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quality indicators and mortality in Belgian STEMI networks

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Background

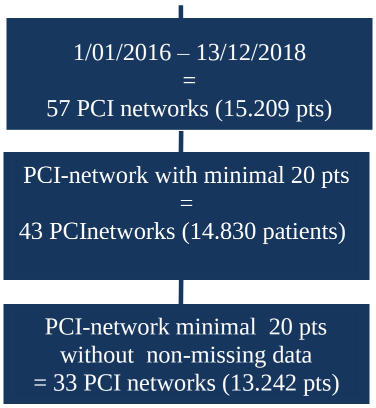
The current guidelines for the management of ST-segment elevation myocardial infarction (STEMI) recommend primary percutaneous coronary intervention (pPCI) as the preferred treatment strategy if it can be conducted in a timely fashion by an experienced catheterisation team. However, because of logistical restraints, PCI can only be offered in less than 50% of Belgian hospitals. This has formed the basis of the development of STEMI networks with pre-arranged rapid transfer protocols between community hospitals and PCI centres. This concept was promoted at the start of the Belgian STEMI registry in 2007. To assess the quality of acute cardiac care, quality indicators have been developed by international task forces and within the college and the working group of acute cardiology. The most important indicators concerning treatment of STEMI have been defined and implemented in the Belgium STEMI database from 2009. Recent large scaled international studies have shown a clear correlation between adherence to quality and mortality. In all these studies the analysis was patient/hospital based but not network-based. Analysis at the level of the network might decrease the variation in case-mix and allow also the global assessment of the quality of care across the chain of care-givers from the different hospitals belonging to the network. Accordingly, the present report describes the adherence to quality and its effect on mortality for the different PCI networks in Belgium during the period 2016-2018.

Methods:

We extracted data from the STEMI database which is an electronic web-based registry that is governed by an independent software company specialised in electronic data capture solutions (Lambda-plus- website: http://www.lambdaplus.com).

Gewijzigde veldcode

A PCI network was defined as network with minimal one PCI capable hospital surrounded by hospitals without PCI capacities that send their STEMI patients to the PCI capable hospital.



Flowchart 2

We focused the analysis for the period after the legislation about PCI capable hospitals without cardiac surgery (B2 hospitals). During the period 2016-2018 there were 57 PCI networks. After exclusion of network with less than 20 completed patient files, the final study population consists of 13242 STEMI patients admitted in 33 networks. (see flowchart)

A number of baseline characteristics for each patient was included which allowed to stratify the patients according to a previous validated TIMI risk score: age, gender, history of coronary artery disease (CAD) or peripheral artery disease (PAD), location of infarction, total ischemic time. age, hemodynamic status on admission, history of atherovascular disease, history of hypertension or diabetes. Collapse with cardiopulmonary resuscitation (CPR) was also registered as this factor is not incorporated into the TIMI risk score.

Quality indicator:

Following quality parameters were registered and are based upon the European QI's for STEMI:
a)Types of reperfusion strategy: thrombolysis (TL), percutaneous coronary intervention (PCI) or no reperfusion.
b)Time delays between diagnosis and treatment, subdivided into diagnosis-to-balloon time (time between first ECG with STEMI diagnosis and the balloon inflation, recommended time delay<90min) and the door-to-balloon (time between arrival in the PCI centre and the balloon inflation, recommended time delay <60min)).
c) discharge medication: P2Y12 inhibitors and statins
For each PCI network, a global quality score was assigned according to the following rules (the higher the score the more adherent to quality recommendations, see figure 2). The cut-off score values are based upon data from the literature and take also into account the median value and IQR of the quality indicator in this study.

Composite QI: score 0-10

Score	% Diagnosis-to-balloon time
0	<60%
1	60-80%
2	>80%

Score	% Diagnosis-to-balloon time
0	<60%
1	60-80%
2	>80%

Score	% P2Y12 inh
0	<90%
1	90-95%
2	>95%

Score	% PCI
0	<90%
1	90-95%
2	>95%

Score	% statines
0	<80%
1	80-90%
2	>90%

Figuur 2

The primary endpoint was in-hospital death from all causes as late as 30 days after admission. Vital status was assessed in the final hospital before home discharge.

Statistical Analysis

Continuous variables are presented as mean ± SD and as median values with inter quartile range (IQR). Independent determinants of in-hospital death at network level was assessed by linear regression analysis including the composite QI as well as TIMI risk score and cardiac arrest rate.
Added-variable plots (of partial regression plots) are generated to show the relation between composite QI and mortality after correction for case mix (cf TIMI risc score and Cardiac arrest rate). For all analyses, a value of $p<0.05$ was considered statistically significant.

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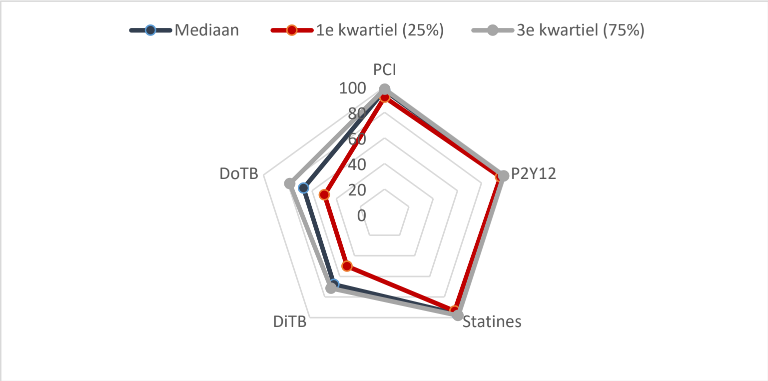
Results

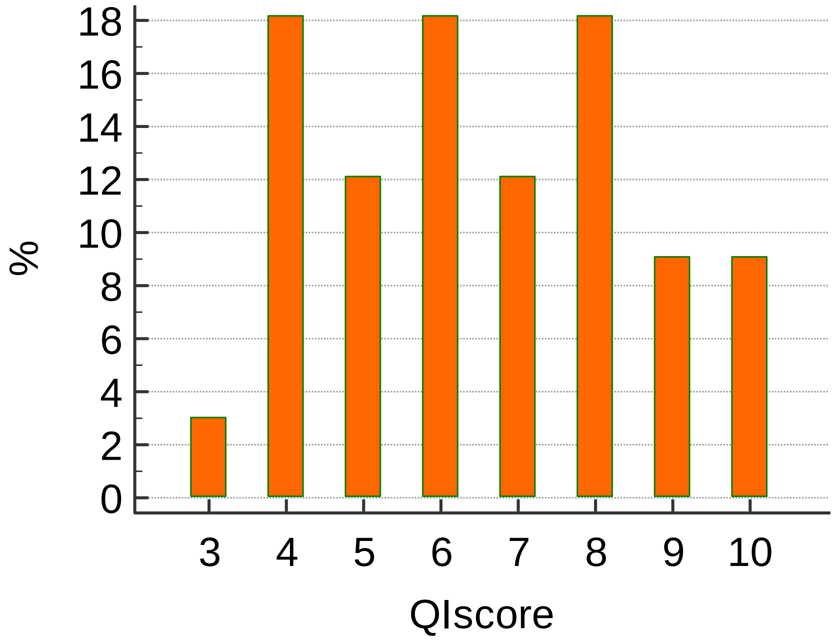
Table 2 describes the risk profile and quality indicators of the 33 PCI networks. The average TIMI risk score is 4.0 (range 4-8). In almost 11% of the patients, STEMI was complicated with cardiac arrest. (see Table 1)

	mean ± SD	Mediaan IQR
Baseline characteristic:		
man, %	75 ± 3,5	75 (73-78)
Cardiac arrest,%	10,6 ± 3,4	10,8 (8.1-12.6)
TIMI risico score	4.04 ± 0,34	4.0 (3-4)
Quality indicator: PCI, %	92,8 ± 11.5	97,3 (92-98)
TT, %	3,9 ± 9,4	1,05 (0.5-2.2)
P2Y12, %	96,3 ± 3.1	97,3 (95.5-98.2)
statine, %	94,4± 6.1	96,3 (93.5-98)
DiTB<90min, %	63,2± 17.2	67,7 (50.1-71.5)
DoTB<60 min, %	64,7± 18.6	67.0 (50 – 78.3)
QI score	6,4± 2.1	6,0 (4-8)

The majority of PCI network (93%) underwent primary PCI as reperfusion therapy. Thrombolysis was given in 4% of the patients and 3% of the patients did not receive any reperfusion therapy mainly because of late presentation and/or severe comorbidity.
The recommended DiaTB<90min and DoTB<60min across the different networks was achieved in 63% and 65%, respectively. The use of P2Y12 inhibitors and statins was high (about 95%). The radial flowchart shows that the main gaps in quality adherence are related to time delays.



The average global quality score was 6.4 ± 2.1 with a median of 6. The distribution of the score is depicted in figure 2. 20% of the networks have a QI <5 and almost 20% of the networks have a QI>8.



Quality indicators and relation with mortality

The in-hospital mortality of the total study population was 5.8% and varied among the PCI networks between 0% and 12.7%. Figure 3 shows the relationship between the composite QI score and the in hospital mortality for the different networks. No significant relationship could be seen.

However, when correcting for baseline risk profile, the relationship became evident with lower mortality for higher quality score (see figure 4).

Figure 3

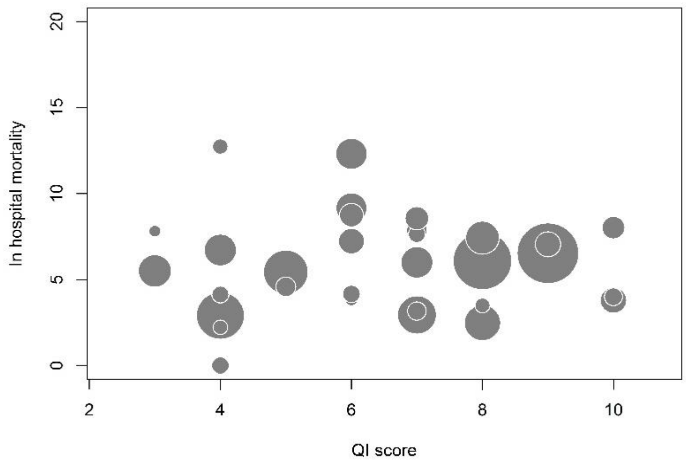


Figure 4

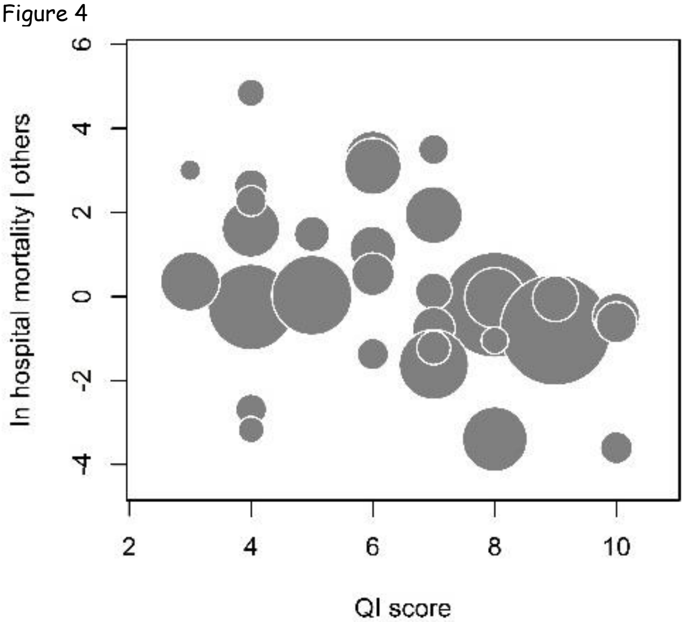


Table 4 shows the regression analysis between in hospital mortality and the composite QI score and baseline risk profile. Quality adherence as well as baseline risk profile are independent predictors of in hospital mortality. The individual QI's were not significantly related to the in hospital mortality.

	Univariate linear regression		Multiple linear regressio,	
	Estimate (SE)	P-value	Estimate (SE)	P-value
Composite QI-score	0,13 (0,21)	0,54	0,43 (0,16)	0,012
TIMI risc score	3,45 (1,26)	0,01	2,78 (0,96)	0,007
CPR	0,49 (0,10)	<0,001	0,54 (0,10)	<0,001

DISCUSSION and CONCLUSIONS

The present report describes the relation between adherence to STEMI quality indicators and in hospital mortality at the level of PCI-networks in Belgium.

We could demonstrate, for the first time, that mortality was higher in networks with lower composite quality scores. The effect was only seen after correction for baseline risk profile and for the composite score (not for the individual quality indicator). This suggests that a composite quality score reflects better the global adherence to evidenced based medicines than the individual scores. In addition, our findings underscore the impact of baseline risk profile (cf cardiac arrest, TIMI risk score) on the in-hospital mortality. This implies that in-hospital mortality, alone, is not a valid quality indicator and should be corrected for the case-mix.

Among the 33 PCI networks there was a great variation in the quality score, most prominent for time delays to reperfusion therapy. In 25% of the networks recommended time delays (both diagnosis-to-balloon as door-to-balloon) was achieved in only 50% of the cases. Still many patients have prolonged diagnosis to treatment times because of suboptimal transfer policy and/or because of suboptimal internal organisation within the PCI centre. The most optimal transfer policy is the direct transfer of STEMI patients (from home or from community hospital) to the nearest PCI capable hospital with early notification of the catheterisation laboratory team, preferentially by EMS and direct transfer to the cath lab, bypassing the emergency room.

It can be expected that the global mortality in Belgium will further decrease if recommended optimal reperfusion therapy is offered to all our STEMI patients.

The present findings are in line with recent international studies. The study of Bebb et al demonstrate in a population of AMI (both STEMI and non-STEMI) that eleven Qis, among them timely pPCI, were significantly inversely associated with 30-day mortality and that a composite QI more strongly depicts the relationship as the separate QI's.
The present analysis highlights also that many patients were excluded because of many missing data (particularly time delay and medication figures) . Data quality is crucial for quality assessment. Previous studies have shown that underreporting was associated not only with high risk patient profile but also with less adherence to recommended reperfusion therapy. (Macbe et al)

The present findings will be communicated to the participating hospitals and are a strong argument to further monitor the quality of care of STEMI patients, particularly time delay indicators in all patients admitted in all Belgian hospitals.

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