency Department (ED), triage aims to quickly assess patients by assigning a color code indicating the priority level for medical evaluation and treatment; trained nurses assign a priority level to patients using a well-defined triage system based on an initial visual assessment and a subsequent subjective and objective assessment, with data collected from the patient's history and physical examination, with the goal of ensuring efficient use of ED resources. In the case of syncope, triage should prioritize patients at high risk due to an underlying cardiovascular cause, but the few studies investigating this topic have found limited accuracy in identifying patients with cardiac syncope.<sup>1,2</sup>

Regional recommendations<sup>3</sup> require ED triage assessment to be based on decision flow diagrams to standardize the approach; in the case of syncope, the operating flow chart in our ED (Figure 1) focuses on promptly identifying patients with underlying acute cardiovascular diseases requiring urgent evaluation and treatment. Such a standardized approach could increase the accuracy of triage in identifying patients with cardiac syncope. Moreover, the 2019 National Guidelines on intra-hospital triage<sup>4</sup> promote the use of a five-level triage system, since it is better suited to predict each patient's level of care complexity and resource use, taking into account factors such as age, frailty, and comorbidities. Because syncope admission is frequently driven by old age, comorbidities, and social concerns,<sup>5,6</sup> triage assessment may also play a role in identifying the most complex syncopal patients, allowing targeted efforts to reduce inappropriate admissions, in agreement with the 2018 European Society of Cardiology Guidelines on syncope management (ESC GL).<sup>7</sup> Based on these observations, authors believe that ED triage could help optimize the management of patients with syncope, which is still plagued by a very high hospitalization rate (up to 50%) and huge expenses,<sup>6,8</sup> as well as a not negligible incidence of short-term adverse events.<sup>8</sup>

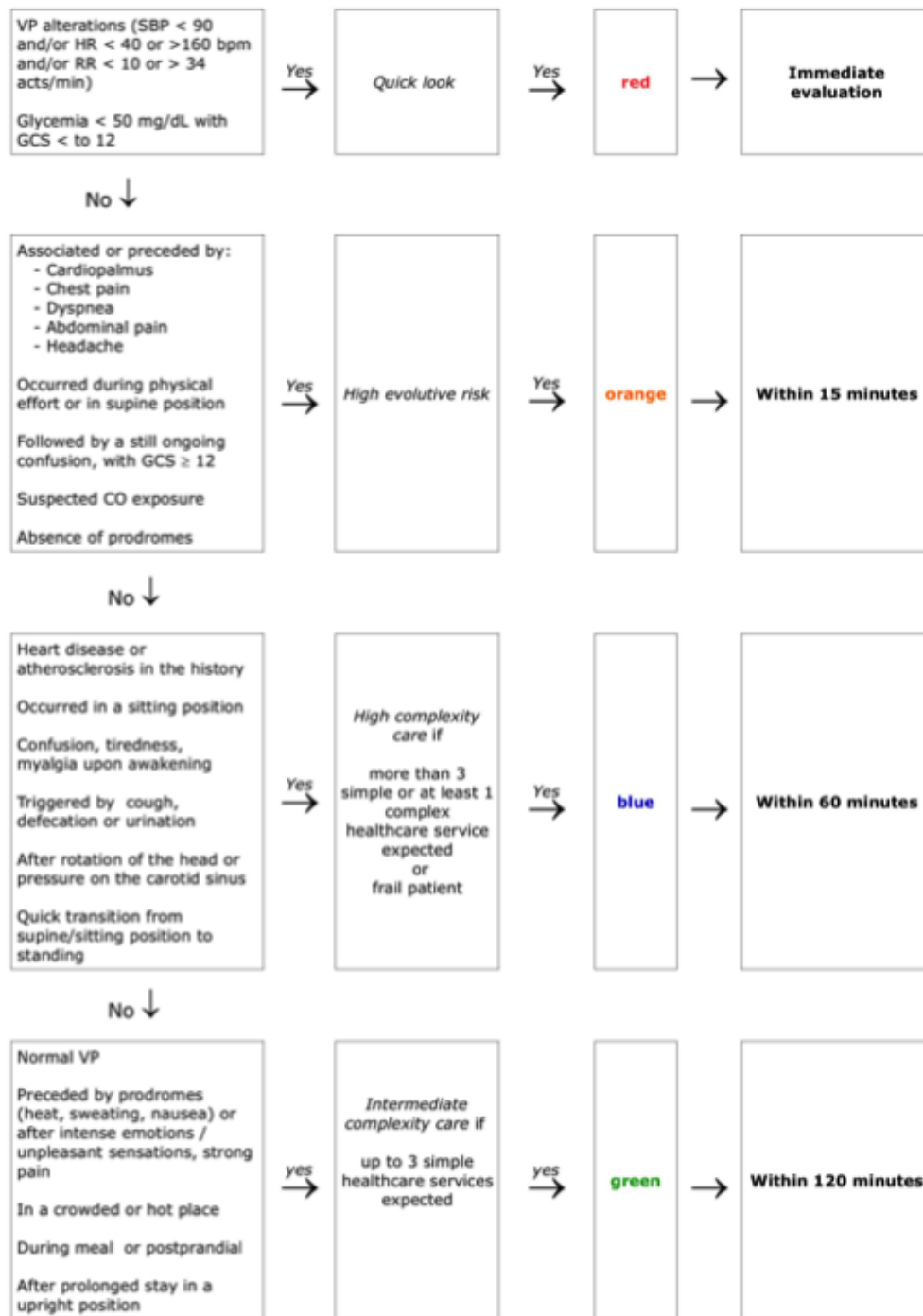
To this aim, they also think that, as in other clinical contexts (such as heart attack, stroke, and sepsis),<sup>9</sup> even in the case of syncope, the arrival mode in ED is a critical point. The most serious

cases should reach the ED with Emergency Medical Services (EMS) rather than in an ambulance or autonomously. However, no study has addressed this issue yet.

## Aims

This study is purposed to investigate the current modalities and efficacy of taking charge of patients with syncope, from pre-hospital

setting to ED triage. The specific aims of the study are: i) to describe the arrival mode to the ED of patients with syncope and priority codes assigned upon triage evaluation; ii) to assess the efficacy of nurse triage in the case of patients with syncope by investigating the relationship between triage priority code and the following outcomes: cardiac syncope, syncope associated with Acute Principal Diseases (APDs); syncope requiring admission.



**Figure 1.** ED triage decision flowchart on syncope. VP, vital parameters; SBP, systolic blood pressure; HR, heart rate; RR, respiratory rate; GCS, Glasgow coma scale; CO, carbon monoxide.

## Materials and Methods

### Study design, period, and setting

This research is an observational analytic study carried out on a sample of patients evaluated for syncope in the Emergency Department of the Hospital-University of Parma, a large ED with up to 85,000 attendances every year, from October 2022 to March 2023.

### Enrolment criteria

During the study period, we consecutively enrolled patients of both genders, aged  $\geq 18$  years, evaluated in the ED for an episode of syncope, namely a transient loss of consciousness (TLOC), which is characterized by rapid onset, short duration, and spontaneous and complete recovery, usually associated with postural tone loss. We adopted the following exclusion criteria: i) advanced cognitive impairment, advanced neoplasms, and other serious diseases that severely limit biological validity, autonomy in carrying out daily life activities, and life expectancy; ii) inability to give informed consent to participation in the study, due to language or other barriers; iii) syncopal episodes occurred more than 24 hours before; iv) age  $< 18$  years; v) non-syncopal causes of TLOC (hypoglycemia, seizures, intoxication, *etc.*); vi) non-specific complaints, such as vertigo, dizziness, light-headedness.

### Measures

Through direct patient interviews and ED medical records consultation, we collected the following data: i) age; ii) gender; iii) heart diseases in the history, considering coronary heart diseases, heart failure (reduced left ventricular ejection fraction), cardiomyopathies; iv) previous syncopal episodes; v) prodromal symptoms (such as pallor, sweating, nausea, *etc.*); vi) arrival mode, classified as follows: autonomous, ambulance (with only lay personnel), EMS; vii) execution of the electrocardiogram (ECG) during triage upon arrival; viii) triage priority color code, according to the current classification system:<sup>3</sup> red (for emergency, requiring immediate evaluation by ED physicians), orange (unavoidable urgency, maximum waiting time 15 minutes), blue (deferrable urgency, maximum waiting time 60 minutes), green (minor urgency, maximum waiting time 120 minutes), white (not urgent, maximum waiting time 240 minutes); ix) ED diagnosis of syncope, classified as cardiac, reflex, orthostatic, or unexplained, based on ESC GL diagnostic criteria and clinical features suggesting a diagnosis upon initial evaluation;<sup>7</sup> x) presence of underlying APDs considering the following conditions,<sup>10</sup> provided that a plausible pathophysiological relationship with syncope could be established, either as a direct cause or as a triggering factor: acute coronary syndrome; major arrhythmias (such as sustained ventricular tachycardia, supra-ventricular tachycardia with hemodynamic instability, complete heart block or other critical bradyarrhythmias); other acute cardiovascular events (such as acute heart failure, pulmonary embolism, or aortic syndrome); hemorrhage or anemia requiring blood transfusion; neurological disorders; internal acute diseases with pain, fluid loss or hypotension; infectious diseases; xi) physical injuries, excluding those that did not require instrumental examination or any urgent care; xii) final destination, classified as follows: discharge, admission, death.

### Statistical analysis

All data were entered and analyzed in SPSS statistic software (V. 21). To describe the characteristics of patients as well as to detail

the arrival mode and triage color priority codes, we utilized descriptive statistics. To evaluate the accuracy of triage evaluation, we compared the presence of the outcome between patients with a low vs. a high triage priority code, using contingency tables and a chi-square test; in this regard, to assess the triage diagnostic yield for cardiac syncope and APDs, we compared patients with a low (white, green, and blue) vs. a high (orange and red) triage priority code in terms of clinical severity, while to assess the triage diagnostic yield for syncope requiring admission, we compared patients with a low (that is white and green) vs. a high (that is green, orange and red) care complexity triage priority code, according to regional guidelines.<sup>3</sup> To explore how to improve the accuracy of the triage assessment, we compared patients with and without the outcomes considered, with regard to personal data, medical history (previous syncopal episodes and heart diseases), triage priority code, and clinical features of the syncopal episode (presence of witnesses, prodromal symptoms, injuries), using contingency tables and a chi-square test.

### Ethics and regulatory aspects

The study was carried out in agreement with the ethical guidelines of the Declaration of Helsinki and under the terms of all relevant local legislation. The study also received regulatory approval from the local ethical committee (reference No. 632/2022; amendments protocol No. 35100, 6/9/23, and No. 15658, 8/4/2024). Each patient provided informed consent for inclusion in the study.

## Results

Table 1 shows the characteristics of patients and of syncopal episodes. Our series included subjects of quite advanced age, of both genders, in a minority of cases affected by significant heart diseases in the history (10.4%); syncopal episodes were not preceded by prodromal symptoms in more than one-third of total cases, and they frequently were complicated by physical injuries (*i.e.*, 22%). The

**Table 1.** Patients and syncopal episodes characteristics.

	n (%)
Males	195 (51.6)
Age	64.1 (20.7)
Heart diseases in the history	40 (10.6)
Previous episodes	217 (57.4)
Prodromes	237 (62.7)
ED diagnosis	
Reflex	135 (35.7)
Orthostatic	94 (24.9)
Cardiac	25 (6.6)
Unexplained	124 (32.8)
Physical injuries	83 (22)
Acute underlying diseases	86 (22.8)
Acute coronary syndrome	3 (3.5)
Major arrhythmias	1 (1.2)
Other acute cardiovascular events	4 (4.7)
Hemorrhage or anemia requiring blood transfusion	6 (7)
Neurological disorders	8 (9.3)
APDs with pain, fluid loss or hypotension	39 (45.3)
Infectious diseases	25 (29.1)

Age is reported as mean and standard deviation; ED, emergency department; APDs, acute principal diseases.

most frequent ED diagnoses were reflex (35.7%) or unexplained syncope (32.8%). Over a fifth of patients (*i.e.*, 22.8%) were found to have APDs underlying syncope, mostly internal acute diseases with pain, fluid loss or hypotension, and infectious diseases. Table 2 shows data on arrival mode, triage evaluation, and final ED disposition. Just under half of the patients (48.4%) arrived in the ED with EMS, while the remaining arrived autonomously (24.1%) or by ambulance with only lay personnel (27.5%). An electrocardiogram was performed at triage in a small minority of cases (12.4%). Even in the case of cardiac syncope (*Supplementary Table 1*), less than half of patients arrived in the ED with EMS (44%), and in very few cases (8%), an electrocardiogram was performed at the triage. As for the final destination, most patients were discharged (73.8%), a quarter of total patients were admitted (25.7%), and 2 of them died in the ED. Regarding triage priority code, our series was mostly composed of patients with green, blue, and orange codes (altogether 95.2%), nearly evenly distributed. Table 3 shows the contingency used to explore the efficacy of triage evaluation in identifying patients with cardiac syncope: the attribution of a high severity code (that is, orange or red) was significantly associated with the presence of cardiac syncope ( $p<0.05$ ), with a sensitivity of 52% (95% CI 31.3-72.2%) and a specificity of 69% (63.7-73.6); the negative predictive value was 95.3%. *Supplementary Table 1* presents the comparison between patients with vs. without cardiac syncope, showing that only advanced age and absence of prodromal symptoms were associated with this outcome. Table 4 shows the contingency table used to explore the efficacy of triage evaluation in identifying patients with APDs: the attribution of a high severity code (that is, orange or red) was significantly associated with the presence of APDs ( $p<0.05$ ), with a sensitivity of 43% (95% CI 32.39%-54.15%) and a specificity of 70.5% (95% CI 64.96-75.72%); the negative predictive value was 80.8%. *Supplementary Table 2* presents the comparison between patients with vs. without APDs, showing that only the absence of previous episodes was associated with this

outcome. Table 5 shows the contingency table used to explore the efficacy of triage evaluation in identifying patients with a need for admission: the attribution of a code of high care complexity (that is, blue, orange, or red) was strongly associated with this outcome ( $p=0.0000$ ), with a sensitivity of 86.6% (95% CI 78.2-92.7) and a specificity of 40.5% (95% CI 34.7-46.5); the negative predictive value was 89.7%. *Supplementary Table 3* presents the comparison between patients with vs. without need of admission, showing that age, absence of prodromal symptoms, and injuries were associated with this outcome; the triage priority code was also significantly different between the two groups.

**Table 2.** Arrival mode, triage evaluation, and final ED disposition.

Arrival mode	n (%)
Autonomous	91 (24.1)
Ambulance	104 (27.5)
EMS	183 (48.4)
Triage priority code	
White	9 (2.4)
Green	117 (31)
Blue	129 (34)
Orange	114 (30.2)
Red	9 (2.4)
Execution of ECG at triage	47 (12.4)
Final disposition	
Discharge	279 (73.8)
Admission	97 (25.7)
Death	2 (0.5)

EMS, emergency medical service; ECG, electrocardiogram.

**Table 3.** Contingency table comparing the presence of a cardiac syncope between patients at high vs. low severity triage code.

	Non-cardiac syncope	Cardiac syncope
High severity triage code	110	13
Low severity triage code	243	12
P-value	<0.05	
Sensitivity	52% (31.3-72.2%)	
Specificity	68.8% (63.7-73.6%)	
NPV	95.3% (93-96.8%)	
PPV	10.6% (7.3-15.1%)	

NPV, negative predictive value; PPV, positive predictive value.

**Table 4.** Contingency table comparing the presence of an underlying acute principal disease between patients at high vs. low severity triage code.

	Presence of APDs	No APDs
High severity triage code	37	86
Low severity triage code	49	206
P-value	<0.05	
Sensitivity	43% (32.4-54.1%)	
Specificity	70.5% (65-75.7%)	
NPV	80.8% (77.5-83.7%)	
PPV	30.1% (24.1-36.8%)	

APDs, acute principal diseases; NPV, negative predictive value; PPV, positive predictive value.

## Discussion

Our study included syncopal patients with a quite advanced age and episodes often complicated by injuries and associated with underlying acute principal diseases, in line with previous studies;<sup>8,10</sup> as a result, our sample comprises a substantial proportion of subjects difficult to deal with, for which admission is frequently required,<sup>5,6</sup> and represents a good test bench to assess the efficacy of the taking charge of patients with syncope, from prehospital context to ED triage. Just over half of the patients arrived in the ED autonomously or by ambulance with only lay personnel. This finding may be explained by the fact that syncope is a common and sometimes recurrent event; therefore, it rarely causes serious concern in patients suffering from it. Moreover, it is noteworthy that patients with syncope who are evaluated in ED constitute only a small minority of all syncopal events occurring in the general population (2-10%).<sup>11</sup> Upon arrival in the ED, the majority of patients (over two-thirds of the total) were given a low-severity triage priority code, as already shown by previous studies on this topic.<sup>1,2</sup> In only a small proportion of cases (12.4%), an electrocardiogram was performed at triage, and this finding could be attributed to the absence of significant Vital Parameters (VP) changes, particularly heart rate, in most patients. However, it should also be noted that the current triage flowchart (Figure 1) does not include ECG as a routine evaluation tool and that, currently, there are no guidelines on so-called diagnostic anticipation, in which the triage professionals initiate diagnostic or therapeutic actions before patients are seen by Emergency Physicians (EPs); nurse triage relies mostly on their own clinical judgment.

Another important factor to consider is that when nurses conduct an ECG during triage, they must take it to EPs for interpretation. This results in a loss of time, as nurses currently have limited ability to read ECGs themselves. Additionally, for legal reasons, they often do not fully trust their own interpretations.

As previously reported,<sup>12</sup> improving nurses' ability to interpret the ECG is both feasible and crucial for optimizing ED management of patients with cardiovascular complaints, including syncope.

As regards taking charge of patients with cardiac syncope, it is noteworthy that fewer than half of them arrived in the ED with EMS. Since, in our context, the decision of the mode of transport by the operating center is already standardized, based on high-risk features (persistence of altered mental state, pain, advanced age, cardiovascular history), this finding highlights the need for better public education on recognizing warning symptoms that require EMS activation. An electrocardiogram was performed at triage in only a small minority of patients with cardiac syncope (2/25); therefore, to avoid dangerous delays in the evaluation and treatment of high-risk cases, ECG use should be increased in patients with

risk factors for cardiac syncope even in the absence of VP alterations (warranting an immediate medical evaluation), namely those with orange or blue code. As regards the triage efficacy in identifying patients with cardiac syncope, the most important finding of our study is the high negative predictive value of triage evaluation. Although specificity remains low, the triage assessment proved to be useful in ruling out cardiac syncope, with a good level of certainty in case of a low severity code; the apparent contrast of low sensitivity is linked to the low prevalence of the disease. Based on a comparison of patients with and without cardiac syncope, and because the evaluation of symptoms preceding syncope is already included in the current flowchart, it may be useful to include advanced age as a factor warranting a higher severity code to improve triage evaluation accuracy. As regards the triage efficacy in identifying patients with APDs, a high-level severity code was found to be associated with this outcome, with a high negative predictive value; the sensitivity was rather low, likely due to the low incidence of these APDs, which were mostly not severe, without changes in VP or warning symptoms. On the basis of the comparison between patients with and without APDs, to increase the accuracy of triage evaluation, it may be useful to investigate previous syncopal episodes in the history, as a first syncopal episode, especially in older subjects, could be due to an underlying acute disease. Given the high prevalence of APDs underlying syncope, mostly non-serious, it may also be beneficial to train triage nurses to systematically check for a limited set of accompanying symptoms (*e.g.*, fever, vomiting, diarrhea, or pain) and document them in the descriptive section of the triage report.

As regards the triage efficacy in predicting patients requiring admission, the implementation of a five-level triage system, recommended by current guidelines,<sup>3</sup> confirms its efficacy in stratifying patients complexity: a low care complexity triage code, in fact, has been found to have a high sensitivity and equally a high negative predictive value in highlighting patients who will not require hospitalization; the high prevalence of this outcome justifies the seemingly low specificity. The comparison between patients with vs. without the need for admission shows that the main factors associated with hospitalization were advanced age and injuries due to syncope, both factors often hampering a direct discharge from ED,<sup>5</sup> as well as the absence of prodromal symptoms, a feature associated with cardiac syncope and physical injuries.<sup>7</sup> Since ESC GL focus on reducing inappropriate admissions and test,<sup>7</sup> the triage identification of syncopal patients with a low severity but a high care complexity level, that is, those with blue code, should be valorized; these patients, in fact, could be managed without admission through alternative care pathways, such as ED observation units, and an enhanced collaboration with geriatrics in the form of a fast track to outpatient clinics.

**Table 5.** Contingency table comparing the need for admission between patients at high vs. low complexity care triage code.

	Admission	Discharge
High-complexity care triage code	84	166
Low-complexity care triage code	13	113
P-value	0.000	
Sensitivity	86.6% (78.2-92.7%)	
Specificity	40.5% (34.7-46.5%)	
NPV	89.7% (83.7-93.6%)	
PPV	33.6% (30.9-36.4%)	

NPV, negative predictive value; PPV, positive predictive value.

## Limitations

The main limitations of this study are: i) a possible selection bias, as study enrolment was not continuous for 24 hours, and thus our series included proportionally more patients who had longer ED stay because they were more seriously ill; ii) the monocentric design of the study, with limited generalizability of the results to different hospital settings; iii) the small sample size.

## Conclusions

Results of this study indicate that the ED taking charge of patients with syncope, from pre-hospital setting to ED triage, can be improved, leading to benefits in both organizational efficiency and patient safety. In the pre-hospital, every effort should be made to increase the proportion of patients transferred to the ED by the EMS, primarily through health education interventions on symptoms that warrant its activation. Upon arrival in the ED, the triage assessment could be improved by increasing the use of ECG and systematically assessing key factors, such as the patient's age, previous episodes in the history, and accompanying symptoms suggesting underlying acute diseases, even not serious, able to justify the syncope without the need of further investigation.

Syncopal patients with a high care complexity but low severity triage code represent a subset of cases for which novel care pathways should be implemented, in collaboration with geriatrics, to avoid unnecessary hospitalization.

Further multi-center studies are needed to confirm the results of this study. In the meantime, the healthcare administration should strengthen the training of triage nurses in ECG interpretation and update the current triage decision flow diagram on syncope.

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### Online Supplementary Materials:

Supplementary Table 1. Characteristics of patients with vs. without cardiac syncope.

Supplementary Table 2. Characteristics of patients with vs. without acute principal diseases (APDs) underlying syncope.

Supplementary Table 3. Characteristics of patients with vs. without need of admission.