Impact of Changing Definitions for Myocardial Infarction: A Report from the AMIS Registry

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ABSTRACT

BACKGROUND: To assess the impact of the new definitions of myocardial infarction, we retrospectively analyzed 9190 patients from 63 hospitals with reported peak troponin values included between 2001 and 2007 in the Swiss AMIS (Acute Myocardial Infarction in Switzerland) Plus registry.

METHODS: Patients were classified as belonging to the "classic" myocardial infarction group (peak total CK or CK-MB above the upper limit of normal, or troponin T [TnT] >0.1 μg/L or troponin I [TnI] >0.1-0.8 μg/L [depending on the assay]) or "new" myocardial infarction group (TnT >0.01 μg/L or TnI >0.01-0.07 μg/L).

RESULTS: There were 489 patients in the "new" group who were similar to the 8701 "classic" patients in terms of age, sex, and prevalence of both diabetes and renal failure, but more frequently had a history of prior coronary artery disease, hypertension, and hyperlipidemia. At admission, they less frequently had ST elevation on their electrocardiogram, were more frequently in Killip class I, and received less primary percutaneous coronary intervention. Hospital mortality was 3.5% in the "new" and 6.7% in the "classic" myocardial infarction group ($P = .004$). In a subset of patients with a longer follow-up, mortality at 3 and 12 months was 1% and 5.6%, respectively, for "new" and 1.6% and 4%, respectively, for "classic" myocardial infarction (NS).

CONCLUSIONS: Patients with minimal elevation of serum troponin have smaller infarctions, less aggressive treatment, fewer early complications, and a better early prognosis than patients with higher serum biomarker levels. After discharge, however, their prognosis currently appears no different from that of patients with a "classic" myocardial infarction event.

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KEYWORDS: Acute coronary syndrome; Biomarkers; Coronary artery disease; Myocardial infarction; Troponin

The diagnosis of acute myocardial infarction has long rested on the initial World Health Organization definition[1] requiring at least 2 of the following elements to be present:

symptoms of myocardial ischemia, elevation of cardiac markers concentrations in the blood above twice the upper limit of normal, and a typical electrocardiographic pattern with development of Q waves or persistent T-wave changes. A number of threshold values have been used for different biomarkers to define acute myocardial infarction,[2-4] and a first set of international recommendations was published 8 years ago.[5] More recently, an international consensus document was published by a joint European Society of Cardiology/American College of Cardiology Foundation/American Heart Association/World Heart Federation task force;[6] this article categorizes myocardial infarction into 5 groups (type 1 = spontaneous, type 2 = primary event not related to a coronary plaque, type 3 = sudden cardiac death, type 4 a and

b = associated with percutaneous coronary intervention (a) or with stent thrombosis (b), and type 5 = associated with bypass surgery). It also confirms troponin as the most appropriate biomarker, and defines the 99th percentile of normal for any given assay as the best threshold value to make a diagnosis of type 1, 2, or 3 myocardial infarction.

Because lowering the threshold required to make a diagnosis of myocardial infarction will necessarily increase the number of patients thus labeled,[7,8] the change, when widely implemented, can be expected to have a significant impact on resource allocation and utilization, patient perception of the clinical event, use of rehabilitation programs, adherence to secondary prevention measures, and the epidemiological evaluation of the prevalence of coronary artery disease. It also might be that the additional patients labeled as having suffered myocardial infarction differ from those traditionally diagnosed as myocardial infarction, with a higher biomarker threshold value. We therefore retrospectively analyzed the Acute Myocardial Infarction in Switzerland (AMIS) database in order to characterize a subgroup of patients that were initially categorized as acute coronary syndrome with unstable angina and would now be diagnosed as myocardial infarction. These "new" patients were then compared with the "classic" myocardial infarction patients.

> ## CLINICAL SIGNIFICANCE
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> - Lowering the troponin threshold for making a diagnosis of myocardial infarction will increase the number of patients with this diagnosis.
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> - Patients with only minimal troponin elevation have a better short-term prognosis despite receiving less aggressive treatment during a shorter hospital stay.
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> - Their 3- and 12-month prognoses, however, appear similar to those of patients with higher peak troponin values.

MATERIAL AND METHODS

The structure and design of the AMIS registry has been previously reported.[9-13] Briefly, 67 hospitals currently are participating, using paper or electronic data capture to collect information on patients admitted for acute coronary syndrome. Data are entered by dedicated research personnel or by junior physicians. Definitions of the main parameters are available online in pop-up menus, for use during data capture. Data checks for completeness, consistency, and plausibility are carried out systematically at the central data center (Institute of Social and Preventive Medicine, University of Zurich), but there are no specific recommendations concerning frequency or type of serum marker evaluation. 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 Appendix). The registry was approved by the regional Ethical Committees for clinical studies and the Swiss Board for Data Security.

Over a 10-year period (1997-2007) the AMIS project has collected data on 27,314 acute coronary syndrome patients, and has gradually expanded to include 75 participating hospitals (of a total of 106 hospitals treating acute coronary patients in Switzerland). In 2000, data collection was extended beyond acute myocardial infarction to all acute coronary syndromes. Among 18,869 patients included between January 2001 and December 2007, a subset of 9190 patients from 63 hospitals satisfied the following conditions: a peak value of troponin was reported, the type of troponin assay used was known, and both the cutoff values applied and the 99th percentile for normal values were available (for troponin T, 7175 patients and for troponin I, 2015 patients). During the same period, creatine kinase (CK) and CK-MB values were obtained for 18,415 (97.6%) of all patients. CK-MB mass was measured in only 3 hospitals (302 patients) and was not used in the present analysis.

The 9190 patients were separated into 3 groups: unstable angina: no elevation of either CK, CK-MB, or troponin beyond the 99th percentile; "classic" myocardial infarction: CK or CK-MB above the upper limit of normal used at each individual hospital or TnT >0.1 μg/L, or TnI >0.1-0.8 μg/L (depending on the assay used);[14] "new" myocardial infarction: no biomarker measurement beyond the cutoff used for "classic" myocardial infarction, and at least one measurement of TnT >0.01 μg/L or TnI >0.01-0.07 μg/L (depending on the assay used). All patients in any of the 3 groups also were required to have a clinical presentation or electrocardiogram (ECG) changes consistent with acute coronary syndrome. Since 2005, a subset of 44 hospitals has collected follow-up information at 3 and 12 months after hospital discharge for 2218 patients.

Only types 1 and 2 myocardial infarction patients were included in AMIS, but because of insufficient information in our database, no attempt was made to ascribe them to one of these 2 categories; it is very likely, however, that the great majority of AMIS patients were, in fact, type 1 patients. Patients with type 3 infarction were not included because that category is defined by the absence of positive serum markers. Patients with infarction related to percutaneous intervention (type 4a), stent thrombosis (type 4b), or coronary artery bypass surgery (type 5) were not considered. Because minimal troponin elevation may sometimes be associated with very early death (when the patient does not survive long enough for a true peak value to be recorded), a repeat analysis of only those patients who survived beyond the first 24 hours after admission also was carried out.

Major adverse clinical events were defined as cardiovascular death, re-infarction, or stroke. Left ventricular ejection fraction, when a measurement was available at any time during the hospital admission, was considered severely depressed if it was <40% by echography or <35% by contrast ventriculography. When more than one value was reported, the lowest one was used. Although only the peak value of each biomarker was recorded in the database, the local investigators were instructed to record myocardial re-infarction when they noted the occurrence of new Q waves or an increase in CK above twice the upper limit of normal range or an increase by more than 50% over the previous value.

Statistics

Continuous variables are expressed as mean ± standard deviation, and discrete variables as counts and percentage. In univariate tests, the chi-squared and Fischer's exact t test were used for categorical variables, and Student's t test or U test was used for continuous variables. A P value lower than .05 was considered statistically significant. SPSS (version 14.0, SPSS Inc., Chicago, Ill) was used for all statistical analyses.

RESULTS

During the 7 years covered by the present analysis, 18,869 patients were included in AMIS with a diagnosis of acute coronary syndrome, and 9190 had at least one recorded value for troponin. There were 8701 patients considered as "classic" and 489 as "new" myocardial infarction, based on the definitions given above. For both groups, baseline characteristics, in-hospital management and outcome, and treatment at discharge are reported in Tables 1, 2, and 3. Patients in the "new" group were similar to "classic" myocardial infarction patients in terms of age, sex, and prevalence of diabetes or moderate/severe renal failure, but more frequently had a history of prior coronary artery disease, hypertension, and hyperlipidemia. At admission, they less frequently had ST elevation on their ECG, and

Table 1   Baseline Characteristics

n/N (%)	"Classic" Myocardial Infarction n = 8701	"New" Myocardial Infarction n = 489	P Values
Demographics + prehospital phase			
Male sex (%)	6140/8701 (70.6)	351/489 (71.8)	.610
Age, mean years (SD)	66.4 (13.7)	67.2 (13.7)	.178
Main presenting symptoms (not mutually exclusive)			
Chest pain	7028/8427 (83.4)	395/480 (82.3)	.529
Shortness of breath	2307/8225 (28)	137/468 (29.3)	.561
Other	1446/8701 (16.6)	62/489 (12.7)	.000
Median delay (min) from symptom onset to admission (interquartile range)	240 (115, 704)	210 105, 570)	.765
CPR before admission	287/8467 (3.4)	1/475 (0.2)	.000
Cardiovascular risk factors (%)			
History of coronary artery disease	2845/7470 (38.1)	254/447 (56.8)	.000
Diabetes	1683/8333 (20.2)	110/467 (23.6)	.087
Hypertension	4962/8210 (60.4)	321/459 (69.9)	.000
Dyslipidemia	4222/7457 (56.6)	269/403 (66.7)	.000
Current smoking	3024/8071 (37.5)	140/438 (32.0)	.022
Obesity (BMI >30 kg/m²)	1477/7523 (19.6)	95/420 (22.6)	.148
Renal failure (plasma creatinine >160 ug/L)	647/8325 (7.8)	48/476 (10.1)	.080
Electrocardiographic characteristics at admission (%)			
No significant abnormality	574/8576 (6.7)	88/470 (18.7)	.000
ST-segment elevation	4694/8688 (54.0)	111/488 (22.7)	.000
Left bundle branch block	435/8685 (5.0)	34/488 (7.0)	.071
Q-waves	1062/8687 (12.2)	36/488 (7.4)	.001
ST-segment depression	2515/8687 (29.0)	131/488 (26.8)	.330
T-waves changes	211/8687 (24.3)	126/488 (25.8)	.448
Mean peak total CK value (IU/L)	1384	128	.000
Mean peak Troponin I value (µg/L)	41.3	0.09	.000
Mean peak Troponin T value (µg/L)	11.3	0.07	.002
Killip class at admission			.004
Killip class I	6825/8658 (78.8)	407/483 (84.3)	
Killip class II	1300/8658 (15.0)	63/483 (13.0)	
Killip class III	341/8658 (3.9)	11/483 (2.3)	
Killip class IV	192/8658 (2.2)	2/483 (0.4)	

CPR = cardiopulmonary resuscitation; BMI = body mass index; CK = creatine kinase.

Table 2   In-Hospital Management and Outcome

	"Classic" Myocardial Infarction n = 8701	"New" Myocardial Infarction n = 489	P Values
Reperfusion treatment and left ventricular function			
Thrombolysis	430/8699 (4.9)	9/489 (1.8)	.001
PCI	6358/8630 (73.4)	313/482 (64.9)	.000
CABG done or planned	518/8522 (6.1)	30/473 (6.3)	.895
LVEF severely depressed (<35% angio or <40% echo)	864/5722 (15.1)	19/262 (7.3)	.001
In-hospital complications			
Re-infarction	135/8602 (1.6)	5/486 (1.0)	.449
Cerebrovascular event	84/8509 (1.0)	0/481	.023
Cardiogenic shock	449/8623 (5.2)	16/486 (3.3)	.071
Duration of hospital stay (median in days) (interquartile range)	7 (4-11)	5 (2-8)	.000
In-hospital outcome			
Major adverse clinical event (%)	712/8513 (8.4)	18/481 (3.7)	.000
Mortality during first 24 hours	175/8701 (2.0)	8/489 (1.6)	.789
Overall mortality (%)	579/8701 (6.7)	17/489 (3.5)	.004

PCI = percutaneous coronary intervention; CABG = coronary artery bypass surgery; LVEF = left ventricular ejection fraction.

were more frequently in Killip class I. They received less primary percutaneous coronary intervention, and less frequently had severely depressed left ventricular systolic function than patients with "classic" myocardial infarction.

Since 2005, for a subset of 2218 patients from 44 hospitals, telephone follow-up information was obtained from the patient, his family, or his doctor. There were 2298 of 2396 eligible patients (96%) contacted at 3 months and 1521 of 1567 (97%) at 12 months. The results of these enquiries are given in Table 3. Hospital mortality was 3.5% in the "new" and 6.7% in the "classic" myocardial infarction group (*P* = .004). The odds ratio for "new" myocardial infarction was 0.51 (95% confidence interval [CI], 0.31-0.83), and for "classic" myocardial infarction it was 1.98

(95% CI, 1.21-3.23) *P* = .006. However, this difference in short-term prognosis was no longer observed for the subset of patients who were followed-up at 3 and 12 months (Figure, Table 3).

When patients with non-ST segment elevation myocardial infarction (NSTEMI) on their admission ECG were analyzed separately, the differences noted between the "classic" and the "new" myocardial infarction groups remained similar. There were 3643 patients with "classic" and 343 with "new" NSTEMI. The rate of in-hospital major adverse clinical events and mortality was 8% and 6.4%, respectively, for "classic" versus 3% and 2.9%, respectively, for "new" NSTEMI patients (*P* <.0001 and *P* <.007). The longer-term mortality was 23/889 (2.6%) versus 1/74 (1.3%) at 3 months (NS) and 35/595 (5.9%) versus 4/57 (7.0%) at 1 year (NS). When patients

Table 3   Treatment at Discharge and Follow-up Data

	"Classic" Myocardial Infarction n = 8701	"New" Myocardial Infarction n = 489	P Value
Aspirin	7594/8085 (93.9%)	439/472 (93%)	.429
Clopidogrel	6083/8067 (75.4%)	307/468 (65.6%)	.000
Statins or fibrates	7142/8070 (88.5%)	397/472 (84.1%)	.005
Beta blockers	6798/8058 (84.4%)	384/471 (81.5%)	.104
ACEI or ARB	6050/8051 (75.1%)	294/466 (63.1%)	.000
Rehabilitation course planned	1417/8352 (17.0%)	45/477 (9.4%)	.000
Follow-up:			
Mortality at 3 months	34/2122 (1.6%)	1/96 (1.0%)	1.000
Mortality at 12 months	56/1392 (4.0%)	4/71 (5.6%)	.530
Re-infarction at 3 months	31/2063 (1.5%)	0/93 (0%)	.642
Re-infarction at 12 months	29/1331 (2.2%)	1/67 (1.5%)	1.000
Hospital readmission at 3 months	251/2042 (12.3%)	13/92 (14.1%)	.626
Hospital readmission at 12 months	156/1327 (11.8%)	9/67 (13.4%)	.697
Major adverse clinical event at 3 months	274/2064 (13.3%)	13/92 (14.1%)	.755
Major adverse clinical event at 12 months	156/1326 (11.8%)	9/67 (13.4%)	.697

ACEI = angiotensin-converting enzyme inhibitor; ARB = angiotensin receptor blocker.
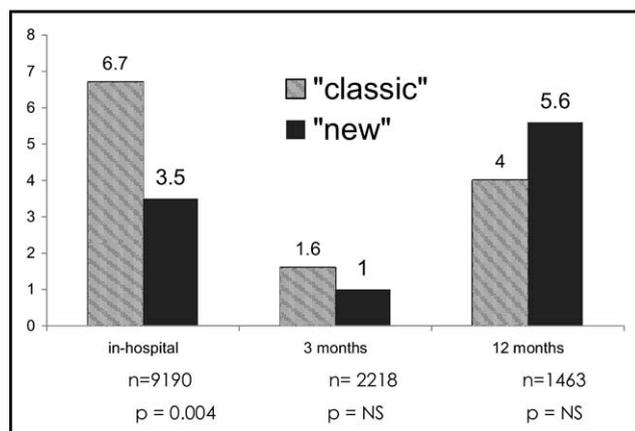
Figure   Mortality: in-hospital, at 3 months, and at 1 year.

dying within 24 hours were excluded (to exclude those potentially misclassified as "new" infarction because death occurred before a true peak value could be recorded), in-hospital mortality was 1.9% in the "new" and 4.7% in the "classic" myocardial infarction group ($P <.05$).

To evaluate the impact of the year of admission and of percutaneous revascularization, the odds ratio of hospital death for "new" myocardial infarction was re-calculated after adjusting for these parameters: it was thus 0.50 (95% CI, 0.31-0.82) when adjusted for admission year and 0.40 (95% CI, 0.25-0.66) when adjusted for the use of percutaneous intervention. Finally, because chronic renal failure can be associated with elevation of serum troponin levels, both groups also were compared after exclusion of 695 patients with a serum creatinine value >160 umol/L at admission: no major differences were observed (hospital mortality 5.7% for "classic" vs 3.3 for "new" myocardial infarction, $P = .03$).

DISCUSSION

The 2 main findings from the present analysis are:

- The routine application of the new definition for types 1, 2, or 3 myocardial infarction will be associated with an "increase" of at least 6% of the incidence of infarction in Switzerland;
- These "new" patients are not different from "classic" myocardial infarction patients in terms of baseline characteristics such as, age, sex, and prevalence of diabetes, but they more frequently have a history of prior coronary artery disease. They have smaller infarctions[15] with a better in-hospital prognosis despite receiving less aggressive acute treatment. Their pharmacological treatment at discharge is somewhat less comprehensive than that of patients with "classic" myocardial infarction. The medium and long-term survival and major adverse event rates, however, appear similar in both groups.

Despite the undisputed value of troponin in terms of both specificity and sensitivity, the Euro-Heart Survey published

in 2003[16] documented the reluctance of many physicians to use very low cut-off values for making a diagnosis of myocardial infarction. This may be because the increase in the reported prevalence of myocardial infarction will clearly have important consequences:

- A diagnosis of myocardial infarction has significant psychological and social effects on patients. It can be expected to lead to longer hospital stays with more aggressive acute phase management, an increase in admissions to rehabilitation programs, and to a wider use of secondary prevention measures. Most of these effects are positive, but they will have both a financial and a social cost, with a potential impact on, for example, employment, insurability, renewal of driving and flying licenses.
- For epidemiological evaluations, the incidence of myocardial infarction often is used as a surrogate to estimate the trends in prevalence of coronary artery disease. Unless the change in definitions is properly accounted for, there is a risk of false alarm about a "surge" in the incidence of myocardial infarction.[17] In the current series, the number of patients with "new" myocardial infarction (6% of the entire cohort) is small compared with the data reported by others.[7,8] This may, in part, be related to sampling issues (see "Limitations" section) but is largely a consequence of the low threshold for diagnosis already used for the AMIS "classic" infarction group; patients with troponin values >0.1 μg/L for TnT, or >0.1-0.8 μg/L for TnI were thus diagnosed as myocardial infarction ever since these measurements have been available. Other series[7,8] compared a diagnosis of myocardial infarction based solely on CK or CK-MB to one based on troponin, and the proportion of patients with "new" infarction was thus much greater, at 41% and 83%, respectively.
- A broader definition of infarction leads to the inclusion of patients with a better in-hospital prognosis. This could lead to the erroneous conclusion that early mortality from myocardial infarction is decreasing to a greater degree than it really is. This point is well illustrated by the fact that hospital mortality was nearly half as low for "new" myocardial infarction patients (3.5%) in the present series than it was for "classic" patients (6.7%). The trend was similar when patients potentially suffering type 3 myocardial infarction (death within 24 hours of admission) were excluded from the analysis.
- For clinical trials, the definition used for infarction can significantly affect the results: French and White[18] report that for the RITA-3 trial,[19] using the definition of infarction proposed in 2000[5] rather than the original trial definition would mean that the number of infarctions occurring in the invasive versus the conservative arm increase from 45 versus 56 (NS) to 84 versus 129 (relative risk 0.67, $P = .002$). Such a change would, of course, profoundly alter any conclusions drawn from the data.

Despite these considerations, there are obvious advantages to applying internationally accepted definitions of

myocardial infarction with a sound physiopathological basis, using parameters that are widely available and have appropriate sensitivity and specificity. Serial determinations of serum troponin clearly fit these requirements, and have been shown to have powerful prognostic value.[15,20-23] In order to address some of the limitations of a broader definition, there is a need to further qualify and quantify the diagnosis. Jaffe et al[20] have proposed that when peak troponin values are near the 99th percentile, the myocardial infarction be qualified as "minor" or "small." This is an essential distinction. Additional important qualifiers of infarction include left ventricular ejection fraction, presence of significant residual ischemia and extent of coronary artery disease. Large databases such as AMIS may need to incorporate more such information in a systematic manner in order to better track the "real" changes in acute coronary syndrome presentation, treatment, and prognosis over time.

Chronic renal failure is known to be associated with an increased prevalence of chronically elevated serum troponin. In the present series, the proportion of patients with significant elevation of plasma creatinine (>160 umol/L) was similar in both groups (7.8% for "classic" and 10.1% for "new" myocardial infarction, NS). When both groups were compared after patients with renal function impairment were excluded, no major changes were observed relative to the data derived from the overall population.

Limitations

Although most hospitals in Switzerland generally measure serum markers every 6-8 hours for the first 24-48 hours in patients admitted for acute coronary syndrome, no standard recommendation was made about this for patients included in AMIS. It is possible, therefore, that the current analysis underestimates the true incidence of "new" myocardial infarction, because the peak biomarker value may sometimes have been missed, and the patient consequently classified as suffering from unstable angina.

The AMIS project does not have a centralized ECG core laboratory, and all tracings were classified based on the assessment of the local investigators. If the ECG was reported as normal, then a diagnosis of myocardial infarction was made only if typical clinical symptoms were present, together with biomarker elevation. It is a little surprising to find 111 (22.7%) patients presenting with ST-segment elevation in the "new" infarction group. While rapid reversal of transient transmural ischemia probably explains the very limited myocardial damage reported in some patients, it is also possible that other factors played a role: patients dying very early after admission may never had more than a single serum biomarker determination and their peak troponin values were therefore missed, leading to the false conclusion that they belonged to the "new" infarction group; and some patients may have been mistakenly considered as ST-elevation myocardial infarction because of fixed ST changes due to prior infarction or other ECG abnormalities such as bundle branch block or presence of a pacemaker.

The postdischarge follow-up was available only for a subset of patients, and the numbers are still small, particularly in the "new" infarction group. Larger numbers will be required to narrow the confidence interval and to ascertain whether the long-term prognosis is indeed similar in both groups.

CONCLUSIONS

Broadening the definition of infarction to include patients with minimal elevation of serum troponin will lead to a moderate increase in the incidence of myocardial infarction in Switzerland by including patients with similar baseline characteristics but smaller, less complicated acute events, associated with a better short-term prognosis despite less aggressive treatment. Although the longer-term prognosis will need to be evaluated in a larger patient cohort, it would appear that the mid-term event rates at 3 and 12 months are similar for patients with "new" and "classic" myocardial infarction.

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APPENDIX

List of Centers and Investigators

The following hospitals participated from 2001-2007 in the AMIS project on which this work is based (in alphabetical order): Aarau, Kantonsspital (P Lessing/S Mörk/A Altmann); Affoltern am Albis, Bezirksspital (F Hess); Altdorf, Kantonsspital (R Simon); Altstätten, Kantonales Spital (P-J Hangartner/M Rhyner); Baden, Kantonsspital (M Neuhaus); Basel, Kantonsspital (P Hunziker); Bern, Inselspital (B Meier/S Windecker); Bern, Tiefenau Spital Netz Bern (P Loretan); Biel, Spitalzentrum (H Schläpfer); Brig-Glis, Oberwalliser Kreisspital (D Evéquoz); Bülach, Spital (U Muench/M Kruhl); Burgdorf, Regionalspital Emmental (D Ryser); Chur, Kreuzspital (R Jecker); Davos Platz, Spital (G Niedermaier); Dornach, Spital (A Koelz/H Lederer); Flawil, Kantonales Spital (T Langenegger/ J Haarer/A Walser); Frauenfeld, Kantonsspital (H-P Schmid); Fribourg, Hôpital cantonal (B Quartenoud); Frutigen, Spital (S Moser/K Bietenhard); Genève, Hôpitaux universitaires de Genève (HUG) (J-M Gaspoz); Glarus, Kantonsspital (W Wojtyna); Grenchen, Spital (A Oestmann/R Schönenberger); Herisau, Kantonales Spital (P Staub/M Schmidli); Interlaken, Spital (P Sula/E-M Weiss); La Chaux-de-Fonds, Hôpital (H Zender); Lachen, Regionalsspital (I Poepping/C Steffen); Langnau im Emmental, Regionalspital Emmental (J Sollberger); Lugano, Cardiocentro Ticino (G Pedrazzini); Laufenburg, Gesundheitszentrum Fricktal (E Koltai); Luzern, Kantonsspital (P Erne); Männedorf, Kreisspital (J von Meyenburg/T Luterbacher); Mendrisio, Opitale regionale (A Pagnamenta); Meyrin, Hôpital de la Tour (P Urban); Moutier, Hôpital du Jura Bernois (F Berger); Münsingen, Regionales Spital Zentrum (F Repond); Münsterlingen, Kantonsspital (F Widmer); Muri, Kreisspital für das Freiamt (K Rudaz-Schwaller/M Ammon); Nyon, Groupement Hospitalier de l'Ouest Lémanique (R Polikar); Olten, Kantonsspital (S Basssetti); Rheinfelden, Gesundheitszentrum Fricktal Regionalspital (H-U Iselin); Rorschach, Kantonales Spital (M Pfister/A Fischer); Samedan, Spital Oberengadin (P Egger); Sarnen, Kantonsspital Obwalden (T Kaeslin); Schaffhausen, Kantonsspital (R Frey); Schlieren, Spital Limmattal (B Risti/V Stojanovic/T Herren); Schwyz, Spital (P Eichhorn); Scuol, Ospidal d'Engiadina Bassa (G Flury/C Neumeier); Solothurn, Bürgerspital (P Hilti/B Oertli); St. Gallen, Kantonsspital (W Angehrn/H Rickli); Sursee, Kantonales Spital Sursee-Wolhusen (S Yoon); Thun, Spital (U Stoller); Uster, Spital (D Maurer/J Muntwyler); Wädenswil, Schwerpunktspital Zimmerberg-Horgen (B Kälin/B Federspiel); Walenstadt, Kantonales Spital (H Matter/P Müller); Wetzikon, GZO (M Graber/C Bianda); Winterthur, Kantonsspital (A Haller); Wolhusen, Kantonales Spital Sursee-Wolhusen (M Peter); Zofingen, Spital (H J Meier/S Gasser); Zollikerberg, Spital (P Siegrist/R Fatio); Zug, Kantonsspital (D Ramsay); Zürich, Universitätsspital (F Eberli/M Maggiorini); Zürich, Stadtspital Triemli (O Bertel); Zürich, Stadtspital Waid (M Brabetz/S Christen).