BMJ Open

Quality indicators for cardiac rehabilitation after myocardial infarction in China: a consensus panel and practice test

Xianghui Zheng,[1,2] Maomao Zhang,[1,2] Yang Zheng,[1,2] Yongxiang Zhang,[1,2] Junnan Wang [ID],[3] Ping Zhang,[4] Xuwen Yang,[5] Shan Li,[6] Rongjing Ding,[7] Gaowa Siqin,[8] Xinyu Hou,[1,2] Liangqi Chen,[1,2] Min Zhang,[1,2] Yong Sun,[1,2] Jian Wu [ID],[1,2] Bo Yu[1,2]

For numbered affiliations see end of article.

Correspondence to
Dr Jian Wu;
wujian780805@163.com

ABSTRACT

Objectives Cardiac rehabilitation (CR) improves outcomes after myocardial infarction (MI), but it is underused in China. The purpose of this study was to develop a set of quality indicators (QIs) to improve clinical practices and to confirm the measurability and performance of the developed QIs for CR in Chinese patients after MI.

Design and setting The QIs were developed by a Chinese expert consensus panel during in-person meetings. The five QIs most in need of improvement were selected using a national questionnaire. Finally, the completion rate and feasibility of the QIs were verified in a group of MI survivors at university hospitals in China.

Participants Seventeen professionals participated in the consensus panel, 89 personnel in the field of CR participated in the national questionnaire and 165 MI survivors participated in the practice test.

Results A review of 17 eligible articles generated 26 potential QIs, among which 17 were selected by the consensus panel after careful evaluation. The 17 QIs were divided into two domains: (1) improving participation and adherence and (2) CR process standardisation. Nationwide telephone and WeChat surveys identified the five QIs most in need of improvement. A multicenter practice test (n=165) revealed that the mean performance value of the proposed QIs was 43.9% (9.9%–86.1%) according to patients with post-MI.

Conclusions The consensus panel identified a comprehensive set of QIs for CR in patients with post-MI. A nationwide questionnaire survey was used to identify the QIs that need immediate attention to improve the quality of CR. Although practice tests confirmed the measurability of the proposed QIs in clinical practice, the implementation of the QIs needs to be improved.

Trial registration number This study is part of a study registered in ClinicalTrials.gov (NCT03528382).

Strengths and limitations of this study

► This is the first study proposing immediate improvement in cardiac rehabilitation (CR) quality indicators (QIs) on the basis of the results of a nationwide survey and instituting improvement guidelines for CR in China.

► The completion rate and feasibility of the developed QIs were revealed by a multicenter practice test.

► The composition of the consensus panel may have resulted in bias in the selection of QIs.

► The national questionnaire was not distributed to all regions and CR centres in the country.

infarction (MI) is less than 10%, but up to 20% of patients experience relapse within the first year.[3] A cardiovascular disease report published in 2018 stated that in China, due to the ageing population, the mortality rate of AMI, which is exponentially higher in rural areas, increased from 2002 to 2016.[4] Only 55.9% of Chinese patients return to work within 12 months after AMI.[5] Among the hospitalisation expenses for cardiovascular and cerebrovascular diseases in 2016, AMI accounted for 19.085 billion yuan.[4] Thus, Chinese people with a history of MI represent a substantial healthcare burden.

Cardiac rehabilitation (CR), a comprehensive secondary prevention framework, aims to improve the overall quality of life as well as morbidity and mortality in patients with heart disease.[6 7] CR has a pivotal role along with timely reperfusion strategies and optimised lifestyle and pharmacological therapies in the contemporary approach to patients with post-MI.[8] Previous data, including randomised trials and systematic reviews, have established the positive impact of CR and its significant role in reducing morbidity and mortality in

INTRODUCTION

Acute myocardial infarction (AMI) is highly prevalent globally and a leading cause of mortality and adult disability.[1 2] Currently, the annual mortality rate due to myocardial

patients with post-MI.[9–11] Other known benefits of CR include improvements in exercise capacity and quality of life and positive effects on coronary endothelial function, blood pressure, insulin resistance and inflammatory markers.[12–16] There is a strong association between the number of CR sessions and long-term post-MI outcomes, with different studies reporting the importance of compliance with these programmes with regard to cardiac events.[17 18] Given these data, CR is considered a class I recommendation for patients with post-MI by the American Heart Association, the American College of Cardiology and the European Society of Cardiology.[19 20]

CR programmes are clinically underused, and participation in CR is dismally low worldwide.[21–23] Notably, contemporary data from the EUROASPIRE V registry underscores the notion that many coronary patients have unhealthy lifestyles, namely in regard to smoking, diet and sedentary behaviour.[24] CR is available in only 111/203 (54.7%) countries globally.[25] A report described the rate of CR participation as ranging between 6.6% and 53.5% in the USA.[23] CR was used by only 13.9% of patients hospitalised for AMI and 31.0% of patients after coronary artery bypass graft surgery.[23] A European survey reported that less than half of the patients were advised to attend CR programmes.[22] Only 34% of Canadian patients with the appropriate indications participated in CR.[21] At present, to the best of our knowledge, there are no data on the CR participation rate in China. In addition, adherence to evidence-based CR performance measures is suboptimal in China.[26] Therefore, effective strategies to increase enrolment and adherence to CR are urgently needed.

Quality improvement is characterised by improvements in healthcare and systems of care delivered by individual physicians.[27 28] Quality indicators (QIs) provide direction and specific methods for quality improvement.[29 30] A study involving intensive care unit patients showed that a multifaceted quality improvement intervention improved the adoption of care practices.[31] A multifaceted quality improvement intervention resulted in significant improvements in hospital personnel adherence to evidence-based performance measures evaluating the care of patients with acute ischaemic stroke.[32] The European Association of Preventive Cardiology (EAPC) has defined minimal and optimal cardiovascular rehabilitation standards to increase the quality of cardiovascular rehabilitation programmes.[33] In addition, many countries, such as the USA, Japan and Canada, have developed QIs for improving CR, but QIs are lacking in China. Implementation of QIs can increase long-term participation and adherence by patients with post-MI. For example, a 2-year study reported a significant increase in enrolment in CR after the implementation of a series of quality improvement interventions, including policy changes, a 7-minute video describing the benefits of CR and incentives.[34] The early utilisation of a cardiac access clinic resulted in an unprecedented (approximately threefold) increase in the number of patients with ST-elevation MI participating

in CR.[35] A randomised controlled trial also revealed that early appointments within 10 days of hospital discharge improved CR attendance compared with standard appointments after 35 days.[36]

CR can play important roles in reducing mortality in patients with MI, improving patient's quality of life and reducing China's healthcare burden.[37–39] CR process standardisation in China needs to be improved.[40] Increasing participation is an important goal for the successful implementation of CR programmes, which could decrease morbidity and mortality due to MI. This study aimed to describe candidate QIs and test their feasibility and applicability to provide a basis for future strategies to improve the CR participation and compliance rates in Chinese patients with post-MI.

METHODS
QI development
Databases including PubMed, CINAHL EBSCO and EMBASE were searched for eligible articles published through August 2018 using the keywords cardiac rehabilitation, quality indicator and myocardial infarction; Medical Subject Headings (MeSH) terms and Emtree headings. Two authors (XZ and MaoZ) conducted the literature review by first reading titles and abstracts and then reading the full text of potential articles. Articles from the search results were included if the following conditions were met: (1) the study provided QIs for CR and (2) the study was published in English. The compiled QIs were further divided into two domains: improving CR participation and adherence rates and standardising CR processes. Any disagreement about study inclusion was resolved by a third author (JWu).

Consensus panel
The consensus panel consisted of 17 individuals, with a maximum of 2 individuals from each CR centre. Members were selected on meeting the following criteria: (1) the individual had at least 1 year of experience in CR; (2) the individual held a position as a leader of a regional CR programme; (3) the individual was committed to the advancement of CR and (4) the individual agreed to participate in an in-person meeting to discuss CR quality improvement. Two authors (XZ and YZheng) assessed the qualifications of the members, and disagreements were resolved by consensus or a third author (JWu). Members were responsible for scoring the collected QIs based on their experience and determining the final QIs for CR in patients with post-MI.

Scoring method and selection criteria
The candidate QIs generated from the literature were scored on a 10-point scale. Scoring criteria were based on four aspects: whether they were evidence based, the feasibility of implementation, their validity and reliability. The QIs were judged according to the clinical experience of the consensus panel. The four criteria were used to

generate one score. QIs that received scores ≥7 and were considered to be significant in the improvement of CR were included in the study. QIs with <7 but >5 points were not considered in this study, and QIs with <5 points were excluded. A QI was considered acceptable for improving the quality of CR in Chinese patients with post-MI based on its average score.

National questionnaire

A questionnaire-based survey was conducted nationwide by either telephone or WeChat (a communication tool in China). Participants included cardiologists, nurses, physical therapists, clinical psychologists, registered dietitians and follow-up staff caring for patients with CR (health managers who follow-up patients via telephone, etc) who met the following criteria: (1) working in an established CR centre and (2) at least 1 year of experience in CR. JWu and YZhang conducted a questionnaire-based survey with the participants. The participants were asked to select 3 out of 26 candidate QIs that they felt required urgent improvement to allow the selection of the top 5 QIs that required immediate improvement in China. The top five most important QIs were determined based on the frequency selected by the participants. Additionally, participants could suggest new QIs outside of those mentioned in the questionnaire.

Practice test

A practice test was performed to review the adaptability of each QI before implementation due to differences in healthcare systems and social circumstances, such as the size of the CR centre and patient education, to assess the completion rate of the proposed QIs selected by the consensus panel. The patient inclusion criteria were as follows: (1) a history of AMI; (2) completion of phase I and II CR at one of the five teaching hospitals (Beijing Tsinghua Changgung Hospital, the Second Hospital of Jilin University, Tianjin Chest Hospital and The Affiliated Hospital of Qingdao University and the Second Affiliated Hospital of Harbin Medical University) between 3 September 2018 and 31 October 2019 and (3) consent to participate in the study. Patients filled out a 17-question questionnaire (online supplemental table S1) about the proposed QIs that was developed specifically for this study and evaluated whether the CR centre implemented the proposed QIs. The patients did not answer if they were unsure or did not understand the question. In addition, the consensus panel unanimously agreed that a score greater than 70% was considered good performance, whereas a score less than 30% was considered a poor performance. The questionnaire was approved by the ethics committees of the five teaching hospitals.

Patient and public involvement

Patients and the public were not involved in the design of the study.

Data collection and analysis

Two authors (XZ and YZheng) were responsible for data collection and cross-checking. The mean score of each QI was calculated as the sum of all participants' ratings/number of participants. The percentage score for each QI was calculated as follows: the number of times the QI was achieved/the number of participants (excluding participants who did not answer)×100. The mean performance was the average of the percentages of all QIs.

RESULTS

Collection of QIs

A review of the literature identified 203 articles, and after screening the titles and abstracts, 176 were excluded, as they were not related to QIs for CR. After the full-text screening, 17 articles were eligible and subsequently included.[34 36 41–55] A list of 26 potential QIs, including 16 regarding the improvement of the CR participation and adherence rates and 10 regarding the standardisation of the CR processes, was generated (online supplemental table S2). A flowchart of the literature search and selection of eligible articles is shown in online supplemental figure S2.

The consensus panel and proposal of QIs of CR in patients with post-MI

The consensus panel included 17 experts in the field of CR from 12 CR centres (online supplemental table S3). Seventeen experts who met the inclusion criteria were cardiologists and individually rated each QI on a 10-point scale. The rating of each QI is shown in online supplemental figures S2 and S3. After careful evaluation, only QIs with an average score ≥7 that could potentially improve the quality of CR in China were accepted (figure 1). Finally, a total of 17 QIs were selected and divided into two domains: (1) improving participation and adherence and (2) standardising CR processes (table 1). There were two more supplementary indicators: extending the hospital rehabilitation time and strengthening the application of traditional Chinese sports.
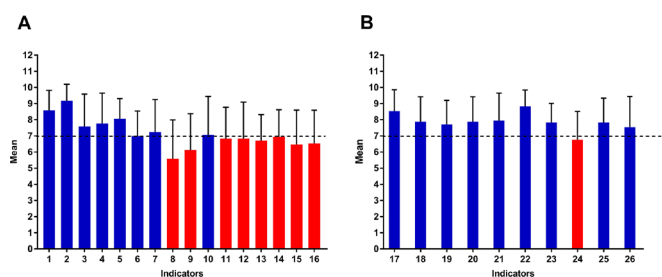

Figure 1 Mean of all the indicators identified by the consensus panel. (A) The mean of domain 1: improving CR participation and adherence. (B) The mean of domain 2: CR process standardisation. CR, cardiac rehabilitation.

Table 1 The proposed quality indicators and percentage scores for CR of patients with myocardial infarction

Quality indicators	Numerator/denominator	Performance %
Domain 1: Improving CR participation and adherence		
QI-1: Recommending CR in discharge guidance	142/165	86.1
QI-2: Automatically referring all eligible patients at the time of discharge	56/163	34.4
QI-3: Employing full-time staff for educating patients about CR	72/162	44.4
QI-4: Providing patients with written invitations and programme brochures	49/165	29.7
QI-5: Employing liaison staff for CR	51/161	31.7
QI-6: Immediate enrolment in CR for referral patients	31/164	18.9
QI-7: Enrolment in CR before discharge	67/162	41.4
QI-10: Frequency of CR enrolment and recommendation as indicators for assessing doctor performance	28/153	18.3
Domain 2: CR process standardisation		
QI-17: Assessment and education of patients regarding coronary disease risk factors	79/165	47.9
QI-18: Communication between referral physician and patient about CR	95/157	60.5
QI-19: Assessment and education of patients about dietary habits	81/165	49.1
QI-20: Assessment and treatment of psychological issues	85/165	51.5
QI-21: Assessment of and education of patients about tobacco and alcohol consumption	119/165	72.1
QI-22: Prescribing exercise based on an assessment of physical fitness	86/165	52.1
QI-23: Reassessment of exercise capacity	71/165	43
QI-25: Education about the importance of adherence to prescribed medication	91/165	55.2
QI-26: Holding multidisciplinary meetings	16/162	9.9

These are the QIs with a rating ≥7, with the same numbers as those in online supplemental table S2.
CR, cardiac rehabilitation.

National questionnaire and top five QIs for imminent improvement

A total of 89 professionals met the national survey participation criteria; among them, 60 people participated in a telephone survey, and 29 people participated in a WeChat survey. The survey response rate was 100%. The 89 participants from 4 municipalities and 18 provinces in China included 21 cardiologists, 15 nurses, 18 physical therapists, 11 clinical psychologists, 13 registered dietitians and 11 health follow-up staff. Each participant selected three QIs considered critical to improve post-MI CR in China (figures 2 and 3). The results showed that the five most important QIs were 'automatically referring all eligible patients at the time of discharge', 'recommending CR in discharge guidance', 'prescribing exercise based on an assessment of physical fitness', 'employing full-time staff for educating patients about CR' and 'assessment and education of patients regarding coronary disease risk factors' (table 2), with score ratios of 47.2%, 38.2%, 28.1%, 25.8% and 19.1%, respectively.

Practice test

The practice test was completed by 165 patients who met the inclusion criteria, and no patients refused to participate in the study (30 patients from Beijing Tsinghua Changgung Hospital, 30 patients from the Second Hospital of Jilin University, 34 patients from Tianjin Chest Hospital, 30 patients from The Affiliated Hospital of Qingdao University and 41 patients from the Second Affiliated Hospital of Harbin Medical University). The
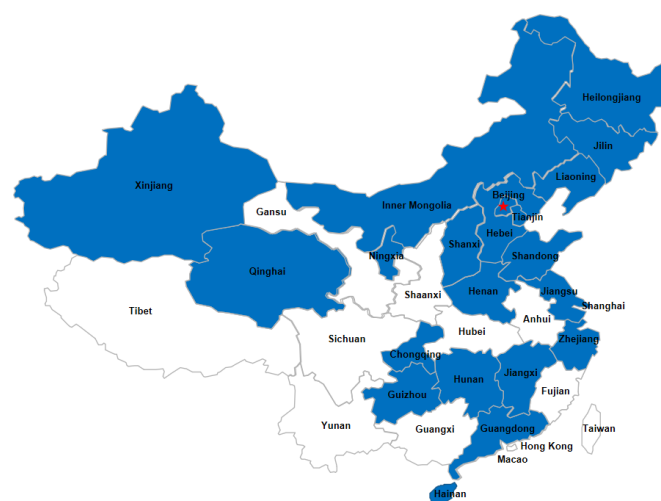

Figure 2 Regional distributions of the national questionnaire. Blue represents the areas surveyed, while white represents areas not surveyed.

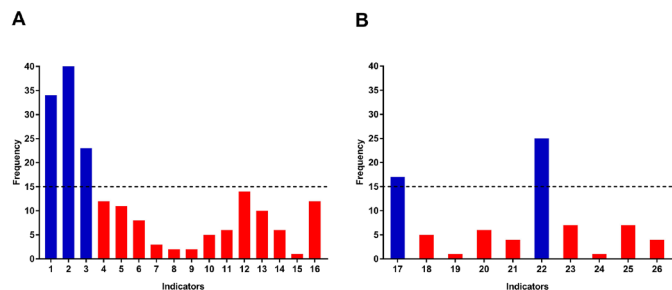Zheng X, *et al. BMJ Open* 2020;**10**:e039757. doi:10.1136/bmjopen-2020-039757

Figure 3 Quality indicators from the national questionnaires that were identified as needing immediate improvement (blue). (A) Domain 1: improving CR participation and adherence. (B) Domain 2: CR process standardization.

results revealed a mean performance value of 43.9% (9.9%–86.1%). The QIs that achieved good performance (minimum–maximum: 72.1%–86.1%) were 'assessment and education of patients on tobacco and alcohol consumption' and 'recommending CR in discharge guidance'. There were also several low-performing QIs (minimum–maximum: 9.9%–29.7%), including 'holding multidisciplinary meetings, 'frequency of CR registration and recommendation as QIs for assessing doctor performance', 'immediate enrolment in CR for referral patients' and 'providing patients with written invitations and programme brochures' (table 1).

DISCUSSION

In this study, 26 QIs generated from 17 articles were assessed as candidate QIs for CR. Out of the 26 QIs, 17 were selected by a Chinese expert consensus panel and divided into two domains based on participation and adherence and CR process standardisation. The findings of the nationwide questionnaire could guide clinical quality improvement. The practice test showed the feasibility and applicability of all 17 QIs in the Chinese context.

This is, to the best of our knowledge, the first study proposing an immediate improvement in CR QIs on the basis of the results of a nationwide survey and the implementation of improvement guidelines for CR in China. However, although still in its infancy, CR in China has developed rapidly. According to data published by the Chinese Society of Rehabilitation Medicine, the number

of CR centres has increased from 6 in 2012 to more than 500 currently.[56] Hence, the improved implementation of CR programmes is imperative, given the current situation. We consider that QI development is a time-efficient and resource-saving approach.[57] In many countries, CR is strongly associated with quality of life improvement. For example, the USA has effectively implemented QI monitoring to increase the CR participation rate.[41] Similarly, Canada has developed QIs to promote the broad development of CR programmes,[44] and Japan has also proposed QIs to assess improvements in the quality of CR after acute coronary syndrome.[46] Moreover, the EAPC described QIs to assess improvements in the CR process standardisation in Europe.[33] In this study, we propose QIs to promote the improvement of CR in China considering the recommendations reported in these previous studies.

CR is still in the early phase of development in China.[40] Given the uneven distribution of CR programmes, the consensus panel selected QIs to promote improvements in participation and adherence that were simple, practical and in line with the current status of CR in the country. For example, the present report suggests that 'recommending CR in discharge guidance' was key in emphasising the importance and necessity of CR, and 'automatically referring all eligible patients 'at the time of discharge' was one of the best ways to increase participation in CR. Other suitable QIs were 'employing full-time staff for educating patients about CR' and 'employing CR liaison staff'. In addition, the study revealed QIs that are necessary for CR process standardisation in China, such as 'assessment and education of patients regarding coronary disease risk factors', 'assessment and education of patients about dietary habits' and 'prescribing exercise based on physical fitness'. It is worth mentioning that the completion rate of 'holding multidisciplinary meetings' was very low in the practice test, but the implementation of this QI can improve recovery in patients with multiple diseases.[29 58 59] Moreover, measuring the completion rate of the proposed QIs is important.[60–62] There are some measurement methods. First, QIs should be recorded in the medical record. In this way, the completion of the QIs can be checked. Second, from the perspective of patients, a questionnaire about the implementation of QIs was conducted at discharge. Relevant medical staff should be evaluated by self-assessment and other assessment

Table 2	Top five quality indicators that need improvement		
Indicators		**Numerator/ denominator**	**Importance (%)**
Top 1: Automatically referring all eligible patients at the time of discharge		42/89	47.2
Top 2: Recommending CR in discharge guidance		34/89	38.2
Top 3: Prescribing exercise based on an assessment of physical fitness		25/89	28.1
Top 4: Employing full-time staff for educating patients about CR		23/89	25.8
Top 5: Assessment and education of patients regarding coronary disease risk factors		17/89	19.1

CR, cardiac rehabilitation.

scales. In addition, clinical audits, a method of establishing whether healthcare is being provided in line with the relevant standards and identifying areas for improvements, should be performed.[63] CR programmes could be improved by continuous assessment.[64]

It is also important to understand the barriers to appropriate CR, including lack of health awareness, inadequate policies, insufficiency of CR, lack of healthcare system support and inadequate professional guidelines and information systems.[65–67] Balady et al reported that older females with low socioeconomic status, with a low education level, with poor self-efficacy, with multiple comorbidities and without the ability to communicate in English were more likely to not participate in CR.[48] Enrolment in the CR programme is affected by many healthcare system-related factors, including lack of referral, limited facilitation of enrolment after referral, lack of programmes that serve specific geographic areas and low-income communities and gender-dominated programmes.[68] In this study, we proposed QIs that could aid in overcoming some of these barriers and also in the successful implementation of CR.

During the course of the study, two additional supplementary indicators, 'extending the hospital rehabilitation time' and 'strengthening the application of traditional Chinese exercise', were added. Tai Chi Chuan practice was associated with a VO_2 peak increase in patients with MI.[69] Baduanjin exercise therapy in patients with post-MI reduced adverse left ventricular (LV) remodelling and was associated with beneficial effects in terms of inflammation and extracellular matrix organisation.[70 71] Baduanjin sequential therapy also appeared to improve the quality of life in patients with AMI after percutaneous coronary intervention, with additional benefits of reducing the abdominal circumference and body mass index and improving the level of cardiac function.[72] Therefore, traditional Chinese exercises, such as Tai Chi Chuan and Baduanjin, may constitute effective forms of CR in patients with MI.

In summary, the application of these QIs could help standardise and improve the quality of CR in China. This study provides guidance for the development of CR in our country. Nevertheless, further studies are needed to evaluate the validity, reliability and feasibility of these QIs and to determine whether improvements in these parameters are associated with clinical benefits in this patient population.

STUDY LIMITATIONS

There are many limitations of our study. First, in the QI development section of the methods, we retrieved the literature from public databases; hence, there is a possibility of publication bias. Second, investigation bias may exist because the consensus panel participants were all cardiologists and the national questionnaire was not distributed to all regions and CR centres in the country. The baseline characteristics were not collected

for the professionals in the national questionnaire, and no specific calculation was performed to determine the sample size needed for the national questionnaire. These factors may also lead to bias in the results of the practice test due to the absence of data from non-teaching hospitals, the relatively small sample size and the lack of data concerning baseline characteristics of the patients (ie, sex, age, marital status, cardiovascular risk factors, prior history of MI, ST-segment or non-ST-segment elevation MI, LV ejection fraction, percutaneous coronary intervention, coronary artery bypass grafting, medication, etc). Moreover, to assess the measurability and completeness of the proposed QIs, only patients who participated in CR programmes were selected to complete the practice test. As such, data from those who did not participate in these programmes were not available.

CONCLUSION

In this study, a consensus panel identified 17 candidate QIs to assess improvements in the quality of CR in patients with post-MI in China. A nationwide survey revealed the five QIs that required imminent improvement to facilitate increased enrolment in CR programmes in the country. Moreover, a practice test administered to MI survivors confirmed the feasibility and completeness of the developed QIs. The application of the proposed QIs could improve the quality of CR care in Chinese patients with post-MI.

Author affiliations
¹Department of Cardiology, the Second Affiliated Hospital of Harbin Medical University, Harbin, Heilongjiang Province, China
²The Key Laboratory of Myocardial Ischemia, Harbin Medical University, Ministry of Education, Harbin, Heilongjiang Province, China
³Department of Cardiology, the Second Hospital of Jilin University, Changchun, Jilin Province, China
⁴Department of Cardiology, Beijing Tsinghua Changgung Hospital, Beijing, China
⁵Department of Cardiology, Tianjin Chest Hospital, Tianjin, China
⁶Department of Cardiology, Affiliated Hospital of Qingdao University, Qingdao, Shandong Province, China
⁷Department of Cardiology, Peking University People's Hospital, Beijing, China
⁸Department of Cardiology, Inner Mongolia People's Hospital, Huhhot, Inner Mongolia, China

ORCID iDs
Junnan Wang http://orcid.org/0000-0003-1788-989X
Jian Wu http://orcid.org/0000-0002-1192-321X

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