European Heart Journal
Acute Cardiovascular Care
EUROPEAN SOCIETY OF CARDIOLOGY®

*Original scientific paper*

European Heart Journal: Acute Cardiovascular Care
1(4) 312–319

DOI: 10.1177/2048872612463542
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# Self-referral to chest pain units: results of the German CPU-registry

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**Abstract**

**Background:** Chest pain units (CPUs) are increasingly established in emergency cardiology services. With improved visibility of CPUs in the population, patients may refer themselves directly to these units, obviating emergency medical services (EMS). Little is known about characteristics and outcomes of self-referred patients, as compared with those referred by EMS. Therefore, we described self-referral patients enrolled in the CPU-registry of the German Cardiac Society and compared them with those referred by EMS.

**Methods and results:** From 2008 until 2010, the prospective CPU-registry enrolled 11,581 consecutive patients. Of those 3789 (32.7%) were self-referrals (SRs), while 7792 (67.3%) were referred by EMS. SR-patients were significantly younger (63.6 *vs.* 70.1 years), had less prior myocardial infarction or coronary artery bypass surgery, but more previous percutaneous coronary interventions (PCIs). Acute coronary syndromes were diagnosed less frequently in the SR-patients (30.3 *vs.* 46.9%; $p<0.0001$). SR-patients showed ST-segment changes in their initial ECG in 19.6% of cases. EMS-patients underwent more coronary angiographies (60.0 *vs.* 47.5%; $p<0.0001$), while SR-patients underwent more stress tests (11.3 *vs.* 7.8%; $p<0.001$). PCI was performed in 32.6% of the EMS- and in 24.0% of the SR-group ($p<0.0001$).

**Conclusion:** These data demonstrate that patients who contact a CPU as a self-referral are younger, less severely ill and have more non-coronary problems than those calling an emergency medical service. Nevertheless, 30% of self-referral patients had an acute coronary syndrome.

**Keywords**

Chest pain unit, self-referral, emergency medical service, acute coronary syndrome

Received: 8 May 2012; accepted: 13 September 2012

## Introduction

Chest pain units (CPUs) are increasingly established as an integral part of emergency cardiology services. The purpose of a CPU is the quick and targeted identification of the origin of acute unclear chest pain. Data from Germany[1,2] and, in particular, from the United States and the UK prove that the organization models of a CPU result in a cost reduction by means of rational diagnostics and therapy as well as by shortening the average hospital stay.[1,3–5] Utilization of a CPU has the potential to improve the prognosis of patients with acute chest pain as well.[6]

The German Cardiac Society defined obligatory minimal standards for CPUs, which include 24 hour catheterization and intervention facilities.[7] The goal of the subsequent German CPU-registry is the internal and external validation of the medical care quality in the area of CPUs, including benchmark reports for general performance and risk-adjusted comparisons between centres. This ongoing

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registry enrols patients admitted to a CPU in Germany prospectively and continuously. All CPUs are located at institutions with 24 hour coronary intervention facilities.

Usually, the general population and patients are advised to alarm emergency services in the case of acute chest pain. Nevertheless, with increasing awareness about CPUs in the population, patients refer themselves to a CPU in the case of acute chest pain or with other acute problems presumably of cardiac origin. Little is known about the characteristics and outcomes of such self-referred patients as compared with those who are referred to a CPU by emergency medical services or by other medical professionals. Until now, mostly patients with myocardial infarction and self-transport were being studied.[8,9] The aim of this study is the description of self-referral patients enrolled in the CPU-registry of the German Cardiac Society, comparing them with those referred by an emergency medical service (EMS).

## Methods

From 1 December 2008 until 31 December 2010 a total of 11,581 patients were enrolled into the prospective CPU-registry of the German Cardiac Society. The list of participating centres is given in Appendix 1 (online supplementary material). As all certified CPUs are the gate to a catheterization lab, referral to a CPU serves a fast-track to coronary angiography and intervention if needed.

Patients presenting to a CPU as self-referral are compared with those being referred to by EMS.

With the admission to a CPU, all patients are consecutively included in the CPU-register. There are no exclusion criteria. Patient data are filed anonymously to an electronic case report form. After admission all patients are initially informed orally about inclusion into the registry and receive written information about the registry. Depending on their condition, they are later asked to sign an informed consent form for follow-up. The registry received ethical review board approval.

The following data are recorded: demographical data, symptoms, time interval from symptoms to first medical contact to admission, cardiac history, risk factors and associated diseases, pre-hospital findings, admission findings such as ECG and blood tests, leading diagnoses in CPU and therapy (interventional, surgical or medical). For patients with acute coronary syndrome specific laboratory values, therapy in CPU or pre-hospital and intra-CPU complications are recorded. The number of topics entered is variable and depends on the diagnosis and treatment of the patients.

After discharge from the CPU post-discharge treatment and discharge modalities were assessed. For patients having signed an informed consent form, follow-up after three months was accomplished by phone contact via study nurses from the Institut für Herzinfarktforschung.

There was no formal monitoring of the data in the CPU registry.

### Statistics

Descriptive statistics were calculated separately for patients in the self-referral and the EMS group. Continuous variables are described by their medians, lower and upper quartiles, and categorical variables by percentages.

Differences between the two groups were tested applying the Mann–Whitney–Wilcoxon rank sum test to continuous variables and Pearson's chi-square test to categorical variables.

A difference simply called 'significant' in the text refers to a significance level of 0.05. There was no adjustment for multiple testing.

For dichotomous variables, differences between the self-referral and the EMS group are also assessed by odds ratios with 95% confidence limits (Tables 1–7).

All statistical analyses were conducted using SAS® version 9.2 (SAS Institute, Cary, NC, USA).

## Results

From the 11,581 patients included in the registry 7792 (67.3%) were referred by EMS. The remaining 3789 patients (32.7%) presented as self-referral (SR). Demographic data and data for the cardiovascular history of both groups are shown in Table 1. SR-patients were significantly younger, had less prior myocardial infarction or coronary artery bypass surgery, but more previous percutaneous coronary interventions, as compared with the EMS-patients.

Table 2 shows cardiovascular risk factors and concomitant diseases of the patients. It is obvious that the patients of the SR-group had fewer risk factors and lower rates of comorbidities, than those of the EMS-group. In the SR-group, a positive family history of cardiovascular diseases was significantly more present and there was no difference between both groups with respect to smoking. In the EMS-group, 25.3% of the patients contacted their general practitioner before calling the EMS.

Most interestingly, in the SR-group the median symptom-to-admission time was nearly four hours longer than in the EMS-group (see Table 3). Pre-hospital ECGs had been registered in only 20.6% of the EMS-patients, showing ST-elevation or ST-depression in 36.4% of cases. The median time between admission and first ECG recording in the CPU was 5 min in both groups. ST-segment changes were significantly more frequent in the EMS-group. The EMS-patients had significantly more frequently chest pain and dyspnoea, while the patients in the SR-group had significantly more tachycardias. Troponin elevations occurred twice as often in the EMS-group.

**Table 1.** Patient demographics and cardiovascular history.

| | Self-referral | Emergency medical services | *p*-value | OR (95% CI) |
|---|---|---|---|---|
| Number of patients | 3789 (32.7%) | 7792 (67.3%) | | |
| Age, years | 63.6 (51.1–73.1) | 70.1 (57.9–78.3) | < 0.0001 | |
| Female | 39.6% | 39.8% | 0.84 | 0.99 (0.92–1.07) |
| **Cardiovascular history** | 62.6% | 64.1% | 0.11 | 0.94 (0.86–1.01) |
| Percutaneous coronary intervention | 37.1% | 33.9% | < 0.001 | 1.15 (1.06–1.25) |
| Myocardial infarction | 18.2% | 21.4% | < 0.0001 | 0.82 (0.74–0.90) |
| Coronary artery bypass Surgery | 9.8% | 12.6% | < 0.0001 | 0.75 (0.66–0.85) |
| Peripheral arterial disease | 5.1% | 7.1% | < 0.0001 | 0.71 (0.60–0.84) |
| Stroke | 4.3% | 5.2% | < 0.05 | 0.81 (0.67–0.98) |
| Chronic heart failure | 7.8% | 10.1% | < 0.0001 | 0.75 (0.65–0.87) |
| Cardiomyopathy | 2.3% | 2.9% | 0.24 | 0.78 (0.51–1.18) |
| ICD or pacemaker | 8.1% | 8.6% | 0.38 | 0.94 (0.81–1.08) |

OR: odds ratio; CI: confidence interval; ICD: implantable cardioverter defibrillator

**Table 2.** Cardiovascular risk factors and concomitant diseases.

| | Self-referral | Emergency medical services | *p*-value | OR (95% CI) |
|---|---|---|---|---|
| Number of patients | 3789 (32.7%) | 7792 (67.3%) | | |
| **Risk factors** | | | | |
| Diabetes | 16.5% | 24.2% | < 0.0001 | 0.62 (0.56–0.68) |
| Chronic kidney disease | 6.0% | 10.1% | < 0.0001 | 0.56 (0.48–0.66) |
| Smoking | 26.1% | 27.2% | 0.24 | 0.95 (0.87–1.04) |
| Dyslipidaemia | 40.7% | 44.2% | < 0.001 | 0.87 (0.80–0.94) |
| Hypertension | 67.7% | 75.0% | < 0.0001 | 0.70 (0.64–0.76) |
| Positive family history (coronary artery disease) | 26.4% | 21.8% | < 0.0001 | 1.28 (1.17–1.41) |
| **Concomitant diseases** | 22.4% | 25.7% | < 0.05 | 0.83 (0.72–0.97) |
| Chronic obstructive pulmonary disease | 4.7% | 6.7% | < 0.05 | 0.68 (0.51–0.91) |
| Thyroid disease | 9.5% | 8.9% | 0.51 | 1.08 (0.86–1.34) |
| Malignancy | 1.4% | 2.4% | < 0.05 | 0.57 (0.34–0.96) |

OR: odds ratio; CI: confidence interval

In Table 4 the leading diagnoses that were obtained in the CPU-patients are shown. All forms of acute coronary syndromes were diagnosed less frequently in the SR-patients, while arrhythmias were diagnosed more often. Nevertheless, in 30.3% of the SR-patients, an acute coronary syndrome was diagnosed and 19.6% of the SR-patients showed ST-segment changes in their initial ECG.

In Table 5, the diagnostic and therapeutic procedures for both groups are shown. In EMS- patients rates of coronary angiographies were significantly higher (60.0 *vs.* 47.5%), while SR-patients underwent significantly more stress tests (11.3 *vs.* 7.8%). Additionally, the coronary angiographies were performed on a more urgent basis in the EMS-group. Percutaneous coronary interventions had been performed in 32.6% of the EMS-group and in 24.0% of the SR-group.

Table 6 shows the modalities of discharge from the CPU. Significantly more patients of the SR-group had been discharged home or transferred to a regular ward, while the EMS-patients had been more often transferred to the catheterization laboratory and/or to the intensive care unit.

The data for the patients with a diagnosis of an acute coronary syndrome are given in Table 7. Unstable angina was the leading diagnosis for the self-referral patients.

A three month telephone follow-up could be performed with only 5111 patients (44.2% of the total registry population), who signed an informed consent form. These included 1447 patients of the SR-group (38.2%) and 3664 of the EMS-group (47.0%). Thus, a sound interpretation of these data is currently not possible.

## Discussion

CPUs are specialised units to provide emergency cardiology services. In a French study, 20% of patients referred themselves directly to the CPU, but were not analysed further.[10] Thus, we have sparse knowledge about the characteristics of such self-referred patients, as compared with those who are referred to a CPU by EMS or by other

**Table 3.** Findings at CPU-admission.

| | Self-referral | Emergency medical services | *p*-value | OR (95% CI) |
|---|---|---|---|---|
| Number of patients | 3789 (32.7%) | 7792 (67.3%) | | |
| Symptom-to-CPU time, h:min | 10:31 (2:54–38:49) | 6:45 (2:17–27:37) | < 0.0001 | |
| **Pre-hospital ECG** | 2.4% | 20.6% | < 0.0001 | 0.09 (0.07–0.14) |
| ST-elevation | 0.0% | 18.6% | < 0.01 | Not available |
| ST-depression/T-inversion | 6.5% | 17.8% | 0.10 | 0.32 (0.08–1.36) |
| LBBB | 3.2% | 4.2% | 0.80 | 0.77 (0.10–5.82) |
| **Symptoms at admission** | | | | |
| Chest pain | 70.4% | 77.7% | < 0.0001 | 0.69 (0.63–0.75) |
| Dyspnoea | 23.8% | 29.2% | < 0.0001 | 0.76 (0.69–0.83) |
| Tachycardia | 13.4% | 10.6% | < 0.0001 | 1.31 (1.16–1.47) |
| Syncope/presyncope | 6.3% | 7.6% | < 0.01 | 0.81 (0.70–0.95) |
| Other symptoms | 15.9% | 12.1% | < 0.001 | 1.37 (1.14–1.64) |
| **CPU ECG** | | | | |
| ST-elevation | 3.9% | 8.3% | < 0.0001 | 0.45 (0.37–0.54) |
| ST-depression/T-inversion | 15.7% | 23.6% | < 0.0001 | 0.60 (0.54–0.67) |
| LBBB | 3.8% | 5.8% | < 0.0001 | 0.64 (0.52–0.78) |
| Atrial fibrillation | 10.4% | 10.6% | 0.77 | 0.98 (0.86–1.11) |
| High degree AV-block | 0.6% | 1.0% | < 0.05 | 0.60 (0.37–0.96) |
| Pacemaker ECG | 2.2% | 1.7% | 0.23 | 1.32 (0.84–2.09) |
| Troponin elevated | 13.9% | 27.7% | < 0.0001 | 0.42 (0.38–0.47) |

OR: odds ratio; CI: confidence interval; LBBB: left bundle branch block; AV-block: atrioventricular block

**Table 4.** CPU-diagnosis.

| | Self-referral | Emergency medical services | *p*-value | OR (95% CI) |
|---|---|---|---|---|
| Number of patients | 3789 (32.7%) | 7792 (67.3%) | | |
| **Leading coronary diagnosis** | | | | |
| Acute coronary syndrome | 30.3% | 46.9% | < 0.0001 | 0.49 (0.45–0.53) |
| STEMI | 2.4% | 7.7% | < 0.0001 | 0.30 (0.24–0.37) |
| NSTEMI | 9.3% | 19.7% | < 0.0001 | 0.42 (0.37–0.47) |
| Unstable angina | 18.6% | 19.6% | 0.20 | 0.94 (0.85–1.04) |
| Stable angina | 9.7% | 7.8% | < 0.001 | 1.27 (1.11–1.45) |
| **Leading non-coronary diagnosis** | | | | |
| Acute arrhythmias | 20.2% | 18.7% | 0.07 | 1.10 (0.99–1.21) |
| Hypertensive crisis | 8.5% | 6.8% | < 0.05 | 1.27 (1.00–1.61) |
| Decompensated heart failure | 2.7% | 2.4% | 0.55 | 1.13 (0.76–1.68) |
| Pulmonary embolism | 0.9% | 1.2% | 0.23 | 0.78 (0.53–1.17) |
| Pericarditis/myocarditis | 1.3% | 0.9% | 0.08 | 1.39 (0.96–2.01) |
| Aortic dissection | 0.1% | 0.2% | 0.28 | 0.55 (0.18–1.65) |
| Pleuritis/pneumothorax | 0.2% | 0.3% | 0.58 | 0.81 (0.37–1.74) |
| Tako Tsubo syndrome | 0.0% | 0.3% | < 0.05 | Not available |

OR: odds ratio; CI: confidence interval; STEMI: ST-elevation myocardial infarction; NSTEMI: non-ST-elevation myocardial infarction

medical professionals. We therefore described self-referral patients enrolled in the CPU-registry of the German Cardiac Society. In this registry enrolling 11,581 consecutive CPU-patients, nearly one-third of patients came to the CPU on a self-referral basis.

In the Unites States, hospitals with more than 200 beds were more likely to have a CPU than were smaller ones.[11] In a CPU systematic algorithms and specific management protocols are used, thus resulting in a better one-year prognosis for patients with acute coronary syndrome[6] and a reduced mortality.[12] Acute coronary intervention is the treatment of choice in acute coronary syndrome, especially ST-elevation myocardial infarction. Therefore, a reliable pre-hospital diagnosis including ECG offers the possibility to transfer those patients directly to a catheterization laboratory. As all certified CPUs in Germany must have a 24 hour catheterization facility, it can

**Table 5.** Diagnostic and therapeutic procedures.

| | Self-referral | Emergency medical services | *p*-value | OR (95% CI) |
|---|---|---|---|---|
| Number of patients | 3789 (32.7%) | 7792 (67.3%) | | |
| **Diagnostic procedures** | | | | |
| Coronary angiography | 47.5% | 60.0% | < 0.0001 | 0.60 (0.55–0.66) |
| Stress test before discharge | 11.3% | 7.8% | < 0.001 | 1.51 (1.22–1.87) |
| **Timing of therapy** | | | | |
| Emergency (directly) | 20.3% | 32.7% | < 0.0001 | 0.53 (0.48–0.58) |
| Within next day | 16.9% | 21.4% | < 0.0001 | 0.75 (0.67–0.83) |
| Elective | 56.1% | 39.7% | < 0.0001 | 1.94 (1.80–2.10) |
| No therapeutic consequences | 19.5% | 13.8% | < 0.0001 | 1.51 (1.27–1.78) |
| **Therapy** | | | | |
| Medical therapy only | 68.7% | 57.7% | < 0.0001 | 1.61 (1.48–1.75) |
| Percutaneous coronary intervention | 24.0% | 32.6% | < 0.0001 | 0.65 (0.60–0.72) |
| Coronary artery bypass surgery | 0.6% | 1.8% | < 0.0001 | 0.34 (0.22–0.54) |
| Pacemaker-implantation | 1.4% | 1.9% | < 0.05 | 0.70 (0.51–0.98) |
| ICD-implantation | 0.5% | 0.6% | 0.30 | 0.75 (0.43–1.30) |
| Other therapy | 5.3% | 5.5% | 0.71 | 0.97 (0.81–1.16) |

OR: odds ratio; CI: confidence interval; CT: computed tomography: MRI: magnetic resonance imaging; ICD: implantable cardioverter defibrillator

**Table 6.** Discharge from CPU.

| | Self-referral | Emergency medical services | *p*-value | OR (95% CI) |
|---|---|---|---|---|
| Number of patients | 3789 (32.7%) | 7792 (67.3%) | | |
| **Discharge** | | | | |
| Regular ward | 55.9% | 49.3% | < 0.0001 | 1.31 (1.21–1.41) |
| Home | 32.4% | 29.9% | < 0.01 | 1.12 (1.03–1.22) |
| Catheterization laboratory | 6.3% | 9.4% | < 0.0001 | 0.65 (0.56–0.76) |
| Intensive care unit | 3.8% | 7.5% | < 0.0001 | 0.49 (0.41–0.60) |
| Transfer to other hospital | 1.5% | 4.0% | < 0.0001 | 0.37 (0.28–0.49) |
| Death in CPU | 0.1% | 0.5% | < 0.001 | 0.11 (0.03–0.44) |

OR: odds ratio; CI: confidence interval

be assumed that a transport to such a facility may only cause minor time delay, if any.

If an acute coronary syndrome can be ruled out in the CPU, discharge is safe for the patients, as was shown in several trials.[10,13,14] A study evaluating patients' satisfaction demonstrated that patients treated in a CPU had a higher level of satisfaction as compared with those being treated in a general emergency department for acute chest pain.[15] Additionally CPUs have the potential to reduce costs and hospital occupancy.[16]

Patients and the general population are advised to alarm EMS in the case of acute chest pain. Nevertheless, a considerable percentage of patients are reluctant to call emergency services. Previous studies analysing patients with myocardial infarction revealed that up to 65% of those patients used private transportation, as they thought that self-transport would be faster because of his or her close location to the hospital.[17-20] Although isolated transportation times were shorter for private transportation, patients with myocardial infarction admitted by EMS had significantly shorter time intervals to definite treatment, such as door-to-balloon or door-to-needle times.[8,20,21]

With increasing information about CPUs in the population, patients refer themselves to a CPU in the case of acute chest pain or with other acute problems presumably of cardiac origin. In current ESC guidelines on myocardial revascularization self-referral is already included in the myocardial infarction patient pathway.[22]

SR-patients were considerably younger than those patients referred to by EMS. In both groups more than 60% already had a cardiovascular history, which was more severe in the EMS-patients. Only the rate of previous percutaneous coronary interventions was higher in the SR-group. Additionally, cardiovascular risk factors and concomitant diseases showed a higher prevalence in the EMS-patients. Thus, younger and healthier patients were more likely to refer themselves to a CPU, instead of calling the emergency medical service. One explanation for those differences might be that SR-patients had possibly less severe symptoms, resulting in a longer latency time before

**Table 7.** Subgroup analysis of patients with acute coronary syndrome.

| | Self-referral | Emergency medical services | *p*-value | OR (95% CI) |
|---|---|---|---|---|
| Number of patients | 1135 (23.8%) | 3627 (76.2%) | | |
| Age, years | 63.8 (54.0–72.9) | 69.9 (58.6–75.5) | < 0.0001 | |
| Female | 31.4% | 34.7% | < 0.05 | 0.86 (0.75–0.99) |
| Symptom to CPU time, h:min | 8:20 (2:32–30:39) | 7:30 (2:30–28:45) | 0.44 | |
| CPU ECG | | | | |
| ST-elevation | 9.2% | 15.2% | < 0.0001 | 0.57 (0.45–0.71) |
| T-depression/T-inversion | 27.7% | 33.3% | < 0.001 | 0.77 (0.66–0.89) |
| LBBB | 4.2% | 5.98% | < 0.05 | 0.71 (0.51–0.99) |
| Troponin elevated | 35.8% | 51.0% | < 0.0001 | 0.53 (0.46–0.62) |
| STEMI | 8.0% | 16.3% | < 0.0001 | 0.45 (0.35–0.56) |
| NSTEMI | 30.7% | 42.0% | < 0.0001 | 0.61 (0.53–0.70) |
| Unstable angina | 61.3% | 41.7% | < 0.0001 | 2.22 (1.94–2.54) |
| Coronary angiography | 83.0% | 85.5% | 0.07 | 0.83 (0.68–1.02) |
| Stress test before discharge | 8.7% | 5.3% | < 0.01 | 1.70 (1.16–2.51) |
| Medical therapy only | 47.4% | 38.7% | < 0.0001 | 1.43 (1.25–1.63) |
| Percutaneous coronary intervention | 47.5% | 53.4% | < 0.001 | 0.79 (0.69–0.90) |

OR: odds ratio; CI: confidence interval; LBBB: left bundle branch block; STEMI: ST-elevation myocardial infarction; NSTEMI: non-ST-elevation myocardial infarction

seeking medical help. An older study about patients with myocardial infarction showed that one of the main reasons for a delay in seeking help was the patients' thinking that the symptoms would vanish, because the symptoms were not severe enough. Another was that patients thought the symptoms were caused by another disease.[19]

The symptoms of the patient are the trigger to seek medical help. Chest pain was the leading symptom in more than 70% of both patient groups. But symptoms attributable to an acute coronary syndrome occurred significantly more frequent in the EMS-patients, whilst tachycardias and unspecific symptoms were more frequent in the SR-group. Thus, the presence of non-anginal symptoms might be another reason for patients to avoid emergency services. Accordingly more patients in the SR-group had a leading diagnosis of acute arrhythmias or hypertensive crisis.

The symptom-to-CPU time in both groups was very long. EMS-patients had a median time delay of 6.5 hours, while SR-patients needed 10.3 hours between the onset of symptoms and arrival in the CPU. But it must be emphasized that in this study a variety of symptoms and diagnoses, besides chest pain, was present. Previous studies in patients with myocardial infarction from the United States showed that certain factors like older age, female gender, Hispanic or Black race and diabetes were linked to longer delays to seek medical help.[17,23] Additionally indecision, self-treatment, physician contact and financial concerns might undermine a chest pain patient's intention to use EMS.[18] Regarding only the patients with acute coronary syndrome, the symptom-to-CPU time was still too long.

A pre-hospital ECG was obtained in only 20.6% of the EMS-patients. The EMS system in Germany is mostly provided by paramedics, who can be supported by emergency physicians. Thus, pre-hospital ECGs are only performed in a subgroup of patients. Here is clearly a need for improvement of pre-hospital diagnostics. An intensified ECG-training of paramedics or a transmission of the ECG to the CPU might be a possible solution. As all CPUs are localized at catheterization laboratories, referral to a CPU has always the aim to provide immediate invasive diagnostic, if indicated. A currently presented study shows that a pre-hospital ECG can be a driver of a shortened door-to-balloon time. This study compares patients with ST-elevation myocardial infarction, 157 self-referrals and 199 patients arriving by ambulance. Those patients were not significantly different with respect to age or risk factors, but ambulance users were sicker and needed more critical care.[24]

Pathologic laboratory parameters have been found predominantly in the EMS-patients, showing that those were sicker than the SR-patients. A CPU-diagnosis of an acute coronary syndrome was present in 46.9% of the EMS-patients and in 30.3% of the SR-patients and a ST-elevation myocardial infarction was diagnosed in 7.7% of EMS-patients, compared with 2.4% in SR-patients. Accordingly, self-referred patients underwent less invasive procedures on a more elective schedule as compared with the EMS-patients and percutaneous coronary interventions had to be performed more frequently in the latter. Finally the rate of transferral to the intensive care unit was doubled in the EMS-patients (7.5 *vs.* 3.8%), while significantly more of the SR-patients were dismissed home or were transferred to a regular ward. All these data confirm that patients who call emergency services are usually more severely ill than those who self-refer to the CPU. This is in accordance with a previous study demonstrating that myocardial infarction patients arriving by EMS had higher Killip's scores and a

higher mortality.[8] However, the SR-patients were on average 6.5 years younger that the EMS-referred patients, which could explain at least some of the changes observed in comorbidities and cardiovascular risk factors. Nevertheless, a currently published study reveals that for patients who present to the emergency department with potential acute coronary syndrome, severe pain is not related to likelihood of acute myocardial infarction at presentation or death, acute myocardial infarction or revascularization within 30 days.[25] Therefore, the perception of symptoms is not a reliable marker for the severity of the underlying cardiac problem. Additionally we have to keep in mind that about one-third of the patients in this study did not suffer from acute chest pain.

Analysing the group of SR-patients shows that 30.3% of those had an acute coronary syndrome, with 2.4% with ST-elevation myocardial infarction and 9.3% with a non-ST-elevation myocardial infarction. There is no doubt that the optimal pathway for those would have been the emergency service. But possibly the second best pathway might be self-referral to a CPU instead of doing nothing or waiting for a regular medical consultation. It remains unclear what those patients would have done without the availability of a CPU and if they would have referred themselves to an emergency department. We are not aware of any data evaluating the rate of complications during private transport to a hospital, although many physicians experienced single cases where a patient died during a private transport. One study evaluated complications during interhospital transports to interventional coronary departments in patients with acute coronary syndrome and 25% of 48 patients had a complication during transfer to an interventional cardiology department. In all of those the onset of the acute coronary syndrome was less than 24 hours.[26]

Educating patients and the general population about acute chest pain and use of the emergency service is mandatory and EMS should be called as soon as possible. However, patients may misinterpret symptoms, have atypical symptoms or may want to avoid attracting attention by having an ambulance come to their home. Therefore, it is under discussion to provide a low-threshold access for patients' self-referral to allow a straightforward and early detection of severe cardiac disorders. Self-referral to a general emergency department with redirection to a CPU, if an acute coronary syndrome is suspected, might be an alternative pathway, but this was not assessed in our registry.

### *Limitations*

The data presented here were obtained from a registry and not from a controlled clinical study, thus reflecting real life conditions in the participating centres, while clinical studies provide evidence under strictly defined conditions, but which mostly include only a small portion of the potential patients. The purpose of a registry is not the replacement of such studies, but to analyse data under everyday conditions.

There was no formal monitoring of the data in the CPU-registry.

## Conclusion

These data from the German CPU-registry demonstrate that patients who come to a CPU as a self-referral are younger, less severely ill and have more non-coronary problems than those calling an EMS. Nevertheless, 30% of self-referral patients had an acute coronary syndrome.

### Funding

This work was supported by the German Cardiac Society.

### Conflict of interest

None declared.

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