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Outcome of patients with acute coronary syndrome in hospitals of different sizes

A Report from the AMIS Plus Registry

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Summary

Objective: To assess the impact of admission to different hospital types on early and 1-year outcomes in patients with acute coronary syndrome (ACS).

Methods: Between 1997 and 2009, 31 010 ACS patients from 76 Swiss hospitals were enrolled in the AMIS Plus registry. Large tertiary institutions with continuous (24 hour/7 day) cardiac catheterisation facilities were classified as type A hospitals, and all others as type B. For 1-year outcomes, a subgroup of patients admitted after 2005 were studied.

Results: Eleven type A hospitals admitted 15987 (52%) patients and 65 type B hospitals 15023 (48%) patients. Patients admitted into B hospitals were older, more frequently female, diabetic, hypertensive, had more severe comorbidities and more frequent non-ST segment elevation (NSTE)-ACS/unstable angina (UA). STE-ACS patients admitted into B hospitals received more thrombolysis, but less percutaneous coronary intervention (PCI). Crude in-hospital mortality and major adverse cardiac events (MACE) were higher in patients from B hospitals. Crude 1-year mortality of 3747 ACS patients followed up was higher in patients admitted into B hospitals, but no differences were found for MACE. After adjustment for age, risk factors, type of ACS and comorbidities, hospital type was not an independent predictor of in-hospital mortality, in-hospital MACE, 1-year MACE or mortality. Admission indicated a crude outcome in favour of hospitalisation during duty-hours while 1-year outcome could not document a significant effect.

Conclusion: ACS patients admitted to smaller regional Swiss hospitals were older, had more severe comorbidities, more NSTE-ACS and received less intensive treatment compared with the patients initially admitted to large tertiary institutions. However, hospital type was not an independent predictor of early and mid-term outcomes in these patients. Furthermore, our data suggest that Swiss hospitals have been functioning as an efficient network for the past 12 years.

Key words: acute coronary syndrome; outcome; in-hospital mortality; 1-year mortality; hospital type

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Introduction

Outcome comparison at the hospital level is a sensitive issue and has been intensively debated with regard to the size of hospital and admission during duty-hours compared to admission during off-hours. Furthermore, the availability of catheterisation facilities could have an effect on the performed therapies and outcome in patients with acute myocardial infarction (AMI) [1]. Using only

administrative data or denoting mortality rate as a valuable indicator for the quality of healthcare delivery in one hospital could lead to false interpretations and confusion [2, 3]. However, hospital performance measures are not tightly linked to patient outcomes [4]. In cardiology, many clinical trials, registries and databases have provided a wealth of information to define new therapies and to improve the quality of clinical care through evaluation of both the care processes and outcomes of patients with a wide range of conditions; the latter being more important for studies of real-life situations.

Cardiovascular disease is presently the number one cause of mortality in Switzerland and in the Western world. Even though the mortality rate for ST-segment elevation acute coronary syndrome (STE-ACS) has greatly decreased in Switzerland [5], there is still considerable room for improvement.

AMIS Plus is a large, prospective national registry collecting data on the whole spectrum of patients with ACS in Switzerland. It is now acknowledged that only registries can provide information on clinical characteristics, the treatment patients actually receive and clinical evaluation. By investigating mortality data it is possible to document the implementation of new strategies and treatments, and their value compared to randomised trials. Longitudinal AMIS Plus data enables physicians to identify deficits in medical care, implement the necessary changes in diagnostics and therapeutic procedures and to document its impact on clinical outcome in ACS patients.

The aim of this study was to assess if the type of admission hospital had an impact on early and 1-year outcomes in patients with ACS in Switzerland.

Methods

The AMIS Plus project is a nationwide prospective registry of patients with ACS admitted to hospitals in Switzerland. The registry was initiated in 1997, and patient recruitment has since been ongoing. Participating centres, ranging from community institutions to large tertiary facilities, provide data for each patient through a standardised electronic or paper-based questionnaire. The data are centralised at the Institute of Social and Preventive Medicine of the University of Zurich, checked for plausibility and consistency, and incomplete questionnaires are returned to the enrolment centres for completion. The registry was approved by the Over-Regional Ethics Committee for Clinical Studies, the Swiss Board for Data Security and all cantonal Ethic Commissions. The AMIS Plus project is officially supported by the Swiss Societies of Cardiology, Internal Medicine and Intensive Care Medicine, and is sponsored by unrestricted grants from the Swiss Heart Foundation as well as a number of pharmaceutical and medical device companies (listed in the acknowledgements). Details of the AMIS Plus Project have been published elsewhere [6–10].

The AMIS Plus Steering Committee decided that follow-up data be included in the AMIS Plus project starting in 2005, under the condition that follow-up investigation requires written approval.

Participating centres

Between January 1997 and June 2009, 76 hospitals participated in the AMIS Plus project. Large tertiary teaching institutions with continuous (24 hour/7 day) cardiac catheterisation facilities were classified as type A hospitals. All other participating hospitals were classified as type B. During this period, the number of catheter laboratories and procedural volume increased; in part due to private hospitals purchasing such a unit and therefore is no longer necessarily identical with the hospital type. This was taken into account and additional analyses were carried out.

Duty-hours were from 7 a.m. to 7 p.m. on weekdays and off-hours were from 7 p.m. to 7 a.m. on weekdays or entire weekends.

Patients

The AMIS Plus registry included all patients with ACS: AMI, defined by characteristic symptoms and/or electrocardiogram (ECG) changes and raised biomarker levels (troponin according to hospital-specific assay cut-offs or total creatine kinase or creatine kinase MB fraction at least twice the upper limit of normal), ACS with minimal necrosis (symptoms or ECG changes compatible with ACS and cardiac biomarker levels below the cut-off for MI) and unstable angina (UA; symptoms or ECG changes compatible with ACS without raised levels of cardiac biomarkers). Patients were also categorised as having STE-ACS or non-STE-ACS (NSTE-ACS) based on initial ECG findings. Classification of STE-ACS included evidence of ACS as described above and ST-segment elevation and/or presumed new left bundle branch block (LBBB) on the initial ECG. NSTE-ACS included patients with ischaemic symptoms, ST-segment depression or T-wave abnormalities in the absence of ST-elevation on the initial ECG.

All ACS patients enrolled in the AMIS Plus registry from January 1997 to June 2009 were included for analysis of early outcome according to hospital type. Since 2005, a subset of 53 hospitals has collected follow-up information at 3 and 12 months after hospital discharge. Mid-term outcome analysis was performed using data from the patients who were asked and consented to participate. These patients were interviewed 3 months and 1 year after the initial hospitalisation using the standardised patients' questionnaire.

Early outcome was defined as in-hospital mortality or as a composite endpoint of major adverse cardiac events (MACE) which included reinfarction, a cerebrovascular event or death during hospitalisation. Outcome at 1-year follow-up was defined as mortality within 1 year after discharge or as a composite endpoint of 1-year MACE, which included reinfarction, any re-hospitalisation due to cardiovascular disease and/or death.

Statistical analyses

Data are presented as the proportion of valid cases for discrete variables and as means ± standard deviations

and/or medians with interquartile ranges for continuous variables. Differences in baseline characteristics were compared using either the unpaired t test or the Mann-Whitney U test and the Pearson chi square test. Statistics for each table are based on all cases with valid data within the specified ranges for all variables in each table. Multivariate regression of complete cases was used to analyse the independent effect of hospital type on outcome, adjusting for the following variables: age, gender, Killip classification at admission, time between symptom onset and admission, history of diabetes, hypertension, dyslipidaemia, current smokers, obesity (BMI >30 kg/m^2), ST-segment elevation and/or new LBBB at initial ECG, the weighted Charlson score for comorbidities [11] and transfer. These variables were selected in former publications because they were shown to be independent predictors of in-hospital mortality. Results are presented as odds ratio (OR) with a 95% confidence interval (95% CI). A p value of <0.05 was considered significant. The SPSS software (SPSS Inc., Chicago, Illinois; Version 17.0) was used for all statistical analyses.

Results

Between January 1997 and June 2009, 31 010 ACS patients from 76 Swiss hospitals were enrolled in the AMIS Plus registry. Eleven hospitals were classified as type A hospitals with 15987 (52%) patients and 65 hospitals were classified as type B hospitals with 15 023 (48%) patients.

From a total of 5005 patients enrolled between June 2005 and June 2009 in the AMIS Plus registry who were asked and consented to the follow-up, 4671 were interviewed 3 months after discharge and 3747 were interviewed again 1 year after discharge. Of these patients, 41% were from type A hospitals and 59% from type B hospitals.

Baseline characteristics of the patients according to hospital type are shown in table 1. Patients admitted primarily to type B hospitals were significantly older, were more frequently female, diabetic and hypertensive, and more frequently presented with NSTE-ACS or UA. Of these patients, 27.0% had moderate or severe comorbidities (Charlson Index greater than 2) compared with 21.6% of the patients admitted to the large hospitals (p <0.001). In both type A and type B hospitals, around 7% of patients were in Killip classes greater than II at admission, the time between symptom onset and admission was similar, and a comparable amount of the patients were admitted during off-hours.

Performed therapies are depicted in table 2. In comparison with patients from type A hospitals, patients from type B hospitals were less likely to receive aspirin (93.6% vs 95.0%; p <0.001), clopidogrel (42.5% vs 67.9%; p <0.001) and GPIIb/IIIa antagonists (17.3% vs 44.6%; p <0.001). Type B

Table 1

Patients' baseline characteristics according to the hospital type.

Characteristics	Total population (n = 31010)	A hospitals (n = 15987)	B hospitals (n = 15023)	*p*-value (A vs. B)
Men (%)	72.4	75.0	69.7	<0.001
Age, mean years (SD)	65.6 (13.2)	64.0 (13.0)	67.3 (13.2)	<0.001
Delay, median in minutes (interquartile range)	240 (120, 705)	240 (120, 630)	240 (110, 785)	0.837
Admission during off-hours	14 112/30 453 (46.3)	7215/15 579 (46.3)	6897/14 874 (46.4)	0.927
History of coronary artery disease	8678/22 178 (39.1)	4310/11 625 (37.1)	4368/10 553 (41.4)	<0.001
Diabetes	5969/29 807 (20.0)	12 492/15 399 (18.9)	3061/14 408 (21.3)	<0.001
Hypertension	17 123/29 557 (57.9)	8777/15 389 (57.0)	8346/14 168 (58.9)	0.001
Dyslipidaemia	15 738/27 587 (57.0)	8560/14 858 (57.6)	7178/12 729 (56.4)	0.042
Current smoking	10 995/28 858 (38.1)	6058/14 723 (41.1)	4937/14 135 (34.9)	<0.001
Obesity (BMI >30 kg/m^2)	4781/24 653 (19.4)	2537/13 329 (19.0)	2244/11 324 (19.8)	0.125
STE-ACS	17 980/30 926 (58.1)	9660/15 936 (60.6)	8320/14 990 (55.5)	<0.001
Killip classes >II	2168/30 617 (7.1)	1097/15 772 (7.0)	1071/14 845 (7.2)	0.385
Comorbidities (Charlson weighted Index)* N	21 553	12 078	9475	<0.001
0 (no comorbidities) (%)	53.1	55.5	49.9	
1 (%)	23.0	22.9	23.2	
2 (%)	11.1	10.7	11.7	
=>3 (%)	12.8	10.9	15.3	

* Comorbidities included: past history of myocardial infarction, cardiac insufficiency (NYHA III+IV), peripheral vascular disease (ST III+IV), cerebrovascular disease, haemiplegia, dementia, chronic lung disease, connective tissue disease, peptic ulcer disease, diabetes without and with target organ damage, liver disease, renal disease, malignant neoplasm, leukaemia, lymphoma, metastatic solid tumour and AIDS.

Data are presented as n/N (%) unless stated otherwise.

hospital patients more frequently received low molecular weight heparin whereas patients from type A hospitals (41.9% vs 26.3%; p <0.001) more frequently received unfractionated heparin (73.1% vs 68.2%; p <0.001).

STE-ACS patients initially admitted to type B hospitals received thrombolysis more frequently than patients admitted to type A hospitals (23.1% vs 13.9%; p <0.001). These patients also less frequently underwent percutaneous coronary intervention (PCI); primary PCI (31.1% vs 57.0%; p <0.001) and any PCI (57.6% vs 79.1%; p <0.001). Trends in PCI use in STE-ACS patients from 1997 to 2009 were the same for both groups of patients irrespective of hospital type.

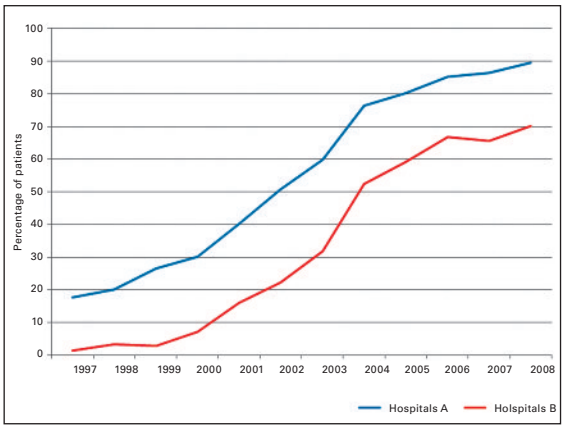

Figure 1

Percutaneous coronary intervention (PCI) in patients with STE-ACS according to hospital type and admission year (N = 17931).
STE-ACS – ST-segment elevation acute coronary syndrome
Hospitals type A – large tertiary teaching institutions with round the clock cardiac catheterisation facilities;
Hospitals type B – small, regional hospitals

Of the ACS patients, 15883 were admitted to hospitals with continuous (7 day/24 hour) catheter laboratory facilities, 2406 to hospitals with catheter laboratories available during duty hours and 12721 to hospitals without catheter laboratories. All analyses were repeated using these facilities as a determinant variable instead of the hospital type. The results were similar resulting in no significant differences.

In 2002, the localisation of PCI was added to the AMIS Plus Questionnaire. From 16647 patients, 66.7% underwent intervention in the admission hospital and 5537 were transferred for intervention. Patients transferred for intervention were comparable with patients who underwent intervention in the admission hospital with regard to age (62.4 years vs 62.6 years; p = 0.46) and comorbidities (Charlson Score >= 3 17.3% vs 17.4%; p = 0.81). Less patients died in-hospital if they were transferred for PCI compared with patients who underwent PCI in the admission hospital (1.9% vs 3.5%; p <0.001). However, 1-year mortality was similar regardless of whether patients were transferred for interventions or not (2.0% vs 2.1%; p = 0.89). The patients initially admitted in type B hospitals and not transferred to type A hospitals for intervention were, in comparison with transferred patients, on average 8 years older (69.6 ± 13.1 y vs 61.9 ± 12.1 y), predominately women (33.7% vs 24.8%), frequently had more severe comorbidities (Charlson Score ≥3; 22% vs 7%), arrived on average 40 minutes later, were more often in Killip classes >I and had STE-ACS less frequently.

Complications and outcome according to hospital type are presented in table 3. The complication rate during hospitalisation was higher in type B hospitals (cardiogenic shock 7.9% vs 5.6%; p <0.001, reinfarction 2.7% vs 1.6%; p <0.001) but frequency of cerebrovascular events was the same (1.0%). Crude in-hospital mortality was higher in patients from type B hospitals than from type A hospitals (7.4% vs 6.2%; p <0.001) as was MACE (9.7% vs 7.9%; p <0.001).

Although the 1-year crude mortality was higher in patients from type B hospitals (4.8% vs 2.8%; p = 0.003), the overall outcome of mortality, reinfarction and any rehospitalisation due to cardiovascular diseases was similar (24.5% vs 23.0%; p = 0.086).

Hospital type, after adjustment for age, gender, risk factors, delay, transfer, STE-ACS and comorbidities, was not an independent predictor of in-hospital mortality (OR 0.94, 95% CI 0.76–

Table 2

Immediate therapies in ACS patients according to hospital type.

	Total population (n = 31010)	A hospitals (n = 15987)	B hospitals (n = 15023)	p-value (A vs B)
Drugs				
Aspirin	29144/30888 (94.4)	15127/15918 (95.0)	14017/14970 (93.6)	<0.001
Clopidogrel	17086/30743 (55.6)	10771/15867 (67.9)	6315/14876 (42.5)	<0.001
GPIIb/IIIa antagonist	8220/25441 (32.3)	6235/13967 (44.6)	1985/11474 (17.3)	<0.001
Unfractionated heparin	21735/30745 (70.7)	11576/15839 (73.1)	10159/14906 (68.2)	<0.001
Low molecular weight heparin	8472/25397 (33.4)	3660/13906 (26.3)	4812/11491 (41.9)	<0.001
Beta blocker	21454/30734 (69.8)	11148/15822 (70.5)	10306/14912 (69.1)	0.010
ACE inhibitors or AT II antagonist	14371/30530 (47.1)	7980/15652 (51.0)	6391/14878 (43.0)	<0.001
Interventional therapy				
Thrombolysis in STE-ACS	3508/17950 (19.5)	1346/9658 (13.9)	2162/8292 (23.1)	<0.001
PCI primary	13744/30904 (44.5)	9086/15949 (57.0)	4658/14955 (31.1)	<0.001
Any PCI	18167/26160 (69.4)	11426/14447 (79.1)	6741/11713 (57.6)	<0.001

Data are presented as n/N (%) unless stated otherwise.

1.16; p = 0.55) or MACE during hospitalisation (OR 0.98, 95% CI 0.82–1.17; p = 0.84).

Hospital type was also not an independent predictor of 1-year mortality or 1-year MACE in patients with ACS. The adjusted odds ratio for hospital type was 1.65 (95% CI 0.90–3.06; p = 0.11) for 1-year mortality, and 1.1 (95% CI 0.85–1.32; p = 0.61) for 1-year MACE.

Table 3

Complications and outcomes in ACS patients according to hospital type.

	Total population	A hospitals	B hospitals	p-value (A vs B)
In-hospital outcome				
Number of patients:	31010	15987	15023	
Cardiogenic shock	2060/30646 (6.7)	890/15814 (5.6)	1170/14832 (7.9)	<0.001
Reinfarction	662/30583 (2.2)	260/15787 (1.6)	402/14796 (2.7)	<0.001
Cerebrovascular event	299/30394 (1.0)	155/15713 (1.0)	144/14681 (1.0)	1.000
Death	2100/31010 (6.8)	987/15987 (6.2)	1113/15023 (7.4)	<0.001
MACE (combined endpoint of death, reinfarction and/or stroke)	2666/30 443 (8.8)	1241/15724 (7.9)	1425/14719 (9.7)	<0.001
1-year outcome				
Number of patients	3747	1515	2232	
Reinfarction	123/3569 (3.4)	44/1460 (3.0)	79/2109 (3.7)	0.263
Rehospitalisation*	769/3585 (21.5)	306/1467 (20.9)	463/2118 (21.9)	0.482
Death	149/3747 (4.0)	43/1515 (2.8)	106/2232 (4.7)	0.004
MACE 1 (combined endpoint of death, reinfarction and/or rehospitalisation)	907/3716 (24.4)	346/1504 (23.0)	561/2212 (25.4)	0.102

Data are presented as n/N (%) unless stated otherwise.
* Rehospitalisation is defined as any rehospitalisation due to cardiovascular disease.

Table 4

Results of multivariate regression analyses. Hospital type adjusted for age, gender, risk factors, type of ACS and comorbidities as independent predictor of:

	Odds ratio	95% confidence interval	p
In-hospital mortality	0.94	0.76–1.16	0.552
In-hospital MACE (combined endpoint of death, reinfarction and/or stroke)	0.98	0.82–1.17	0.837
1-year mortality	1.65	0.89–3.05	0.108
1-year MACE (combined endpoint of death, reinfarction and/or rehospitalisation)	1.06	0.85–1.33	0.607

Table 5

Outcome in ACS patients according to admission time and hospital type.

	In-hospital mortality		p duty vs off-hours	1 year mortality		p duty vs off-hours
Admission during	Duty-hours (07–19h)	Off-hours (19–07h + weekend)		Duty-hours (7–19h)	Off-hours (19–7h + weekend)	
Hospitals type A	478/8364 (5.7)	475/7215 (6.6)	0.025	20/817 (2.4)	23/697 (3.3)	0.354
Hospitals type B	562/7977 (7.0)	539/6897 (7.8)	0.079	58/1190 (4.9)	44/1014 (4.3)	0.611
p (A vs B)	0.001	0.005		0.007	0.311	

Discussion

This analysis of the early and mid-term outcomes of ACS patients according to hospital type showed that patients admitted to smaller regional hospitals differed from patients admitted to large tertiary institutions in Switzerland; they were older and sicker and consequently received less intensive treatment. However, after accounting for all clinical differences, hospital type bore no influence on in-hospital or 1-year mortality, the composite endpoint of reinfarction, cerebrovascular event and death in-hospital or the composite endpoint of reinfarction, any rehospitalisation for cardiovascular reasons or death at 1-year follow-up.

The AMIS Plus registry allows a real-world view of ACS management in Switzerland providing the opportunity to assess daily practice in a large population of ACS patients.

Current political discussions on healthcare delivery and quality of treatment take place in an environment of increasing cost constraints on one side and a growing impact of evidence-based medicine on the other side. Mostly, administrative data of in-hospital mortality have been used as indicators of the quality of care provided by a hospital [12]. In the U.S.A., the public hospital marketing department annually publishes a ranking list of "best hospitals" using scores based on mortality rate, patients' safety and a subjective measurement of reputation [13]. Hospital rankings could change dramatically depending on which data elements and statistical methods are used to assess performance [14]. Adequate comparisons of hospital mortality rates require thorough adjustment for differences among patients with baseline mortality risk [3].

Outcomes in patients with ACS is dependent on age [15], gender [8, 16], risk factors, type of ACS [16, 17], comorbidities [16], delays [18–21] and the medical [6] and interventional therapy received [22]. The most relevant issues from a patient standpoint are advanced age and comorbidities [23]. Additionally, elderly patients across the whole spectrum of ACS are less likely to receive guideline-recommended therapies [7]. An unknown number of very old ACS patients are also refused interventional therapies, a topic that needs to be addressed in the discussion on adherence to guidelines and prognosis for these patients.

ACS encompasses the whole spectrum of ischaemic status although there is a difference of opinion in the literature [16, 17]. Whether or not ACS is a homogenous entity, prognosis seems to depend on the type of ACS [16]. For this reason, outcome was adjusted not only for risk factors and comorbidities but also for the type of ACS.

As the patients initially admitted to type B hospitals were older and sicker and consequently received less intensive therapy, their mortality rate in-hospital and at 1 year was higher than that of patients initially admitted to type A hospitals (7.4% vs 6.2%, 4.7% vs 2.8%, respectively). However, if one accounts for all the clinical differences between these patients, there were no real significant differences in the outcomes of patients whether they were initially admitted to small or large hospitals. An AMIS Plus study by Stolt et al. implied differences between hospitals with and without 24 hour PCI facilities in Switzerland; however, no adjustments were made for comorbidities and follow-ups were not included [5].

PCI plays a central role in the therapeutic management strategies for ACS patients. Starting in the late 1990s, this procedure became the standard and is today the most frequently used therapy, not only for STE-ACS patients but also for high-risk NSTE-ACS or UA patients [24–25]. The outcome of patients who underwent PCI were similar regardless of whether patients presented at a PCI centre or were transferred for intervention [26]. The same results are shown in a recently published study on STE-ACS patients from Denmark [27] that also found no difference in outcome according to admission during working or off-duty hours. In an earlier study, we showed that the outcome of STE-ACS patients admitted out of duty hours was the same as for those patients admitted during regular duty hours [28]. In this study, similar percentages of ACS patients were admitted during off-hours to type A and type B hospitals. A study from Belgium using administrative databases found there was no better outcome for patients initially admitted to hospitals with catheterisation facilities compared with those admitted to hospitals without, although the former delivered more expensive care [29]. In contrary to these and the current results, a French study conducted in 2000 at nearly 900 hospitals, which included 1914 STEMI patients, showed that admission to PCI hospitals was associated with greater use of PCI and improved 1-year survival [1]. This could be because only 1.2% of patients from non-PCI hospitals underwent primary PCI compared to 31.1% in AMIS Plus patients. In this study, patients initially admitted to type B hospitals and not transferred to type A hospitals for intervention were older, sicker, arrived later and in a worse condition with less frequent STE-ACS compared with transferred patients. This could suggest that in the smaller hospitals the physicians in charge do an excellent job in triaging to the greatest benefit of the patients. Furthermore, it could indirectly mean that the guidelines for treatment of ACS patients were well implemented in all Swiss hospitals participating in AMIS Plus regardless of hospital category and that these hospitals have been functioning as an efficient network for the past 12 years.

Currently, access to medical and interventional therapies in Switzerland is guaranteed for everyone regardless of age, insurance, income or

residency. The type of hospital at which the patient initially presented does not appear to be important providing the guideline recommendations for treatment are followed. Optimal effect can only be achieved within an efficient organisational healthcare structure. These observations with regard to the care of ACS contrast with statements in the lay press regarding patients with tumours. If these patients can be documented by registry or other hard data, a detailed analysis with regard to the differences between care for heart and care for cancer patients can be conducted.

In the USA, a number of top hospitals fell short of regularly applying evidence-based care for their heart patients, but many lesser known hospitals routinely provided cardiovascular care consistent with nationally established guidelines [30]. A published analysis of the most recent data at a national level placed the readmission rate as a marker for quality to help hospitals identify and address issues for improvement [31]. The all-cause rehospitalisation rate of the patients who underwent PCI within 30 days of discharge was around 15%, with wide variations between the examined hospitals [32]. In our analysis, the rate of readmission for any cardiovascular reason during the first year after initial hospitalisation for all ACS patients was high but comparable irrelevant of whether patients presented at type A or type B hospitals (20.9% vs 21.9%; p = 0.48).

While we found that crude in-hospital and 1-year mortality was higher in ACS patients initially admitted into type B hospitals, after multivariate adjustment that accounted for age, gender, risk factors, ACS type and comorbidities, both short- and mid-term outcomes for patients initially admitted to types A or B hospitals in Switzerland were similar.

Limitations

Although the data was collected prospectively, these are registry data from hospitals participating voluntarily, which does require highly motivated staff in charge of the patients with heart disease. Therefore, not all patients treated for ACS in Switzerland were included and there was no control as to whether all patients treated in the participating institutions were included. This may have produced an undetected selection bias. However, the great number of patients and hospitals included in this study appears to be representative of the Swiss population. In December 2004, an independent physician reviewed hospital case records on a random sample of 20 patients for internal validation which demonstrated good agreement with the data obtained from questionnaires (κ scores >0.8 for baseline data and therapeutic interventions). The error rate was 0% for therapeutic interventions, 0–0.9% for baseline characteristics and 1.2% for time variables (e.g., time of symptom onset, time of PCI).

In this study, we focused on the impact of the type of admission hospital on the overall outcome of ACS patients in Switzerland and did not assess adherence to guideline-recommended medical or interventional therapies. Furthermore, this study covers a 12-year span, reflecting all the changes in diagnostics and treatments over these years. The AMIS Plus questionnaire has been revised several times in order to keep pace with the latest developments in ACS care, necessitating additional variables.

This study showed that ACS patients admitted to smaller regional Swiss hospitals were older, had more severe comorbidities, more NSTE-ACS and received less intensive treatment compared with the patients initially admitted to large tertiary institutions. However, hospital type was not an independent predictor of early and mid-term outcomes in patients with ACS. Furthermore, the AMIS Plus data suggested that Swiss hospitals have been functioning as an efficient network for the past 12 years.

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AMIS Plus Participants 1997–2009

The following hospitals participated in the AMIS registry from 1997–2009 on which this report is based (in alphabetical order): Affoltern am Albis, Bezirkspital (F. Hess), Altdorf, Kantonsspital (R. Simon), Altstätten, Kantonales Spital (P.J. Hangartner), Aarau, Kantonsspital (P. Lessing), Baden, Kantonsspital (U. Hufschmid), Basel, Kantonsspital (P. Hunziker), Basel, St. Claraspital (C. Grädel), Bern, Beau-Site Klinik (A. Schönfelder), Bern, Inselspital (S. Windecker), Biel, Spitalzentrum (H. Schläpfer), Brig-Glis, Oberwalliser Kreisspital (D. Evéquoz), Bülach, Spital (A. Vögele), Burgdorf, Regionalspital Emmental (D. Ryser), Chur, Rätisches Kantons- und Regionalspital (P Müller), Chur, Kreuzspital (R. Jecker), Davos, Spital (G. Niedermaier), Dornach, Spital (A. Droll /T. Hongler), Einsiedeln, Regionalspital (S. Stäuble), Flawil, Kantonales Spital (J. Haarer), Frauenfeld, Kantonsspital (H.P. Schmid), Fribourg, Hôpital cantonal (B. Quartenoud), Frutigen, Spital (K. Bietenhard), Genève, Hôpitaux universitaires (HUG) (J.M. Gaspoz/P.F. Keller), Glarus, Kantonsspital (W. Wojtyna), Grenchen, Spital (B. Oertli / R. Schönenberger), Grosshöchstetten, Bezirksspital (C. Simonin), Heiden, Kantonales Spital (R. Waldburger), Herisau, Kantonales Spital (M. Schmidli), Interlaken, Spital (E.M. Weiss), Jegenstorf, Spital (H. Marty), La Chaux-de-Fonds, Hôpital (H. Zender), Lachen, Regionalsspital (C. Steffen), Langnau im Emmental, Regionalspital (A. Hugi), Laufenburg, Gesundheitszentrum Fricktal (E. Koltai), Lugano, Cardiocentro Ticino (G. Pedrazzini), Luzern, Kantonsspital (P. Erne), Männedorf, Kreisspital (T. Luterbacher), Martigny, Hôpital régional (B. Jordan), Mendrisio, Ospedale regionale (A. Pagnamenta), Meyrin, Hôpital de la Tour (P. Urban), Monthey, Hôpital du Chablais (P. Feraud), Montreux, Hôpital de Zone (E. Beretta), Moutier, Hôpital du Jura bernois (C. Stettler), Münsingen, Regionales Spital Zentrum (F. Repond), Münsterlingen, Kantonsspital (F. Widmer), Muri, Kreisspital für das Freiamt (H. Lusser), Nyon, Group. Hosp. Ouest lémanique (R. Polikar), Olten, Kantonsspital (S. Bassetti), Rheinfelden, Gesundheitszentrum Fricktal (H.U. Iselin), Rorschach, Kantonales Spital (M. Giger), Samedan, Spital Oberengadin (P. Egger), Sarnen, Kantonsspital Obwalden (T. Kaeslin), Schaffhausen, Kantonsspital (R. Frey), Schlieren, Spital Limmattal (T. Herren), Schwyz, Spital (P. Eichhorn), Scuol, Ospidal d'Engiadina Bassa (C. Neumeier), Solothurn, Bürgerspital Solothurn (A. Grêt/ R. Schöneneberger), St. Gallen, Kantonsspital (H. Rickli), Sursee, Spital (S. Yoon), Tiefenau, Tiefenauspital (P. Loretan), Thun, Spital (U Stoller), Thusis, Krankenhaus (U.P. Veragut), Uster, Spital (E. Bächli), Uznach, Kantonales Spital (A. Weber), Wädenswil, Schwerpunktspital Zimmerberg-Horgen (B. Federspiel / M. Weisskopf), Walenstadt, Kantonales Spital (D. Schmidt / J. Hellermann), Wetzikon, GZO Spital (M. Graber), Winterthur, Kantonsspital (A. Haller), Wolhlusen, Kantonales Spital (M. Peter), Zofingen, Spital (S. Gasser), Zollikerberg, Spital (P. Siegrist / R. Fatio), Zug, Kantonsspital (M. Vogt / D. Ramsay), Zürich, Klinik im Park (O. Bertel), Zürich, Universitätsspital Zürich (M. Maggiorini), Zürich, Stadtspital Triemli (F. Eberli), Zürich, Stadtspital Waid (S. Christen).

Authors' Contributions
Study concept and design: Erne, Radovanovic
Acquisition of data: all authors
Analysis of data: Radovanovic, Erne, Seifert
Interpretation of the data: all authors
Drafting the article: Radovanovic, Erne
Revision of the article: Erne, Radovanovic
Final approval: all authors

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