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Managing in-hospital quality improvement: An importance-performance analysis to set priorities for ST-elevation myocardial infarction care

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Abstract

Background: A focus on specific priorities increases the success rate of quality improvement efforts for broad and complex-care processes. Importance-performance analysis presents a possible approach to set priorities around which to design and implement effective quality improvement initiatives. Persistent variation in hospital performance makes ST-elevation myocardial infarction care relevant to consider for importance-performance analysis.

Aims: The purpose of this study was to identify quality improvement priorities in ST-elevation myocardial infarction care.

Methods: Importance and performance levels of ST-elevation myocardial infarction key interventions were combined in an importance-performance analysis. Content validity indexes on 23 ST-elevation myocardial infarction key interventions of a multidisciplinary RAND Delphi Survey defined importance levels. Structured review of 300 patient records in 15 acute hospitals determined performance levels. The significance of between-hospital variation was determined by a Kruskal–Wallis test. A performance heat-map allowed for hospital-specific priority setting.

Results: Seven key interventions were each rated as an overall improvement priority. Priority key interventions related to risk assessment, timely reperfusion by percutaneous coronary intervention and secondary prevention. Between-hospital performance varied significantly for the majority of key interventions. The type and number of priorities varied strongly across hospitals.

Conclusions: Guideline adherence in ST-elevation myocardial infarction care is low and improvement priorities vary between hospitals. Importance-performance analysis helps clinicians and management in demarcation of the nature, number and order of improvement priorities. By offering a tailored improvement focus, this methodology makes improvement efforts more specific and achievable.

Keywords

Quality improvement, evidence-based medicine, importance-performance analysis, acute coronary syndrome

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Introduction

Closing the delivery gap between evidence and patient care is challenging healthcare providers. In comprehensive and complex-care processes, a complete redesign of practice may be needed to achieve optimal care.[1] Such a fundamental change often surpasses organizational capacity. Healthcare professionals and their organizations struggle with the scope and pace of broad and systematic quality improvement interventions. The cumulative effect of multiple and simultaneous improvement efforts leads to change fatigue, an increase in workload and burn-out,

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specifically in nursing.[2,3] As a result, broad quality improvement interventions deal with resistance, incomplete implementation or failure. To address these challenges, improvement strategies like Plan Do Study Act (PDSA) and the Institute for Healthcare Improvement (IHI)'s Model for Improvement demand to set specific improvement priorities.[4]

Variation in performance between hospitals complicates priority setting. If performance varies across a broad range of key interventions, this opposes the use of a unique set of priorities in a multicentre improvement project. This reinforces the case for tailored quality improvement interventions to address the underlying factors of each individual hospital's performance. However, there is a lack of evidence on how to tailor priorities in quality improvement interventions.[5]

ST-elevation myocardial infarction (STEMI) offers a relevant case to illustrate challenges in priority setting in a multicentre improvement effort. Clinical care for STEMI patients varies persistently within and between hospitals. Differences in patient case mix do not justify the observed variation. Rather, variation is largely driven by a fluctuating and complex process involving a wide range of disciplines and clinical departments under vast time pressure.[6] Nurses play a critical role in streamlining the complex STEMI care process to achieve timely reperfusion and secondary prevention.[7,8] Guidelines and extensive sets of data elements are available to guide this improvement. Yet, the implementation of guidelines is a serious problem, requiring urgent improvement to ensure patients receive optimal evidence-based care.[9]

Importance-performance analysis prioritises key interventions by depicting experts' opinion on importance of a key intervention against the performance on this key intervention. This technique identifies improvement priorities by (graphically) exemplifying disparity between importance and performance. Besides recognising performance as a factor in priority setting, importance-performance analysis can handle input from multidisciplinary expertise.[10] Such approach might result in a clear set of improvement priorities for STEMI.

The aim of this study is to identify quality improvement priorities for in-hospital STEMI care through an importance-performance analysis that links multidisciplinary expert consensus on importance of key interventions with hospital performance levels.

Methods

Design, setting and sample

We performed a cross-sectional multicentre study of adult STEMI patients hospitalised between 2013 and 2014. Fifteen hospitals (response rate 93.7%) were recruited were recruited for the Care Pathways for Acute Coronary Syndrome (CP4ACS) study through the Belgian-Dutch Care Pathway Network, a network of health care organizations in Belgium sharing knowledge on care-pathway methodology. Although we initially aimed to include only 10 hospitals, 15 hospitals agreed to participate and each retrospectively recruited 20 consecutively admitted STEMI patients (n=300). Adult patients admitted within 24 h after symptom onset and eligible for reperfusion strategy (whether thrombolysis or percutaneous coronary intervention (PCI) according to the European Society of Cardiology (ESC) STEMI guidelines were included.[11] Patients with severe concomitant disease resulting in deviations from guideline-recommended care were excluded.

Assessing importance and performance

To assess importance of key interventions, an initial set of 27 interventions was identified through a structured literature review of international STEMI guidelines and improvement articles. Subsequently, 23 key interventions were validated in a RAND Delphi-survey in two rounds. First, a multidisciplinary panel of 34 (76% response rate) cardiologists, nurse managers and quality managers appraised key interventions individually. After receiving feedback, 32 experts (71% response rate) openly discussed items with a content validity index (CVI) above 75% in a consensus meeting and validated the final set of key interventions. CVIs were computed as the proportion of experts that rated a STEMI key intervention as important to quality improvement between 7 and 9 on a nine-point Likert scale. At the outset of the study, the cut-point to consider items as important to STEMI quality improvement was set at 75%.[12]

Adherence to STEMI guidelines was measured by reviewing patient records using a structured audit tool. The audit tool discriminated between documentation and performance of key interventions. Key interventions were considered non-documented whenever information on performance of the intervention was missing or ambiguous. Variables were reported as non-performed when the patient record explicitly stated the absence of the intervention. Performance is reported as a proportion both at patient and hospital level. Our patient-level measure reflects the proportion of relevant key interventions performed for that particular patient. Our hospital-level measure aggregates the proportion of patients for whom relevant key interventions were performed. Data were collected and coded by a local study coordinator. The central study coordinator monitored data quality by verifying a random 10% sample of included patients. The participating hospitals validated the results.

We created an importance-performance matrix by ranking key interventions on CVI and plotting their corresponding performance levels. A 75% cut-point for both importance and performance resulted in four quadrants. The upper right 'quadrant 1' includes key interventions for which both importance as well as performance levels were high.

Hospitals should at least maintain performance levels of key interventions in 'quadrant 1'. The upper-left 'quadrant 2' captures priorities for improvement, i.e. their importance is highly valued by experts whilst hospital performance is low. The lower-left 'quadrant 3' includes low priority key interventions, i.e. expert-rated importance as well as hospital performance is low. The lower-right 'quadrant 4' represents possible overuse, i.e. there is no consensus among experts on the relevance of these key interventions to quality improvement, whilst hospital performance is high.[10]

To illustrate variation between hospitals, we constructed a heat-map that ranked important key interventions (CVI>75%) based on the number of hospitals for which the key intervention was an improvement priority (performance ≤75%).

Statistical analysis

Timely reperfusion was calculated as the interval between first medical contact to primary PCI (defined as wire passage into the culprit artery) and analysed considering the need for transfer (≤120 min in case of transfer; all others ≤90 min).[11]

For each key intervention, the median and interquartile range (IQR) were calculated to describe variation within and between hospitals. Variation in performance between hospitals was assessed by a Kruskal–Wallis test for skewed data distributions within independent samples. Analyses were performed in IBM SPSS version 24.0 and R using packages easyGgplot2 and ggplot2.

Ethical considerations

This study is part of the CP4ACS quality improvement programme registered at ClinicalTrials.gov (NCT02961777). Ethical approval was obtained from the ethical committee of the University Hospitals of Leuven (ML9733). We confirm that this study conforms with the principles outlined in the Declaration of Helsinki.[13]

Results

Patient and hospital characteristics

The characteristics of included patients (n=300) are summarised in Table 1. The mean age upon admission was 64.3 years. Three-quarters (74.7%) of patients were male. Almost half of the patients (44.3%) were directly admitted to a PCI-capable hospital. A vast majority (96.7%) received reperfusion therapy, 99.3% of which were through primary PCI. Nine of 15 participating hospitals had 24/7 PCI capacity, all but one of these having an annual PCI volume over 400. Ten hospitals served as a cardiology training centre and four were academic hospitals.

Documentation of STEMI care differed per key intervention and per hospital. The documentation of five important key interventions was suboptimal: cardiovascular history (64.2%), cardiac rehabilitation (58.1%), nutritional advice (57.7%), smoking cessation for active smokers (49.2%) and home medication upon admission (42.2%). PCI and post-PCI key interventions were documented in >83% of patients, discharge medication was documented in >95% of patients.

Table 1. Documentation of patient characteristics based on the ST-elevation myocardial infarction (STEMI) Thrombolysis In Myocardial Infarction (TIMI) score by Morrow et al.[32]

Patient characteristics	Documented		Not documented	
	n/*N*	(%)	*n*	(%)
Men	224/300	(74.7%)	0	(0.0%)
Weight<67 kg	30/207	(14.5%)	93	(31.0%)
Systolic blood pressure<100	21/270	(7.8%)	30	(10.0%)
Heart rate <100	265/298	(88.9%)	2	(0.7%)
Arterial hypertension	140/248	(56.4%)	52	(17.3%)
Diabetes	40/236	(16.9%)	64	(21.3%)
Hyperlipidaemia	130/206	(63.1%)	94	(31.3%)
Chronic kidney disease	14/201	(6.9%)	99	(33.0%)
Active smoking	131/246	(53.2%)	54	(18.0%)
Coronary artery disease	6/201	(2.9%)	99	(33.0%)
Peripheral vascular disease	22/184	(11.9%)	116	(38.7%)
Killip class	217/300	(72.3%)	83	(27.7%)
1	179/217	(82.4%)		
2	26/217	(11.9%)		
3	5/217	(2.3%)		
4	7/217	(3.2%)		
Reperfusion therapy	290/300	(96.7%)	8	(2.7%)
Primary PCI	288/290	(99.3%)		
Facilitated PCI	1/290	(0.3%)		
Thrombolysis	0/290	(0.0%)		
CABG	1/290	(0.3%)		
Admitted at PCI centre	133/300	(44.3%)	0	(0.0%)
Transferred to a PCI centre	167/300	(55.7%)	0	(0.0%)
Admitted to an academic centre	80/300	(26.7%)	0	(0.0%)

CABG: coronary artery bypass graft; PCI: percutaneous coronary intervention.

Priorities in STEMI performance

An overview of STEMI key interventions and descriptive statistics on importance and performance is provided in Table 2. Figure 1 shows the importance-performance analysis. The 13 of 23 (56.5%) key interventions in 'quadrant 1' were considered important by the expert panel (CVI≥75%) and were performed in >75% of patients. PCI was used in 96.3% of patients as a primary reperfusion therapy. Post-PCI left ventricular evaluation, electrocardiogram (ECG)-monitoring, and discharge medication were performed in >75% of patients. Aspirin, statin and

Table 2. Overview of ST-elevation myocardial infarction (STEMI) key interventions and descriptive statistics importance and performance.

Rank	Key intervention	Median (%)	IQR (%)		CVI (%)	*p*-Value
1	Performance of smoking cessation	27.3	17.1	42.2	76	0.000
2	Assessment of home medication	20.0	10.0	73.8	79	0.000
3	Assessment of cardiovascular risk factors	72.8	62.5	76.4	91	0.000
4	Performance of nutritional advice	41.2	22.5	85.9	85	0.000
5	Performance of cardiac rehabilitation	50.0	30.0	77.5	79	0.000
6	Reperfusion performed within guideline delays	60.0	44.1	82.1	100	0.000
7	Assessment of cardiovascular antecedents	80.0	38.8	91.3	100	0.000
8	Performance of peri-procedural aspirin	75.0	66.7	90.0	85	0.000
9	Performance of peri-procedural anticoagulation	89.5	62.5	100.0	91	0.000
10	Performance of peri-procedural P2Y12 inhibitor	85.0	74.3	92.5	85	0.372
11	Performance of ACE or ARB at discharge	83.3	72.5	85.0	91	0.000
12	Performance of ECG monitoring	100.0	89.2	100.0	85	0.000
13	Assessment of a 12-lead ECG	85.0	77.5	92.5	100	0.000
14	Performance of beta-blocking at discharge	88.9	82.1	94.9	85	0.006
15	Performance of left ventricular function evaluation	94.4	88.9	100.0	91	0.001
16	Assessment of systolic blood pressure	95.0	80.0	100.0	97	0.001
17	Reperfusion performed by primary PCI	100.0	100.0	100.0	91	0.654
18	Performance of aspirin at discharge	100.0	92.5	100.0	94	0.056
19	Performance of statin at discharge	100.0	94.1	100.0	91	0.225
20	Performance of P2Y12-inhibitor at discharge	95.0	94.9	100.0	91	0.632
21	Assessment of Killip class	90.0	72.5	100.0	65	0.000
22	Performance of blood tests	75.8	72.5	84.6	56	0.000
23	Performance of peri-procedural opioid	35.0	25.7	48.7	44	0.001

ACE: angiotensin-converting enzyme; ARB: angiotensin receptor blocker; CVI: content validity index; ECG: electrocardiogram; IQR: interquartile range; PCI: percutaneous coronary intervention.
P2Y12 inhibitors bind to the $P2Y_{12}$ protein receptor that acts as a regulator in blood clotting. Between-hospital variation was tested by a Kruskal–Wallis test for skewed data distributions within independent samples. Key interventions were ranked by priority for improvement.

P2Y12-inhibitors reached performance levels above 95%. Apart from aspirin (72.1%), all important (CVI≥75%) peri-procedural medication interventions were performed in >75% of patients.

Seven of 23 (30.4%) key interventions were considered a priority for STEMI quality improvement (‘quadrant 2’). Timely reperfusion, stratified by transfer status, was provided for 60.7% of patients. Overall, lifestyle interventions were performed for 46.4% of patients: cardiac rehabilitation (52.1%), nutritional advice (49.6%) and smoking cessation in active smokers (37.4%).

‘Quadrant 3’ and ‘Quadrant 4’ illustrate the performance of three key interventions considered less important (CVI<75%) to quality improvement. Guideline-recommended blood tests were performed for 76.8% of included patients. Assessment of Killip class was performed for 72.3% and peri-procedural opioids were administered for 38.3% of patients.

Performance priorities vary between hospitals

Figure 2 illustrates the variation in performance priorities per hospital. The hospitals were ranked by the number of important key interventions performed in ≤75% of patients within the hospital. Between hospitals, the number of performance priorities ranged from 1–11 STEMI key interventions. Six key interventions were underperformed in 10 or more (66.7%) of the participating hospitals.

The data show significant variation in performance levels between hospitals. Except for performance of peri-procedural P2Y12 inhibitor, P2Y12-inhibitor at discharge and primary PCI, between-hospital variation on performance was significant for individual key interventions ($p<0.001$). Variation was small for discharge medication (IQR 5.1–12.7%). Variation was large for interventions on assessment of cardiovascular risk and antecedents (IQR 12.5–63.8%), lifestyle interventions (IQR 25.1–63.4%) and timely performance of reperfusion therapy (IQR 44.1–82.1%). Only one patient received all key interventions needed to provide optimal STEMI care. Remarkably, for every individual key intervention, at least one hospital attained performance levels above 90%.

Discussion

This importance-performance analysis set priorities that serve in development of effective quality improvement interventions for STEMI care. Our study resulted in

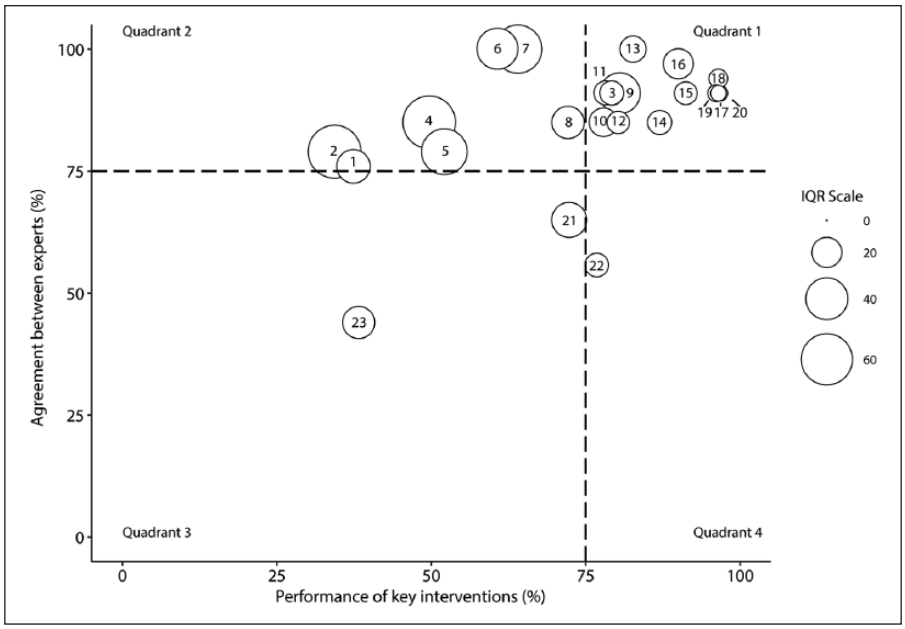

Figure 1. Importance-performance analysis of key interventions for in-hospital ST-elevation myocardial infarction (STEMI) care. Quadrant 1: both importance and performance >75%. Quadrant 2: importance >75%, performance ≤75%. Quadrant 3: both importance and performance ≤75%. Quadrant 4: importance ≤75%, performance >75%. Bubble size represents interquartile (IQR) of between-hospital variation on performance. Key interventions are numbered according to their entrance in Table 2. 1: Performance of smoking cessation; 2: assessment of home medication; 3: assessment of cardiovascular risk factors; 4: performance of nutritional advice; 5: performance of cardiac rehabilitation; 6: reperfusion performed within guideline delays; 7: performance of peri-procedural aspirin; 8: assessment of cardiovascular antecedents; 9: performance of peri-procedural anticoagulation; 10: performance of angiotensin-converting enzyme (ACE) or angiotensin receptor blocker (ARB) at discharge; 11: performance of peri-procedural P2Y12 inhibitor; 12: performance of electrocardiogram (ECG) monitoring; 13: assessment of a 12-lead ECG; 14: performance of beta-blocking at discharge; 15: performance of left ventricular function evaluation; 16: assessment of systolic blood pressure; 17: performance of P2Y12-inhibitor at discharge; 18: performance of aspirin at discharge; 19: performance of statin at discharge; 20: reperfusion performed by primary percutaneous coronary intervention (PCI); 21: assessment of Killip class upon admission; 22: performance of diagnostic blood tests upon admission; 23: performance of peri-procedural opioid.

important observations. First, documentation of care was suboptimal in five of 23 key interventions. Second, our analysis identified seven of 23 key interventions as overall performance priorities. These priorities relate to timely reperfusion by PCI, risk assessment and secondary prevention. Third, we observed significant variation in performance of key interventions between hospitals. Our heat-map provided more depth by showing performance levels per hospital and per key intervention. This revealed important differences in the nature, the number and the order of improvement priorities between hospitals.

These differences in performance refute one-size-fits-all improvement interventions and calls for a tailored approach. The identified priorities may serve as a menu to tailor improvement efforts and focus on distinct care processes. Such a focus makes improvement efforts more tangible and manageable compared to broad, undirected interventions. Vice versa, an overly tight focus may result in a loss of attention for those processes that are not under focus. A combination of continued and incremental improvement offsets the downside of too narrowly focused improvement efforts.[14] Considering that at least one hospital performs well on each of the key interventions, transfer of best practices through collaboration is possible. Collaborative and incremental quality improvement strategies have been applied by the IHI and the American College of Cardiology, albeit without offering clear guidance on how to set priorities.[15,16]

Our focus on care processes is appropriate for quality improvement interventions targeting clinical practice variation. Improvement of care processes is also most likely to increase patient experience and has been associated with significant decreases in in-hospital mortality.[17] Working with care processes has the advantage that they can be addressed directly by clinicians, and require little risk adjustment and limited sample size. Process measures also allow for easy data extraction, rapid feedback and clear goal-setting.[18] A major hurdle when dealing with complex-care processes is the large number of key interventions needed to achieve optimal care.[19] A focus on a small set of evidence-based key interventions has led to significantly better care.[20]

The proportion of patients receiving timely coronary reperfusion is comparable to other European studies and conforms to targets set by international guidelines.[21] Improvement of reperfusion delays will lead to reduced

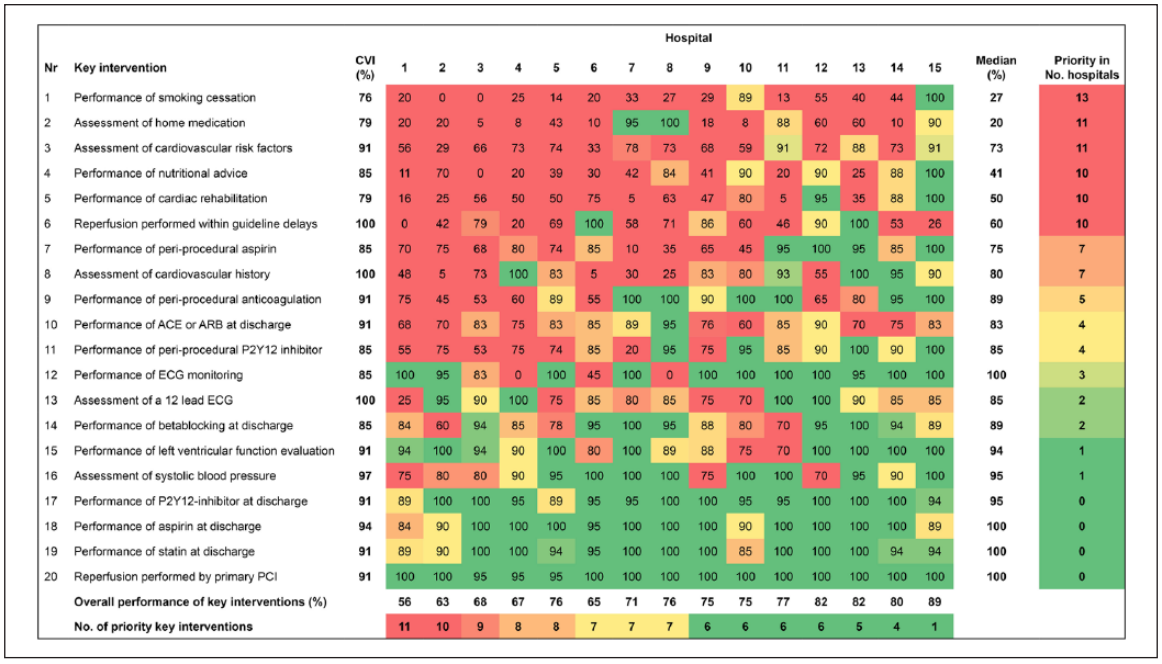

Figure 2. Heat-map of per-hospital performance on important ST-elevation myocardial infarction (STEMI) key interventions. Performance cut-points were set at ≤75% (red); >75% (yellow) <95%; ≥95% (green). Key interventions are numbered according to their entrance in Table 2. 1: Performance of smoking cessation; 2: assessment of home medication; 3: assessment of cardiovascular risk factors; 4: performance of nutritional advice; 5: performance of cardiac rehabilitation; 6: reperfusion performed within guideline delays; 7: performance of peri-procedural aspirin; 8: assessment of cardiovascular antecedents; 9: performance of peri-procedural anticoagulation; 10: performance of angiotensin-converting enzyme (ACE) or angiotensin receptor blocker (ARB) at discharge; 11: performance of peri-procedural P2Y12 inhibitor; 12: performance of electrocardiogram (ECG) monitoring; 13: assessment of a 12-lead ECG; 14: performance of beta-blocking at discharge; 15: performance of left ventricular function evaluation; 16: assessment of systolic blood pressure; 17: performance of P2Y12-inhibitor at discharge; 18: performance of aspirin at discharge; 19: performance of statin at discharge; 20: reperfusion performed by primary percutaneous coronary intervention (PCI). P2Y12 inhibitors bind to the P2Y12 protein receptor that acts as a regulator in blood clotting. CVI: content validity index.

mortality and morbidity both in the short- and long-term. There is sound evidence on effective improvement strategies to reduce reperfusion delays.[22] Performance of necessary lifestyle changes in our study is comparable to other European research.[23] Performance on discharge medication was similar to performance levels in America and Europe, except for angiotensin-converting enzyme (ACE) or angiotensin receptor blocker (ARB) inhibitors and beta-blockers; which were lower than American levels.[24] Lifestyle interventions and guideline-recommended discharge medication are cost-effective and have a significant effect on long-term outcomes.

Improving performance requires joint efforts by a multidisciplinary team and transcends the boundaries of the hospital. Proper risk stratification is a prerequisite for improving STEMI care management. Cardiovascular risk assessment is part of the early triage and diagnosis process with special value in atypical presentations. Better cardiovascular risk assessment may lead to better outcomes through effective triage and timely reperfusion. Nurse practitioners have a direct role in improvement of risk stratification and timely reperfusion.[25,26] Better risk assessment increases inclusion in secondary prevention and rehabilitation programmes targeting lifestyle changes and pharmaceutical therapy. Furthermore, an updated and shared STEMI protocol, use of checklists, and oral and written discharge instructions could improve documentation and prescription of discharge medication.[27]

Our distinction between documentation and performance of care was important because of the differing solutions to both problems. In addition, documenting care has previously been associated with better performance of care processes.[28] Although there is no certainty about the performance of undocumented care, some circumstances may explain suboptimal documentation without compromising performance: in the acute phase of STEMI care, the provision of life-saving care may get priority over its documentation. Likewise, in the post-acute phase, hospitals may no longer bear responsibility for documentation of STEMI care as the patient may have been transferred back to the referring hospital or primary care. In this case, the reported result may be an underestimation of performance.

Some methodological limitations apply. First, to determine importance levels, we pooled multidisciplinary

knowledge and experience. The deliberate involvement of nurses expressed their increasing role in organisation and improvement of care processes that contribute to improved patient care.[29] We did not involve patients in the expert panel to select and validate STEMI key interventions. Patients have preferences on structure, process and outcomes of healthcare and patient involvement could influence priorities for quality improvement.[30] Scarce evidence indicates that patient involvement does shift priorities from technical aspects of clinical care towards idiosyncratic aspects like timely access to care, self-care support and patient participation in clinical decision-making.[31] While patient involvement might influence priority setting for quality improvement, effective patient involvement requires time and dedicated resources to overcome limited clinical knowledge and unbalanced representation. Such efforts exceeded the scope of our study.

Second, our choice of the 75% cut-off score to visualise the delivery gap and prioritise improvement opportunities was pragmatic. Guidelines on Delphi research and previous research in cardiology justify a 75% threshold for importance. The basis for a 75% cut-off score on performance levels is less straightforward. Therefore, we evaluated the impact of our cut-points on priorities by shifting them between 50% and 90%. The ranking of priorities altered when performance cut-points were below 60% or above 90%. Also, between-hospital performance variation could complicate priority setting as key interventions may cross quadrant borders and thus complicate priority setting.

Conclusions

Our study related the importance of key interventions for in-hospital STEMI care to their performance levels. Proper risk assessment, timely reperfusion and secondary prevention were each identified as having overall priority in STEMI quality improvement interventions. Better performance on these care processes has been associated with better outcomes. Furthermore, significant between-hospital variation on performance revealed the need to tailor improvement interventions to hospital-specific improvement priorities.

In healthcare, importance-performance analysis is immature and additional efforts are needed to deepen some methodological aspects. Our study revealed ambiguities about setting the cut-points that discriminate between priorities. Given the between-hospital differences in performance, tailored cut-points seem an interesting element to explore further. Despite this immaturity, we emphasise the need for a broader and widespread use of importance-analysis as it offers the necessary support to make improvement interventions more effective.

Implications for practice

- Better documentation is prerequisite for improvement.
- Objective priorities focus improvement efforts.
- Tailored improvement addresses variation in priorities.
- Nurses have an important role in performance improvement.

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Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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