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TRENDS IN HOSPITAL MANAGEMENT OF ACUTE MYOCARDIAL INFARCTION IN SWITZERLAND, 1998 TO 2008

THE REGION MAKES THE DIFFERENCE: DISPARITIES IN MANAGEMENT OF ACUTE MYOCARDIAL INFARCTION WITHIN SWITZERLAND

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- The region makes the difference: disparities in management of acute myocardial infarction within Switzerland **C. Insam***, F. Paccaud, P. Marques-Vidal (Epalinges, CH) – presentation orale.

Sommaire

ABSTRACT

The aim of this master's thesis was to assess the ten- year trends and regional differences in management and outcome of acute myocardial infarction (AMI) within Switzerland. The thesis is composed of two articles.

First, in the article "Trends in hospital management of acute myocardial infarction in Switzerland, 1998 to 2008" over 102,700 cases of AMI with corresponding management and revascularization procedures were assessed. The results showed a considerable increase in the numbers of hospital discharges for AMI, namely due to the increase of between- hospital transfers. Rates of intensive care unit admissions remained stable. All types of revascularization procedures showed an increase. In particular, overall stenting rates increased with drug-eluting stents partly replacing bare stents.

Second, in the article "The region makes the difference: disparities in management of acute myocardial infarction within Switzerland" around 25,600 cases of AMI with corresponding management were assessed for the period of 2007-2008 and according to seven Swiss regions. As reported by our results, considerable regional differences in AMI management were stated within Switzerland. Although each region showed different trends regarding revascularization interventions, Leman and Ticino contrast significantly by presenting the minimum and maximum rates in almost all assessed parameters. As a consequence these two regions differ the most from the Swiss average.

The impact of the changes in trends and the regional differences in AMI management on Swiss patient's outcome and economics remains to be assessed.

ARTICLE 1: TRENDS IN HOSPITAL MANAGEMENT OF ACUTE MYOCARDIAL INFARCTION IN SWITZERLAND, 1998 TO 2008

ABSTRACT

Purpose: To assess ten-year trends in management and outcome of acute myocardial infarction (AMI) in Switzerland.

Methods: Swiss hospital discharge database for the 1998 to 2008 period. AMI was defined as a primary discharge diagnosis code I21 according to the CIM-10 classification of the World Health Organization. Management and revascularization procedures were assessed.

Results: Overall, 102,729 hospital discharges with a diagnosis of AMI were analyzed. The number of hospital discharges increased almost three-fold from 5530 in 1998 to 13,834 in 2008, namely due to a considerable increase in between-hospital transfers (1352 in 1998, 6494 in 2008). Relative to all hospital discharges, Intensive Care Unit admission rate was 38.0% in 1998 and remained stable (36.2%) in 2008 (p for trend=0.25). Percutaneous revascularization rates increased from 6.0% to 39.9% (p for trend<0.001). Non-drug-eluting stent use increased from 1.3% to 16.6% (p for trend<0.05). Drug eluting stents appeared in 2004 and increased to 23.5% of hospital discharges in 2008 (p for trend=0.07). Coronary artery bypass graft increased from 1.0% to 3.0% (p for trend<0.001). Circulatory assistance increased from 0.2% to 1.7% (p for trend<0.001). Thrombolysis showed no significant changes, from 0.5% to 1.9% (p for trend=0.64). Most of these trends were confirmed after multivariate adjustment.

Conclusion: Between 1998 and 2008 the number of hospital discharges for AMI increased considerably in Switzerland, namely due to between-hospital transfers. Overall stenting rates increased, drug-eluting stents partly replacing bare stents. The impact of these changes on outcome and economics remains to be assessed.

Keywords: acute myocardial infarction; coronary revascularization; epidemiology; Switzerland; trends; drug-eluting stent; coronary artery bypass graft; hospital discharge.

INTRODUCTION

Cardiovascular Diseases (CVD) remain one of the major causes of deaths worldwide. Switzerland has one of the lowest mortality rates due to CVD within Europe [1] but, despite an encouraging downward trend in CVD mortality over the last decades [2], CVD are still the number one cause of death [2]. As a frequent and severe manifestation of CVD, acute myocardial infarction (AMI) can be treated with various drug therapies and revascularization interventions. Indeed, management of AMI, namely regarding revascularization interventions, has evolved over the last decades [3, 4, 5, 6, 7, 8], following the continuously renewed guidelines [9, 10].

There are few data on the evolution of AMI management and outcome in Switzerland. A study published in 2006 [8] based on data from 68 medical centers participating in the AMIS Plus register (http://www.amis-plus.ch/Project.htm) assessed Swiss trends in invasive treatment and outcome for the period 1997 to 2005. Still, it is unknown if the findings from this study also apply to other hospitals, and whether these trends are equally applied in all Swiss regions. Indeed, in Switzerland, health policies are decided at the local (canton) level, with little if no intervention from the central government. These cantons dispose of large autonomy in general policy and are free to adjust health management strategies to their individual needs. Hence, we used the data from the Swiss hospital discharge database to assess the trends in AMI management for the whole country as for the main administrative regions for the period 1998-2008 (**Figure 1**).

METHODS

Databases and available data

Data from the hospital discharge database for years 1999 to 2008 was used. The database was provided by the Swiss federal office of statistics (www.bfs.admin.ch) and covers over 98% of public and private hospitals within Switzerland. Data providing is compulsory (8) and the information collected includes gender, age, length of stay, discharge status (main and secondary diagnoses, vital status) and procedures. The data is anonymous and linkage between stays is currently not possible; as such, a few numbers of stays are related to the same patient and it is not possible to follow the subjects after they left hospital. Four types of stays could be obtained: “passing through”, patients who were admitted from another hospital and transferred to another hospital; “inbound”, patients who were admitted from another hospital and managed on-site; “outbound”, patients who were managed on-site and transferred to another hospital and “in-house”, patients who were admitted and managed without being transferred to another hospital.

Overall length of stay was indicated in days and length of stay in an intensive care unit (ICU) in hours. When the length of stay in the ICU was zero, it was considered as no stay in ICU.

Main and secondary diagnoses at discharge were coded using the International Classification of Diseases, 10th revision (ICD10) of the World Health Organization. Acute myocardial infarction was defined as ICD10 code I21X, where X=any number. Procedures were coded using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD9-CM). The following revascularization procedures (and corresponding IDC9-CM codes) were assessed: any percutaneous coronary intervention (360X); bare, non-drug-eluting stent (3606); drug-eluting stent (DES: 3607); coronary artery bypass grafting (CABG: 361X, 362X and 363X); circulatory assistance (376X and 369X) and thrombolysis (3602, 3604 and 991); and 379x for other procedures.

Inclusion criteria were: 1) age≥18 years and 2) Acute myocardial infarction (ICD10 code I21X) as the main discharge diagnosis. An exclusion criterion was cardiovascular rehabilitation (ICD9-CM code Z500).

Statistical analysis

Statistical analysis was conducted using SAS software version 9.2 (SAS Inc., Cary, NC, US). Results were expressed as number of subjects and (percentage). Trends in the use of revascularisation procedures were assessed by linear regression using the percentage of hospital discharges from AMI reporting the treatment as dependent variable and year as independent variable. A further analysis using year as a continuous variable was conducted using logistic regression adjusting for age, gender and hospital transfers (and region for Switzerland); results were expressed as Odds Ratio (OR) and 95% confidence interval for the increase in one calendar year. Statistical significance was assessed for $p<0.05$.

RESULTS

Trends in hospital discharges

Overall, data from 102,729 hospital discharges from AMI were analyzed. The number of discharges from AMI rose considerably from 5530 in 1998 to 13,834 in 2008 (**Figure 2**), namely due to the increase in between-hospital transfers, which increased from 1352 (24% of hospital stays) in 1998 to 6494 (46.9% of hospital stays) in 2008. These values differed considerably between regions, Leman presenting the lowest (39.5%) and Ticino the highest (67.4%) between-hospital transfer rates in 2008 (**Figure 2**). In 2008, “outbound” discharges reported the lowest

rates of revascularization (23.9% for PCI and 1.1% for CABG), while the highest PCI (79.1%) and CABG (7.0%) rates were reported for “passing through” “inbound” stays, respectively.

Intensive care unit

The percentage of hospital discharges from AMI with reported admission to an ICU was 38.0% in 1998 and remained stable (36.2%) in 2008 (p for trend=0.25, **Figure 3**). Leman had the highest admission rates (stable around 70%); the lowest were in Mittelland (stable under 30%); conversely, rates in Ticino decreased significantly from 64.5% in 1998 to 13.7% in 2008. After multivariate adjustment on age, gender and hospital transfer, a small significant decrease in the likelihood of being admitted to ICU was noted for Switzerland (further adjusted on region: OR=0.99, [0.98 – 1.00] per calendar year) and Ticino (0.85 [0.83-0.87]); while significant increases were found in Leman 1.06 [1.05-1.07]; Eastern (1.10 [1.08-1.11] and Central (1.10 [1.08-1.11]) Switzerland.

Percutaneous revacularizations

Percutaneous revascularizations increased sevenfold, from 6.0% of all hospital discharges from AMI in 1998 to 42.4% in 2006, with a slight decrease to 39.9% in 2008 (p for trend<0.001, **Figure 4**). Bare (non-drug-eluting) stents rose from 1.3% in 1998 to peak at 21.1% in 2003, further decreasing to 16.6% in 2007 (p for trend<0.05, **Figure 4**). Drug eluting stents appeared in 2004 and steadily peaked at 24.3% in 2006, with a slight decrease to 23.5% in 2008 (p for trend=0.07, **Figure 4**). Bare stent use remained stable and high around 30% in Leman since 2002, while in Ticino its use fell abruptly from 37.6% in 2005 to 10.2% 2006, being replaced by DES, which were reported in approximately 30% of hospital discharges from AMI since 2005. After multivariate adjustment on age, gender and hospital transfer, an increase in the likelihood of receiving PCI, bare or DES was noted for Switzerland and for all regions studied (not shown).

Coronary artery bypass graft and circulatory assistance

Coronary artery bypass graft increased from 1.00% in 1998 to 3.3% of hospital discharges from AMI in 2006, further decreasing to 3.0% in 2008 (p for trend<0.001, **Figure 5**). In Ticino, a steep increase in CABG from 0.8% in 1999 to 6.3% in 2000 was noted; a similar trend was found in Mittelland, from 0.3% in 1998 to a peak of 5.6% in 2006. After multivariate adjustment on age, gender and hospital transfer, an increase in the likelihood of receiving CABG was noted for Switzerland (with a further adjustment on region) and for all regions studied except Ticino (1.02 [0.98-1.06]).

Circulatory assistance increased from 0.2% in 1998 to 2.0% in 2007 and decreased to 1.7% in 2008 (p for trend<0.001). After multivariate adjustment on age, gender and hospital transfer, an increase in the likelihood of receiving circulatory assistance was noted for Switzerland (with a further adjustment on region) and for all regions studied except Ticino (1.02 [0.88-1.20]).

Thrombolysis showed no significant changes, from 0.5% in 1998 to 6.0% in 2002 and 1.9% in 2008 (p for trend=0.64). After multivariate adjustment on age, gender and hospital transfer, no trend was found for Switzerland (1.00 [0.99-1.02]), while an increase was found in Leman and in Eastern Switzerland, and a decrease in North-West Switzerland and in Ticino (not shown).

DISCUSSION

To our knowledge, only few studies have assessed the trends in management of AMI in Switzerland. Our results show and increase in most revascularization procedures, namely PCI, while CABG rates tended to decrease in the most recent years. Further, our data show that these trends differ according to region. This increase and change in revascularization procedures is in agreement with the ones observed in other countries [6, 7, 11, 12]. These findings are also in agreement with a previous study conducted on 19,500 patients of the AMIS Plus registry [8], although the increase in PCI procedures observed [13] was considerably stronger than in ours. This difference might be due either to a different coding of the procedure or to a possible "overrepresentation" of PCI procedures among the AMIS Plus registry hospitals, as they participate actively in the registry.

Contrary to other countries [14, 15], the number of hospital discharges for AMI increased over two-fold during the study period in Switzerland. Although part of this increase might be due to population aging [2], the main explanation is the considerable increase in between-hospital transfers, possibly due to the fact that many small, regional hospitals lack the technical facilities to perform coronary revascularization. Indeed, in 1996, the guidelines recommended primary PCI as an option only when rapid access (< 1h) to a catheterization laboratory was possible [16]. If unavailable, individual assessment of the benefits of PCI in relation to the risks and treatment delay of transportation to the nearest catheterization laboratory, compared to in-hospital thrombolysis was suggested. The 2003 guidelines [17] mentioned the DANAMI-2 study, which showed routine transfer strategy to a tertiary care hospital as being superior to in-hospital thrombolysis [18]. The 2005 guidelines [19] recommended the systematic transfer of patients for primary PCI if admitted between 3-12h after onset of symptoms, in-hospital thrombolysis being an alternative if delivered within 3h after onset of symptoms and PCI not available. Finally, the 2008

guidelines [20] recommended the implementation of a 24/7 emergency medical system (EMS) providing an efficient transport service to hospitals with catheterization laboratories within 2h after onset of symptoms. Still, as AMI management is expensive [21], it would be of interest to assess the economic impact of this increase in hospital transfers, as well as its impact on patient outcome. Unfortunately, as no patient identification was available, it was not possible to conduct such an analysis.

ICU admission rates remained relatively stable between 1998 and 2008 in Switzerland. This stabilization might be the consequence of improved management, requiring less ICU admissions before or after a revascularization intervention. Still, considerable differences in ICU admission rates and trends were found between regions, suggesting that other factors such as the number of ICU beds available or local AMI management options might be at play. Unfortunately there is no available information regarding the number of ICU beds in each region, so the rationale for a regional difference in ICU admission for AMI remains to be further assessed.

Stent use increased steeply from slightly over 1% in 1998 to nearly 40% in 2008, a finding in agreement with the literature [22]. Drug eluting stents appeared in 2004 and their use rose steadily until 2006, when several reports questioning their costs [23, 24] and long term complications [25, 26] were published. These reports slowed down DES use, but some Swiss regions were more responsive than others. For instance, Leman kept on preferring bare stents, while in Ticino DES represented nearly all stents implanted since 2005. The reasons for such regional differences are hard to explain and might be more due to local preferences or local agreements regarding the cost of the DES than to decisions based on scientific evidence, a finding also reported by others (ref Austin). Indeed, no clear association was found between the publication of the results of randomized trials regarding DES and changes in DES use according to region (**Figure 6**) and further studies are needed to better assess the reasons for the great differences in stent use between Swiss regions.

The rate of CABG remained relatively stable at 3% throughout the study period, a finding also reported in other countries [3, 6]. As for stents, very different trends according to the region were found. For instance, Ticino showed a steep rise in CABG use, starting in 1999 to reach an average rate of 7%, well above the Swiss average. This trend might partly be explained by the creation in 1999 of new medical centers with the capacity to carry out these interventions. Conversely, in Eastern and Central Switzerland, hardly any CABG was performed until 2007, likely the result of the lack of required infrastructure. Overall, our results show that CABG rates evolved

differently between Swiss regions, the most likely explanations being the existence of infrastructures and local preferences for certain types of revascularization procedures.

This study has some limitations. Medicines are not included in the hospital discharge database, thus precluding the assessment of their trends. This absence might also explain the very low rates for thrombolysis, which are likely due to the absence of coding rather than a true absence of use. Also, it was not possible to assess the impact of the changes in AMI management on outcome, neither the identification of the patients nor out-of-hospital follow-up data being available. The AMIS registry, which collects vital status data for AMI patients hospitalized in the participating institutions, will be able to provide such information in a near future. The strengths of this study are the fact that the Swiss hospital discharge database covers almost all (99%) hospitals within Switzerland and that hospital discharge data has been shown to be reliable regarding the diagnosis of AMI [27].

In summary, our results show that Switzerland has followed the international trends with a steep rise of percutaneous revascularization procedures, and to a lesser degree of CABG. Drug-eluting stents replaced bare stents starting in 2004, but this replacement differed according to region. The impact of these changes on outcome and on economics needs to be assessed.

AUTHORS CONTRIBUTIONS

CI made part of the statistical analyses and wrote most of the article; PMV collected data, made part of the statistical analysis and wrote part of the article; FP revised the article for important intellectual content. PMV had full access to the data and is the guarantor of the study.

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FIGURES

Figure 1: the seven main administrative areas of Switzerland used in this study.

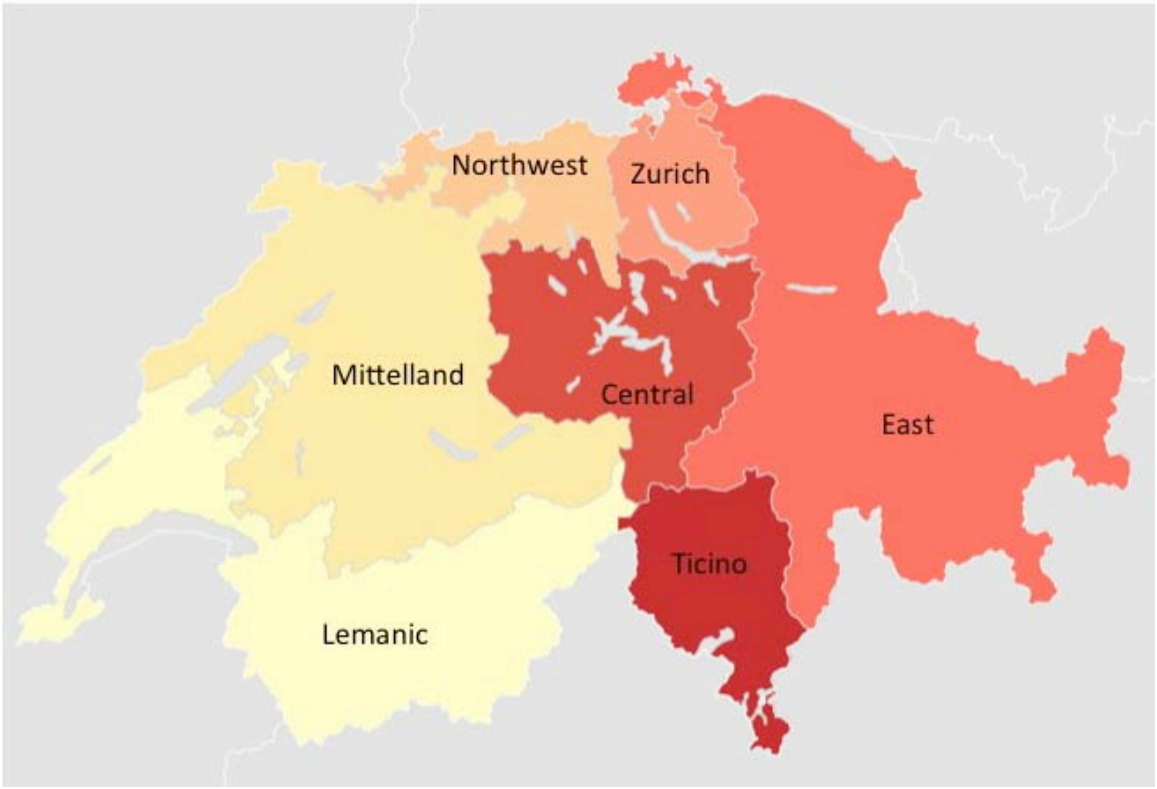


Figure 2: number of hospital discharges with a diagnosis of acute myocardial infarction in Switzerland, overall and by region, for the period 1998-2008. “Passing through”, patients who were admitted from another hospital and transferred to another hospital; “inbound”, patients who were admitted from another hospital and managed on-site; “outbound”, patients who were managed on-site and transferred to another hospital and “in-house”, patients who were admitted and managed without being transferred to another hospital.

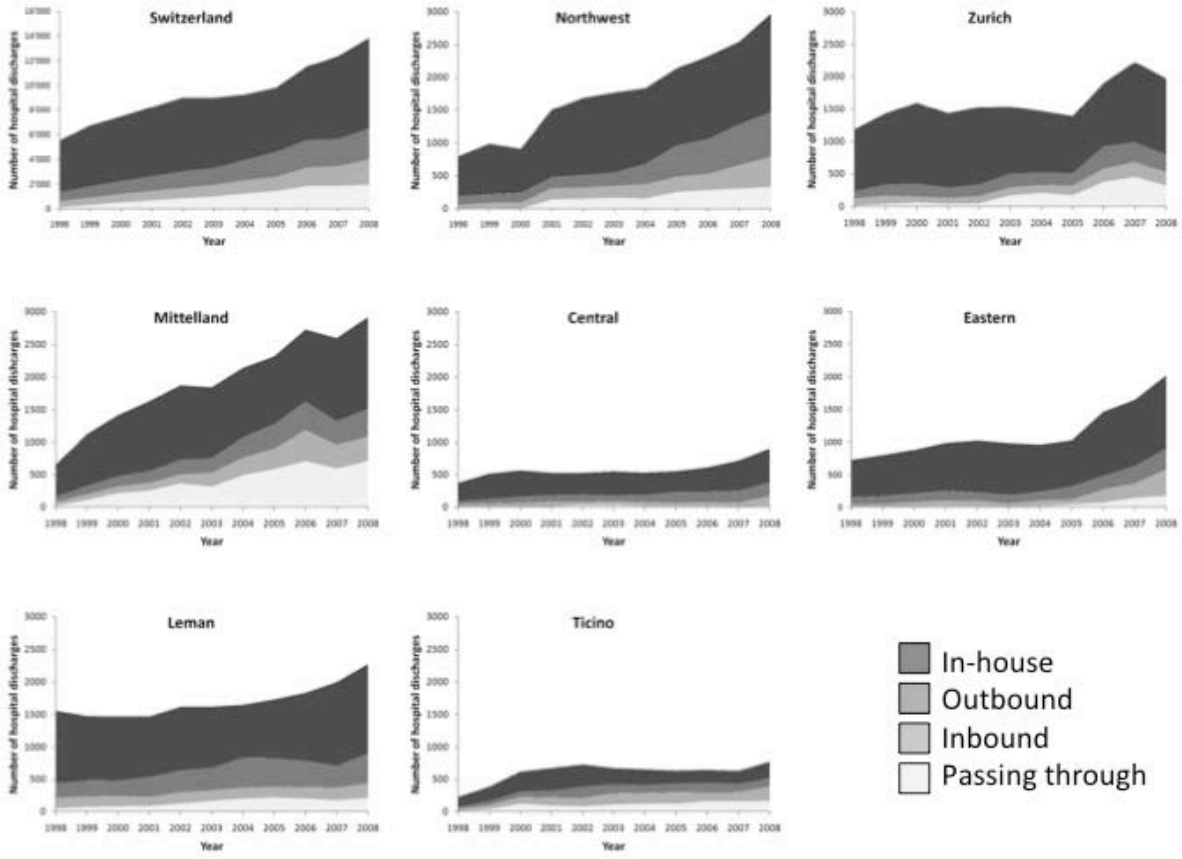


Figure 3: trends in intensive care unit (ICU) utilization for acute myocardial infarction in Switzerland, overall and by region, for the period 1998-2008. Results are expressed as percentage of hospital discharges with a diagnosis of acute myocardial infarction.

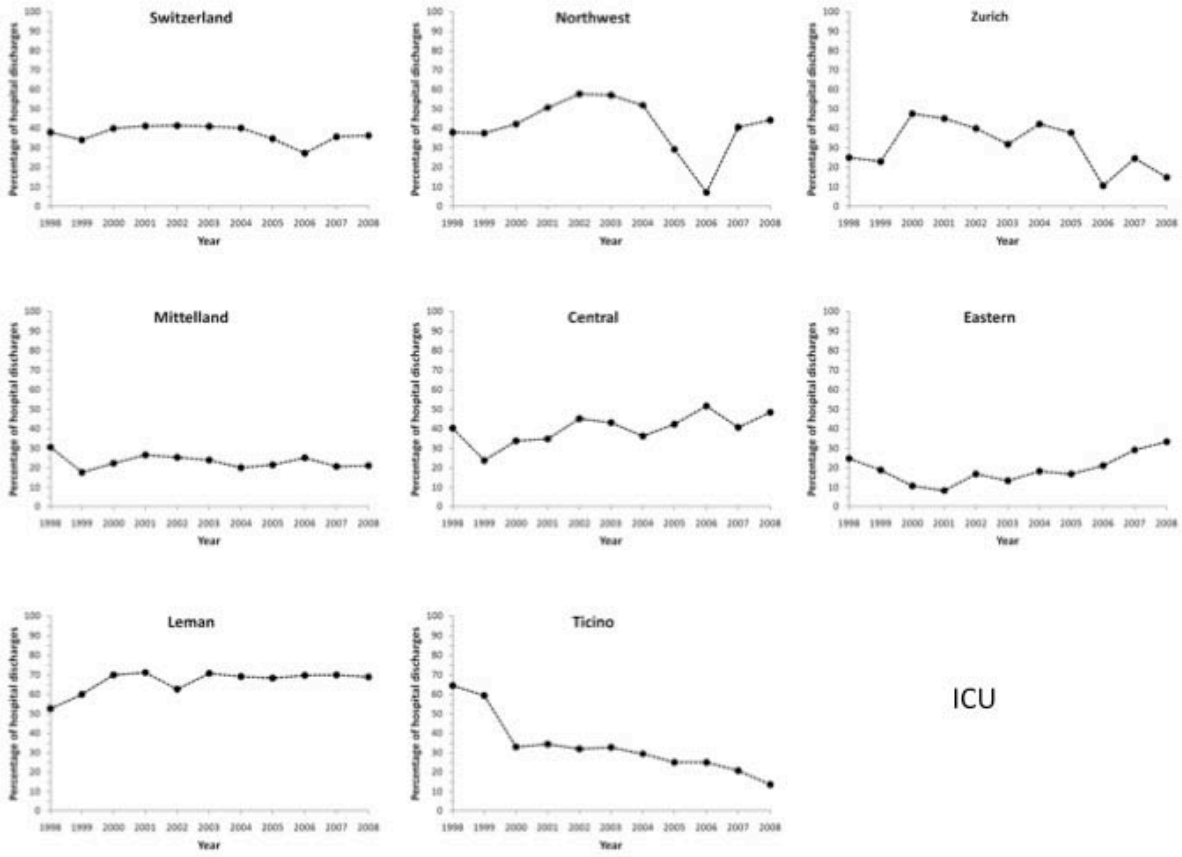


Figure 4: trends in the use of drug-eluting and non-drug-eluting stents for acute myocardial infarction in Switzerland, overall and by region, for the period 1998-2008. Results are expressed as percentage of hospital discharges with a diagnosis of acute myocardial infarction.

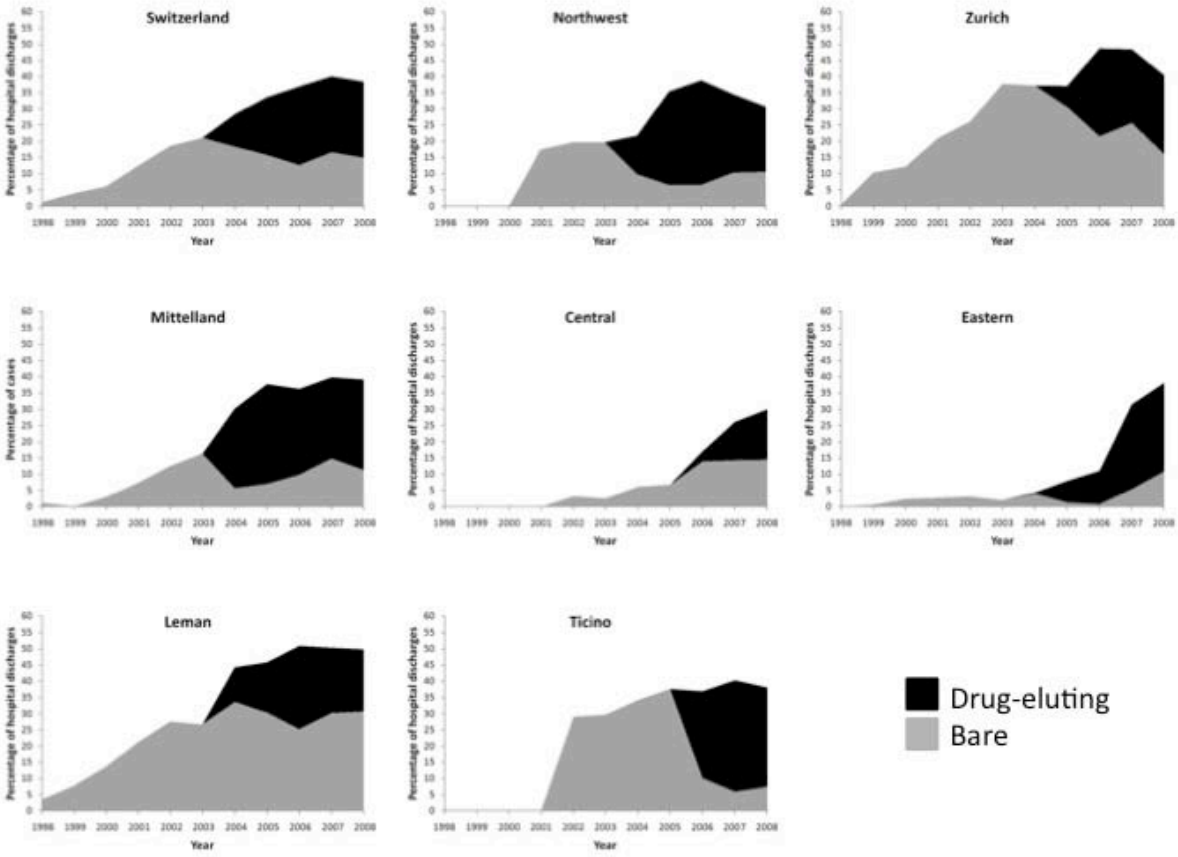


Figure 5: trends in the use of coronary artery bypass graft (CABG) for acute myocardial infarction in Switzerland, overall and by region, for the period 1998-2008. Results are expressed as percentage of hospital discharges with a diagnosis of acute myocardial infarction.

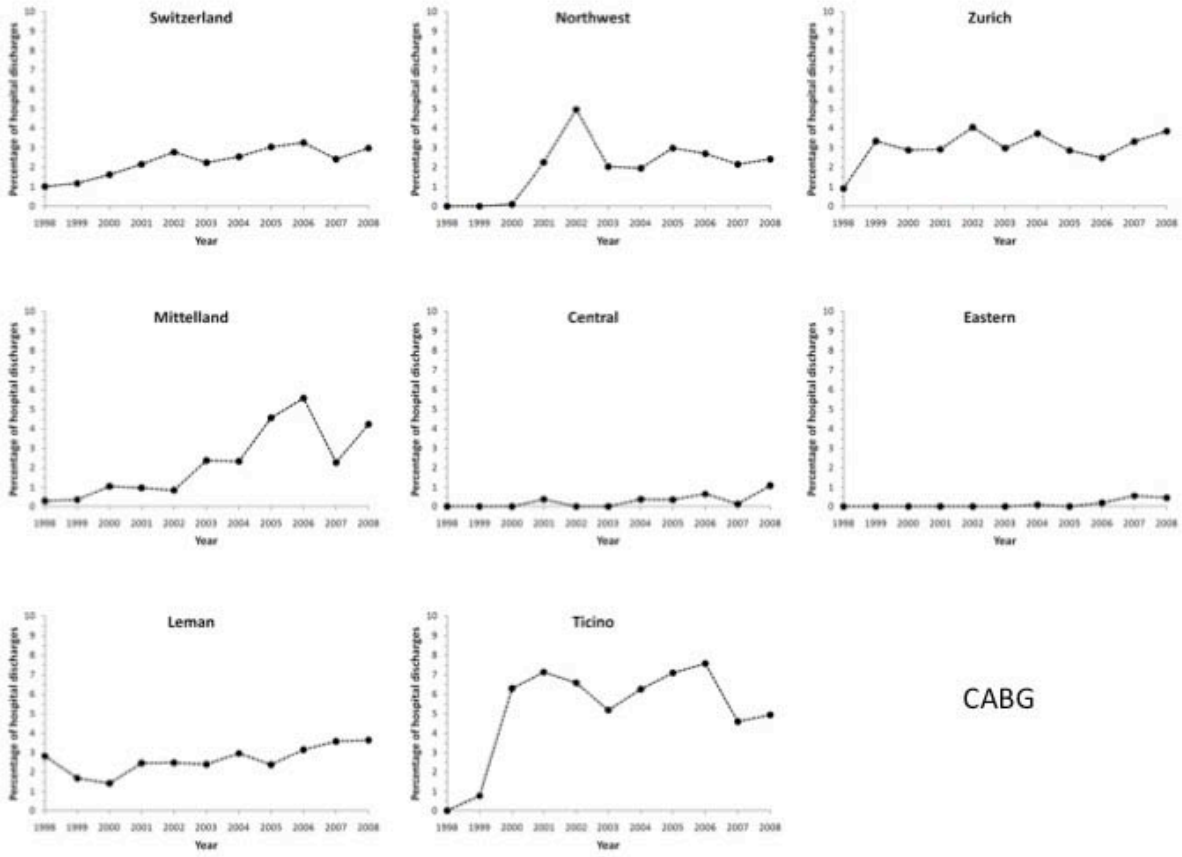
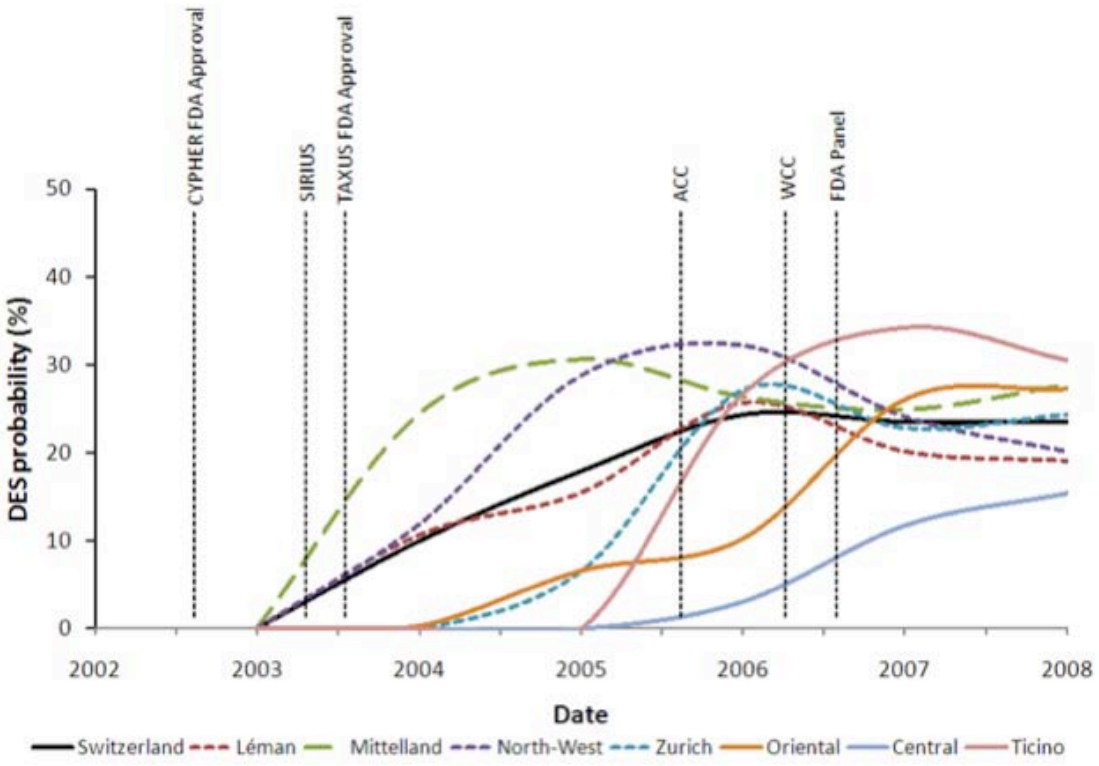


Figure 6: trends in the use of drug-eluting stents (DES) for acute myocardial infarction in Switzerland, overall and by region, for the period 1998-2008. The main randomized controlled trials on DES are indicated.



ARTICLE 1: THE REGION MAKES THE DIFFERENCE: DISPARITIES IN MANAGEMENT OF ACUTE MYOCARDIAL INFARCTION WITHIN SWITZERLAND

ABSTRACT

Introduction: We assessed geographical differences within Switzerland regarding management of acute myocardial infarction (AMI).

Methods: Swiss hospital discharge database for period 2007-2008 (25,674 discharges from AMI). Seven Swiss regions (Leman, Mittelland, Northwest, Zurich, Central, Eastern and Ticino) were analyzed.

Results: Almost 53.6% of discharges from AMI were managed in a single hospital, ranging from 63.1% (Leman) to 31.4% (Ticino). The highest Intensive Care Unit admission rate was in Leman (69.7%), the lowest (16.4%) in Ticino (Swiss average: 35.8%). Intracoronary revascularization rates were highest in Leman (51.6%) and lowest (30.8%) in Central Switzerland (average: 41.4%). Bare (non-drug-eluting) stent use was highest in Leman (33.1%) and lowest (7.0%) in Ticino (average: 15.8%), while drug eluting stent use was highest (32.8%) in Ticino and lowest (13.9%) in Central Switzerland (average: 24.0%). Coronary artery bypass graft rates were highest (4.6%) in Ticino and lowest (0.4%) in Eastern Switzerland (average: 2.6%). Mechanical circulatory assistance rates were highest (4.1%) in Zurich and lowest (0.4%) in Ticino (average: 1.7%). The differences remained after adjusting for age, single or multiple hospital management and gender.

Conclusion: In Switzerland, significant geographical differences in management and revascularization procedures for AMI were found.

Keywords: myocardial infarction; stents; coronary artery bypass graft; National hospital discharge survey; epidemiology; geography; Switzerland.

INTRODUCTION

Cardiovascular disease is one of the leading causes of premature death worldwide, accounting for almost half of deaths in the European Union (Leal et al., 2006). In Switzerland, approximately 30'000 coronary heart disease events, including acute myocardial infarction (AMI) occur each year (Swiss Health Observatory, 2008). Management of AMI associates invasive revascularization interventions and drug therapies as recommended by international guidelines (Kolh and Wijns, 2011; Kushner et al., 2009). Still, significant and persistent geographical variation in AMI management and outcome between (Herlitz et al., 2003; Simes et al., 2010; Ui et al., 2005) and within (Francisci et al., 2008; O'Connor et al., 1999; Rabilloud et al., 2001) countries exist (Fox et al., 2002).

Switzerland is characterized by a low AMI mortality (Müller-Nordhorn et al., 2008). Still, a study published in 2005 showed important between-hospital variation in quality of care provided to AMI patients (Luthi et al., 2005) but, to our knowledge, no study has ever assessed the geographical differences in AMI management and outcome. Hence, we used routine statistics from the Swiss hospital discharge database to assess geographic differences in AMI management in Switzerland, i.e., across seven Swiss administrative regions (**figure 1**).

MATERIALS AND METHODS

Databases and available data

Data from the hospital discharge database for years 2007 and 2008 was used. The database was provided by the Swiss federal office of statistics (www.bfs.admin.ch). Data providing is compulsory and covers over 98% of public and private hospitals in Switzerland and all stays for each hospital are collected (Office Fédéral de la Statistique (Federal Office for Statistics), 2011). The information collected includes gender, age, length of stay, discharge status (main and secondary diagnoses, vital status) and procedures. The data is anonymous and linkage between stays is currently not possible; as such, a few numbers of stays are related to the same patient and it is not possible to follow the subjects after they left hospital. Four types of stays could be obtained: "passing through", patients who were admitted from another hospital and transferred to another hospital; "inbound", patients who were admitted from another hospital and managed on-site; "outbound", patients who were managed on-site and transferred to another hospital and "in-house", patients who were admitted and managed without being transferred to another hospital. Emergency admission (yes/no) was also obtained. Overall length of stay was indicated in

days and length of stay in an intensive care unit (ICU) in hours. When the length of stay in the ICU was zero, it was considered as no stay in ICU.

Main and secondary diagnoses at discharge were coded using the International Classification of Diseases, 10th revision (ICD10) of the World Health Organization. Acute myocardial infarction was defined as ICD10 code I21X, where X=any number. The following risk factors (and corresponding ICD-10 codes) were also taken into consideration in our analysis: hypertension (I10X); dyslipidemia (E78X); diabetes (E10X, E11X, E12X, E13X and E14X); obesity (E66X); previous history of AMI (I252 and I258).

Procedures were coded using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD9-CM). The following revascularization procedures (and corresponding IDC9-CM codes) were assessed: any percutaneous coronary intervention (360X); bare, non-drug-eluting stent (3606); drug-eluting stent (3607); coronary artery bypass grafting (CABG: 361X, 362X and 363X); circulatory assistance (376X and 369X) and thrombolysis (3602, 3604 and 991); and 379x for other procedures.

Inclusion criteria were acute myocardial infarction (ICD10 code I21X) as the main discharge diagnosis and age≥18 years. If the main discharge diagnosis was “coronary heart disease”, the stay was included if and only if one of the secondary discharge diagnoses was coded as ICD10 code I21X. Exclusion criteria included 1) Codes related to cardiovascular rehabilitation (ICD9-CM code Z500) and 2) length of stay ≥ 29 days (corresponding to less than 2% of cases).

Statistical analysis

Statistical analysis was conducted using SAS software version 9.2 (SAS Inc., Cary, NC, US). Results were expressed as number of stays and (percentage) or as mean ± standard deviation. For length of stay, median and interquartile range were used. Comparisons between regions were assessed by chi-square and by analysis of variance (ANOVA) or Kruskall-Wallis nonparametric test. Multivariate analysis of the regional differences in revascularisation procedures was conducted using logistic regression adjusting for age and gender and the results were expressed as odds ratio (OR) and [95% confidence interval]. Secondary analyses were performed using secondary discharge diagnoses including the ICD10 code for AMI I21X. Statistical significance was assessed for $p<0.05$.

RESULTS

Characteristics of hospital stays

Some characteristics of the 25,674 stays with primary diagnosis of AMI at discharge are shown in **Table 1**. Women represented a third of stays, the proportion changing little between regions. The mean age at admission was 67 years, with few variations across the regions, except in Ticino where patients were somewhat older. Diabetes was reported in one out of six stays. In Ticino, this proportion was nearly twice as high as in Eastern Switzerland. Hypertension was reported in one third of stays, with a five-fold regional variation in proportions between Leman and Ticino. Dyslipidemia was reported in a quarter of stays, with a proportion in Leman twice as high as in Eastern Switzerland. Obesity was reported in one-tenth of stays, with a sevenfold higher proportion in Zurich than in Ticino. Previous history of AMI was reported in 8% of stays, the highest levels being reported in Ticino and the lowest in Eastern Switzerland.

Further analyses using secondary discharge diagnoses including the ICD10 code for AMI I21X led to similar conclusions (**supplementary table 1A**).

Management

Almost three quarters of stays reported an emergency referral, the North-West region presenting the lowest level. The percentage of stays treated in a single hospital varied between 63% in Leman to 31% in Ticino; Ticino and Mittelland also presented a high rate of “passing through” stays, i.e. patients admitted from a hospital and discharged to another (**Table 2**). Further, significant differences in revascularization rates were found between management types: regarding PCI, the highest rates (79.1%) were found in “passing through” stays, vs. 23.9% for “outbound” stays ($p<0.001$); for CABG, the highest rates (7.0%) were found in “inbound” stays, vs. 1.1% in “outbound” stays ($p<0.001$).

In-hospital revascularization procedures according to region are summarized in **Table 2**. There was a fourfold variation in the proportion of stays with admission to ICU between Leman (almost 70%) and Ticino (16%). Nearly 40% of AMI patients had a stent, mostly drug-eluting stents. Still, the type of stent used differed between regions: bare (non-drug-eluting) stents were used at least four times more frequently in Leman than in Ticino, while drug eluting stents were implanted more than twice as much in Ticino compared to Central Switzerland. Finally, CABG was carried out ten times more frequently in Ticino than in Eastern Switzerland. Finally, less than one tenth of stays were followed by rehabilitation, this proportion varying from 11.4% in Zurich to almost none in the South (Ticino).

Further analyses using secondary discharge diagnoses including the ICD10 code for AMI I21X led to similar conclusions, although the highest CABG rates were no longer observed for South Switzerland (Ticino) (**supplementary table 2A**).

Multivariate analysis of management

Results of a multivariate analysis of revascularization are shown in **Table 3**. After adjusting for age, management type (in-house, outbound, inbound or "passing through") and gender, all regions were less likely to admit patients to the IC, to report use of PCI, bare stents or thrombolysis (Zurich excepted) than Leman. Conversely, all regions except Zurich and Central Switzerland were more likely to report drug eluting stents. CABG was less reported by Northwest, East and Central Switzerland, while no differences were found for Mittelland, Zurich and TIcino. Further analyses using secondary discharge diagnoses including the ICD10 code for AMI I21X s led to similar conclusions, although the OR for CABG was no longer significant for South Switzerland (Ticino) (**supplementary table 3A**).

DISCUSSION

In Switzerland, there are few or no explicit policies regarding the care of the patients, neither at the federal level (health policy is not a federal mission, with few exceptions) nor at the Canton level. Most policies are in fact decided at the hospital level, largely according the training of doctors and to the professional guidelines. As a matter of fact, each hospital disposes of large autonomy in care policy and is free to adjust health management strategies to the patient's needs and doctor's skill. This disparity-prone situation is further extended by the substantial linguistic and socio- cultural diversity.

There have been previous studies assessing management and outcome of AMI in Switzerland, whether investigating trends in general (Fassa et al., 2006) or comparing different medical institutions within the country (Luthi et al., 2005; Radovanovic et al., 2010). Still, to our knowledge, this is the first study to consider regional variations at the country level.

Regional differences were found regarding the reported prevalence of the main cardiovascular risk factors. These differences might partly be attributable to regional disparities in the prevalence of cardiovascular risk factors or to variation in coding procedures. Another likely explanation is that cardiovascular risk factors aren't necessarily considered with equal relevance by the regional clinicians and hence not equally reported throughout the country. Indeed, comparing our patient's characteristics with those of the AMIS Plus registry (Radovanovic et al., 2010) where all cardiovascular risk factors are systematically screened for, showed considerably

lower cardiovascular risk factor prevalence in our sample, namely regarding obesity (**Table 4**). This suggests that efforts towards a better data reporting and standardization should be made to enable adequate comparisons between regions.

Considerable differences were found between regions regarding transfer of patients. The most likely explanation is that in some regions only a few hospitals are able to perform revascularization procedures, thus forcing the patients from other hospitals to be transferred in order to benefit from these procedures, a measure in agreement with the ESC guidelines for revascularization and the treatment of AMI (Hamm et al., 2011; Van de Werf et al., 2008). Indeed, in Ticino (and to a lesser degree in Mittelland), revascularization rates were low among subjects treated "in-house", suggesting that most hospitals in these regions lack the facilities to perform such procedures. Further, the high rate of "passing through" transfers observed in Mittelland and Ticino also suggests that patients are hospitalized in one hospital, transferred to another hospital in order to have a revascularization procedure, and transferred back to the first hospital, although we cannot confirm this hypothesis as we lack hospital and patient identification. Overall, our data indicate that, in Switzerland, over one third of AMI hospital stays are transferred to another hospital most likely to benefit from revascularization procedures, but further studies are needed to better characterize the itineraries (and associated costs) of these patients.

Despite the scientific evidence and the existence of international guidelines regarding AMI treatment (Kolh and Wijns, 2011), strong variations regarding the nature of AMI management were found within Switzerland. These differences persisted after adjusting for age and gender, suggesting that other factors than clinical characteristics of the patients might influence therapeutic options. For instance, considerable differences were found regarding the type of stents used, drug-eluting stents being mostly used in Ticino while bare (non-drug-eluting) stents were mostly used in Leman. These findings are in agreement with the literature (Austin et al., 2008; Rao et al., 2006) which showed that drug-eluting stent use varied at hospital level within single health care systems. Indeed, the adoption of a given revascularization technique is influenced by the type of hospital (academic/non academic; rural/urban), by local regulations or by priority settings. The personal commitment of the interventional cardiologist to technology adoption is also to be considered (Artis et al., 2006; Austin et al., 2008) as are autonomy of local decision making, responsiveness of payment systems to change and overall levels of healthcare funding (Packer et al., 2006). Finally, there might also be a diverse response to several critical publications, questioning the cost-effectiveness in routine use of drug-eluting stents (Bagust et al.,

2006; Thomas, 2006) or fearing complications such as late stent thrombosis (Camenzind et al., 2007; Nordmann et al., 2006). All these factors could explain the considerable differences in drug-eluting stent use rates between regions, but further research is needed to better identify the reasons for such a differing choice of stent between regions.

Similarly, the between-region variation in CABG rates is likely due (in addition to the above mentioned factors) to variations in the availability of technical and human resources. Indeed, the higher CABG rates were mostly found in regions including university hospitals, with the exception of Ticino, where the highest CABG rates were found despite the absence of a university hospital. Again, our results suggest that local availability of resources might influence the choice of AMI treatment. This might also apply to ICU admission rates, which varied considerably between regions and which might be related to the number of ICU beds available, but unfortunately no data regarding the latter is available to verify this statement.

This study has some limitations and strengths worth indicating. First, drug prescriptions are not included in the hospital discharge database, thus precluding any comparison between regions and the assessment of their impact on in-hospital mortality. This absence might also explain the very low rates for thrombolysis, which are likely due to the absence of coding rather than a true absence of use. Still, our data provide important information regarding non-drug revascularization procedure use in Switzerland. Due to the anonymization of the data, it was also not possible to link hospitalizations when a patient was transferred from one hospital to another; also, it was not possible to assess mortality rates as no follow-up data was available for the patients discharged. The ongoing AMIS registry is currently collecting vital status data for all patients hospitalized with an AMI and it is likely that such information will be available in a near future. The hospital information system has been under development for the last 20 years in Switzerland, and this development is still ongoing (in the perspective of a DRG based payment scheme). Because the implementation of the hospital discharge dataset has been substantially different between regions, it is likely that this had some impact on the regional differences. For example, Leman had the highest proportion of stays with reported dyslipidemia and hypertension, probably related to the fact that a DRG based payment system has been implemented in the early nineties, thus promoting some “DRG creep”. Part of the interregional differences observed in the case management may be similarly related to different incentives in coding the interventions.

The strengths of this study are the fact that the Swiss hospital discharge database covers almost all (98%) hospitals and hospital stays within Switzerland and that hospital discharge data

has been shown to be reliable regarding the diagnosis of AMI (Madsen et al., 2003). Finally, our findings are important for further settings in cardiovascular priorities and should incite to aim nationwide harmonization in case-reporting and optimization of AMI management within the country.

We conclude that in Switzerland, significant regional differences in use of revascularization therapies and other management of AMI could be stated. Further investigation is needed to better characterize the geographical disparities in hospital AMI management and its impact on AMI mortality within Switzerland.

AUTHORS CONTRIBUTIONS

CI made part of the statistical analyses and wrote most of the article; PMV collected data, made part of the statistical analysis and wrote part of the article; FP revised the article for important intellectual content. PMV had full access to the data and is the guarantor of the study.

CONFLICT OF INTEREST

The authors report no conflict of interest.

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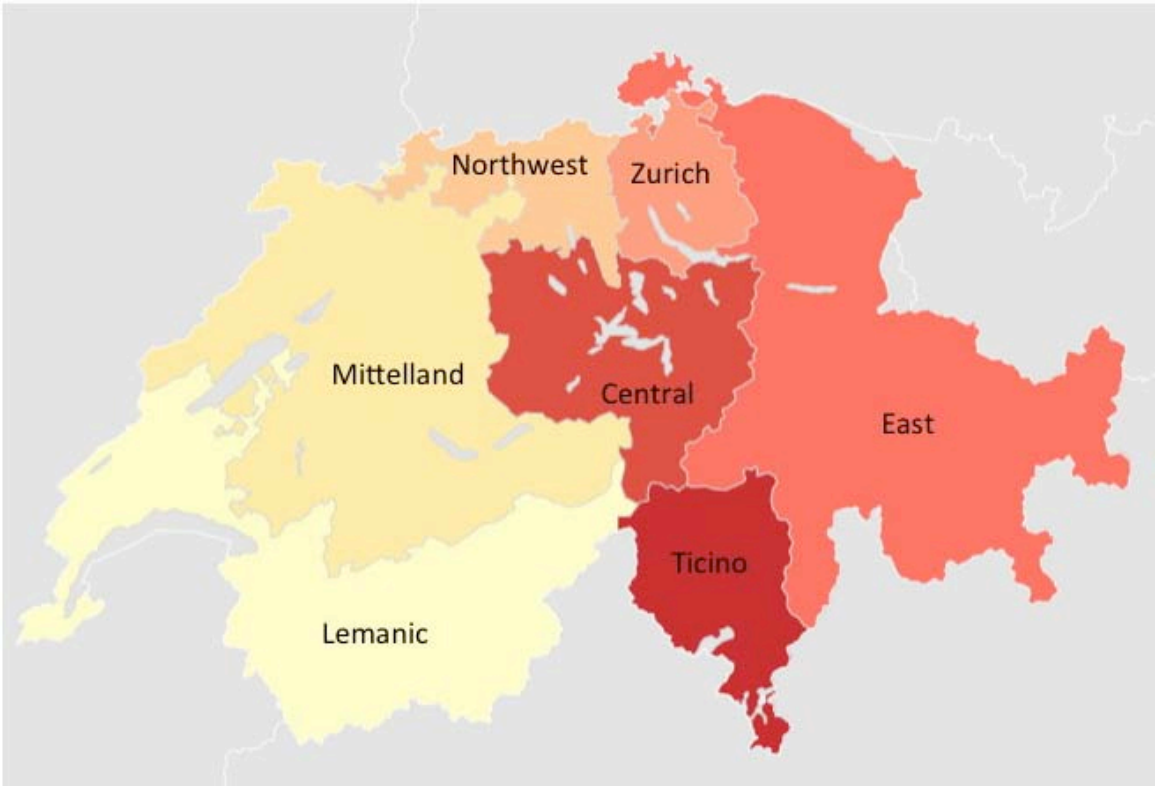
FIGURE

Figure 1: the seven main administrative areas of Switzerland used in this study.



TABLES

Table 1: characteristics of hospital stays with a main diagnosis of acute myocardial infarction at discharge, in Switzerland and by region, 2007-8

	Leman	Mittelland	North-West	Zurich	East	Central	Ticino	Switzerland	Test
Sample size	4149	5446	5367	4124	3611	1596	1381	25,674	
Women (%)	1241 (29.9)	1670 (30.7)	1597 (29.8)	1278 (31.0)	1018 (28.2)	497 (31.1)	476 (34.5)	7777 (30.3)	21.8*
Age (years)	67.3 ± 14	66.9 ± 13.9	66.9 ± 14	67.3 ± 13.8	66.6 ± 13.4	68.6 ± 13.6	70.6 ± 13.8	67.3 ± 13.9	18.26
	68 (57 - 78)	68 (56 - 78)	68 (56 - 78)	68 (57 - 78)	67 (56 - 78)	70 (58 - 80)	72 (61 - 81)	68 (57 - 78)	
Diabetes (%)	646 (15.6)	907 (16.7)	937 (17.5)	681 (16.5)	440 (12.2)	279 (17.5)	319 (23.1)	4209 (16.4)	100.2
Hypertension (%)	1903 (45.9)	1668 (30.6)	2097 (39.1)	1795 (43.5)	802 (22.2)	519 (32.5)	122 (8.8)	8906 (34.7)	1115.1
Dyslipidemia (%)	1818 (43.8)	1272 (23.4)	1526 (28.4)	1219 (29.6)	724 (20.1)	334 (20.9)	329 (23.8)	7222 (28.1)	741.1
Obesity (%)	389 (9.4)	557 (10.2)	473 (8.8)	567 (13.8)	186 (5.2)	159 (10.0)	25 (1.8)	2356 (9.2)	273.0
Previous history									201.0
(%)	444 (10.7)	462 (8.5)	458 (8.5)	298 (7.2)	136 (3.8)	85 (5.3)	182 (13.2)	2065 (8.0)	

Results are expressed as mean ± SD, median and (interquartile range) or as number of stays and (percentage). Statistical analysis by analysis of variance or chi-square test. All differences are statistically significant at $p<0.001$, except *, $p<0.005$

Table 2: in-hospital management of hospital stays with a main diagnosis of acute myocardial infarction at discharge, in Switzerland and by region, 2007-8.

	Leman	Mittelland	North- West	Zurich	East	Central	Ticino	Switzerland	Test
Sample size	4149	5446	5367	4124	3611	1596	1381	25,674	
Emergency referral (%)	3364 (81.1)	4642 (85.2)	2932 (54.6)	3642 (88.3)	2900 (80.3)	1433 (89.8)	1239 (89.7)	20,152(78.5)	2440.0
Type of admission (%)									
Passing through	387 (9.3)	1307 (24.0)	638 (11.9)	778 (18.9)	318 (8.8)	24 (1.5)	327 (23.7)	3779 (14.7)	
Inbound	391 (9.4)	731 (13.4)	788 (14.7)	418 (10.1)	612 (17.0)	209 (13.1)	361 (26.1)	3510 (13.7)	1609.0
Outbound	754 (18.2)	784 (14.4)	1268 (23.6)	583 (14.1)	580 (16.1)	401 (25.1)	260 (18.8)	4630 (18.0)	
In-house	2617 (63.1)	2624 (48.2)	2673 (49.8)	2345 (56.9)	2101 (58.2)	962 (60.3)	433 (31.4)	13,755(53.6)	
Hospital stay (days)									
Mean ± SD	7.3 ± 5.5	6.1 ± 5.2	7.7 ± 6.4	6.9 ± 5.7	8.3 ± 7.1	7.4 ± 6.0	6.4 ± 5.3	7.2 ± 6.0	238.6
Median (IQR)	6 (3 - 10)	4 (2 - 8)	6 (2 - 12)	5 (2 - 10)	6 (2 - 11)	6 (2 - 10)	4 (3 - 9)	6 (2 - 10)	
ICU (%)	2891 (69.7)	1124 (20.6)	2275 (42.4)	817 (19.8)	1147 (31.8)	715 (44.8)	226 (16.4)	9195 (35.8)	3484.9
ICU (hours)									
Mean ± SD	32.5 ± 43.8	9.0 ± 27.4	18.0 ± 33.0	8.1 ± 31.2	11.1 ± 28.1	21.3 ± 49.4	7.3 ± 27.5	15.5 ± 35.1	3636.7
Median (IQR)	23(0 - 43.5)	0 (0 - 0)	0 (0 - 26)	0 (0 - 0)	0 (0 - 18)	0 (0 - 25)	0 (0 - 0)	0 (0 - 22)	
Any IC intervention (%)	2139 (51.6)	2268 (41.7)	1908 (35.6)	1907 (46.2)	1366 (37.8)	492 (30.8)	545 (39.5)	10,625(41.4)	386.7
Type of stent (%)									
Bare	1373 (33.1)	815 (15.0)	737 (13.7)	918 (22.3)	368 (10.2)	297 (18.6)	96 (7.0)	4604 (17.9)	1058.0
Drug eluting	831 (20.0)	1463 (26.9)	1198 (22.3)	985 (23.9)	1016 (28.1)	221 (13.9)	453 (32.8)	6167 (24.0)	251.3
CABG (%)	150 (3.6)	177 (3.3)	109 (2.0)	133 (3.2)	14 (0.4)	11 (0.7)	64 (4.6)	658 (2.6)	156.6
Assistance (%)	70 (1.7)	93 (1.7)	55 (1.0)	167 (4.1)	38 (1.1)	19 (1.2)	6 (0.4)	448 (1.7)	170.9
Thrombolysis (%)	148 (3.6)	124 (2.3)	46 (0.9)	140 (3.4)	65 (1.8)	4 (0.3)	5 (0.4)	532 (2.1)	168.7
Rehabilitation (%)	228 (5.5)	303 (5.6)	582 (10.8)	470 (11.4)	277 (7.7)	132 (8.3)	4 (0.3)	1996 (7.8)	321.7

“Passing through”, patients who were admitted from another hospital and transferred to another hospital; “inbound”, patients who were admitted from another hospital and managed on-site; “outbound”, patients who were managed on-site and transferred to another hospital and “in-house”, patients who were admitted and managed without being transferred to another hospital. IC, intracoronary; ICU, intensive care unit; IQR, interquartile range; SD, standard deviation; CABG, coronary artery bypass graft. Results are expressed as mean ± SD, as median (interquartile range) or as number of stays and (percentage). Statistical analysis by Kruskall-Wallis nonparametric test or chi-square test. All differences are statistically significant at $p<0.001$.

Table 3: multivariate analysis of management of hospital stays with a main diagnosis of acute myocardial infarction at discharge in Switzerland, by region, 2007-8.

	ICU	Any PCI	Bare stent	Drug eluting stent	Thrombolysis	CABG	Hemodynamic assistance
Leman region	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Mittelland	0.10	0.47	0.30	1.19	0.63	0.82	0.94
	(0.09 - 0.11)	(0.43 - 0.51)	(0.27 - 0.33)	(1.07 - 1.32)	(0.49 - 0.08)	(0.66 - 1.03)	(0.68 - 1.28)
Northwest	0.33	0.48	0.32	1.16	0.24	0.50	0.58
	(0.30 - 0.36)	(0.43 - 0.52)	(0.29 - 0.35)	(1.05 - 1.29)	(0.17 - 0.34)	(0.39 - 0.65)	(0.41 - 0.83)
Zurich	0.10	0.65	0.52	1.08	0.95	0.87	2.37
	(0.09 - 0.11)	(0.59 - 0.71)	(0.47 - 0.57)	(0.97 - 1.20)	(0.75 - 1.20)	(0.68 - 1.11)	(1.78 - 3.15)
East	0.20	0.53	0.22	1.62	0.51	0.09	0.58
	(0.18 - 0.22)	(0.48 - 0.58)	(0.20 - 0.25)	(1.46 - 1.81)	(0.38 - 0.69)	(0.05 - 0.15)	(0.39 - 0.87)
Central	0.38	0.49	0.53	0.80	0.07	0.17	0.72
	(0.34 - 0.43)	(0.43 - 0.56)	(0.46 - 0.61)	(0.68 - 0.95)	(0.03 - 0.20)	(0.09 - 0.32)	(0.43 - 1.20)
Ticino	0.09	0.53	0.14	1.95	0.12	0.95	0.22
	(0.08 - 0.11)	(0.46 - 0.61)	(0.12 - 0.18)	(1.68 - 2.26)	(0.05 - 0.29)	(0.70 - 1.30)	(0.10 - 0.52)

Results are expressed as age, management type (in-house, outbound, inbound or “passing through”) and gender-adjusted odds ratio and (95% confidence interval). ICU, intensive care unit; PCI, percutaneous intervention; CABG, coronary artery bypass graft. Statistical analysis by logistic regression.

Table 4: Comparison of main clinical characteristics of hospital stays with a main diagnosis of acute myocardial infarction at discharge between the current study (2007-2008) and AMIs plus registry (1997-2009).

	Current study (n=25,674)	**AMIS plus registry (n= 31,010)**
Women (%)	30.6	27.6
Age (years)	67.5 ± 13.9	65.6 ± 13.2
Hypertension (%)	34.7	57.9
Dyslipidemia (%)	28.1	57.0
Diabetes (%)	16.4	20.0
Obesity (%)	9.2	19.4
Previous history of CAD (%)	8.0	39.1

CAD: coronary artery disease.

Supplementary table 1A: main clinical characteristics of hospital stays with a main or secondary diagnosis of acute myocardial infarction at discharge in Switzerland and by region, 2007-8.

	Lemanic	Mittelland	North- West	Zurich	East	Central	Ticino	Switzerland	Test
Sample size	5038	6336	6145	5337	4175	1814	1937	30,782	
Women (%)	1606 (31.9)	2023 (31.9)	1878 (30.6)	1650 (30.9)	1229 (29.4)	590 (32.5)	678 (35)	9654 (31.4)	24.14
Age (years)	68.3 ± 14.0	67.9 ± 13.9	67.8 ± 14.0	67.8 ± 13.9	67.4 ± 13.6	69.6 ± 13.6	70.9 ± 13.6	68.1 ± 13.9	19.64
	69 (58 - 79)	69 (57 - 79)	69 (57 - 79)	68 (58 - 79)	68 (57 - 79)	71 (59 - 81)	73 (61 - 81)	69 (58 - 79)	
Diabetes (%)	798 (15.8)	1082 (17.1)	1080 (17.6)	917 (17.2)	536 (12.8)	323 (17.8)	445 (23.0)	5181 (16.8)	107.7
Hypertension (%)	2302 (45.7)	1923 (30.4)	2360 (38.4)	2338 (43.8)	960 (23.0)	580 (32.0)	157 (8.1)	10,620 (34.5)	1420.5
Dyslipidemia (%)	2097 (41.6)	1390 (21.9)	1664 (27.1)	1515 (28.4)	828 (19.8)	350 (19.3)	406 (21.0)	8250 (26.8)	836.8
Obesity (%)	448 (8.9)	624 (9.9)	528 (8.6)	730 (13.7)	218 (5.2)	177 (9.8)	43 (2.2)	2768 (9.0)	332.5
Previous history (%)	530 (10.5)	531 (8.4)	526 (8.6)	425 (8.0)	164 (3.9)	98 (5.4)	249 (12.9)	2523 (8.2)	213.7

Results are expressed as mean ± SD, median and (interquartile range) or as number of stays and (percentage). Statistical analysis by analysis of variance or chi-square test. All differences are statistically significant at $p<0.001$.

Supplementary table 2A: in-hospital management of hospital stays with a main or secondary diagnosis of acute myocardial infarction at discharge in Switzerland and by region, 2007-8.

	Lemanic	Mittelland	North- West	Zurich	East	Central	Ticino	Switzerland	Test
Sample size	5038	6336	6145	5337	4175	1814	1937	30,782	
Emergency referral (%)	3848 (76.4)	5231 (82.6)	3292 (53.6)	4600 (86.2)	3284 (78.7)	1596 (88.0)	1509 (77.9)	23,360(75.9)	2303.7
Type of admission (%)									
Passing through	459 (9.1)	1409 (22.2)	724 (11.8)	985 (18.5)	344 (8.2)	32 (1.8)	387 (20)	4340 (14.1)	
Inbound	586 (11.6)	964 (15.2)	890 (14.5)	605 (11.3)	749 (17.9)	232 (12.8)	642 (33.1)	4668 (15.2)	1924.3
Outbound	843 (16.7)	868 (13.7)	1340 (21.8)	742 (13.9)	626 (15.0)	425 (23.4)	322 (16.6)	5166 (16.8)	
In-house	3150 (62.5)	3095 (48.9)	3191 (51.9)	3005 (56.3)	2456 (58.8)	1125 (62.0)	586 (30.3)	16,608(54.0)	
Hospital stay (days)	7.8 ± 6.0	6.7 ± 5.6	8.1 ± 6.6	7.4 ± 6.1	8.6 ± 7.2	7.9 ± 6.2	7.2 ± 5.7	7.6 ± 6.3	211.9
	7 (3 - 11)	5 (2 - 9)	7 (2 - 12)	6 (2 - 11)	7 (3 - 12)	7 (2 - 11)	5 (3 - 10)	6 (2 - 11)	
ICU (%)	3263 (64.8)	1385 (21.9)	2569 (41.8)	1190 (22.3)	1259 (30.2)	800 (44.1)	353 (18.2)	10,819 (35.1)	3289.0
ICU (hours)	32.2 ± 48.2	10.2 ± 31.0	18.6 ± 35.7	11.0 ± 39.5	10.9 ± 28.5	21.6 ± 50.7	8.7 ± 31.0	16.3 ± 38.6	3436.0
	22 (0 - 43)	0 (0 - 0)	0 (0 - 26)	0 (0 - 0)	0 (0 - 15)	0 (0 - 25)	0 (0 - 0)	0 (0 - 22)	
Any IC intervention	2312 (45.9)	2363 (37.3)	2034 (33.1)	2404 (45.0)	1454 (34.8)	508 (28.0)	605 (31.2)	11,680 (37.9)	442.1
Type of stent (%)									
Bare	1479 (29.4)	851 (13.4)	796 (13.0)	1381 (25.9)	381 (9.1)	306 (16.9)	114 (5.9)	5308 (17.2)	1308.6
Drug eluting	897 (17.8)	1522 (24.0)	1268 (20.6)	1017 (19.1)	1088 (26.1)	229 (12.6)	494 (25.5)	6515 (21.2)	241.5
CABG (%)	216 (4.3)	260 (4.1)	140 (2.3)	236 (4.4)	57 (1.4)	12 (0.7)	71 (3.7)	992 (3.2)	161.8
Assistance (%)	97 (1.9)	107 (1.7)	63 (1.0)	245 (4.6)	43 (1.0)	20 (1.1)	35 (1.8)	610 (2.0)	245.8
Thrombolysis (%)	152 (3.0)	142 (2.2)	52 (0.9)	151 (2.8)	83 (2.0)	5 (0.3)	7 (0.4)	592 (1.9)	147.6
Rehabilitation (%)	324 (6.4)	387 (6.1)	671 (10.9)	641 (12.0)	343 (8.2)	149 (8.2)	14 (0.7)	2529 (8.2)	364.3

IC, intracoronary; ICU, intensive care unit; CABG, coronary artery bypass graft. Results are expressed as mean ± SD, as median (interquartile range) or as number of patients and (percentage). Statistical analysis by Kruskall-Wallis nonparametric test or chi-square test. All differences are statistically significant at $p<0.001$ except *, $p<0.05$.

Supplementary table 3A: multivariate analysis of in-hospital management of hospital stays with a main or secondary diagnosis of acute myocardial infarction at discharge, by region, 2007-8.

	ICU	Any PCI	Bare stent	Drug eluting stent	Thrombolysis	CABG	Hemodynamic assistance
Lemanic region	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Mittelland	0.14	0.50	0.31	1.21	0.72	0.88	0.81
	(0.13 - 0.16)	(0.46 - 0.55)	(0.28 - 0.34)	(1.09 - 1.33)	(0.57 - 0.91)	(0.73 - 1.07)	(0.61 - 1.07)
Northwest	0.39	0.53	0.34	1.20	0.28	0.49	0.51
	(0.36 - 0.42)	(0.48 - 0.57)	(0.31 - 0.38)	(1.09 - 1.33)	(0.20 - 0.38)	(0.39 - 0.61)	(0.37 - 0.70)
Zurich	0.14	0.79	0.75	0.91	0.90	1.03	2.35
	(0.13 - 0.16)	(0.73 - 0.86)	(0.68 - 0.82)	(0.82 - 1.01)	(0.72 - 1.14)	(0.85 - 1.24)	(1.85 - 2.99)
East	0.23	0.59	0.23	1.70	0.67	0.26	0.50
	(0.21 - 0.25)	(0.54 - 0.64)	(0.21 - 0.26)	(1.53 - 1.89)	(0.51 - 0.87)	(0.19 - 0.35)	(0.35 - 0.71)
Central	0.45	0.53	0.55	0.83	0.10	0.14	0.59
	(0.40 - 0.50)	(0.47 - 0.60)	(0.48 - 0.63)	(0.71 - 0.97)	(0.04 - 0.24)	(0.08 - 0.26)	(0.36 - 0.96)
Ticino	0.14	0.48	0.15	1.63	0.14	0.58	0.80
	(0.12 - 0.16)	(0.43 - 0.55)	(0.12 - 0.18)	(1.42 - 1.87)	(0.07 - 0.30)	(0.44 - 0.77)	(0.54 - 1.19)

Results are expressed as age, management type (in-house, outbound, inbound or “passing through”) and gender-adjusted odds ratio and (95% confidence interval). ICU, intensive care unit; CABG, coronary artery bypass graft; PCI, percutaneous intervention. Statistical analysis by logistic regression.