Journal of Zhejiang University-SCIENCE B (Biomedicine & Biotechnology)
ISSN 1673-1581 (Print); ISSN 1862-1783 (Online)
www.zju.edu.cn/jzus; www.springerlink.com
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Influence of education and working background on physicians' knowledge of secondary prevention guidelines for coronary heart disease: results from a survey in China*

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Received Sept. 20, 2011; Revision accepted Jan. 18, 2012; Crosschecked Feb. 10, 2012

Abstract: Background and objective: In clinical practice, the standard of secondary prevention for coronary heart disease (CHD) is quite disappointing in China. The physicians' shortage of knowledge of secondary prevention guidelines is thought to be a key factor contributing to the inadequate and delayed translation of guidelines into clinical practice. The purpose of this study is to investigate the influence of physicians' characteristics, including their education and work experience, on their knowledge of secondary prevention in China. Methods: A representative questionnaire survey was made of physicians from cardiology departments in 35 tertiary hospitals in China. The survey contained 19 questions on knowledge of guideline recommendations for the secondary prevention of CHD. We collected basic information about the physicians, including their educational degree, clinical practice duration/work experience and geographic region. Results: In total, 864 physicians participated in the survey. Eight hundred and thirty-seven completed questionnaires were analyzed. For 6 of the 19 questions, physicians with a postgraduate degree were more likely to answer correctly than those without such a degree. For 11 of the 19 questions, physicians with more than three years' clinical experience were more likely to answer correctly than those who had less than three years' experience. For 5 of the 19 questions, physicians from eastern areas were more likely to answer correctly than those from mid/western areas. The mean total score of correct answers to the questionnaire was 11.69 points. Educational degree and clinical practice duration affected total scores significantly while practice location did not (β=0.500, P=0.004; β=0.979, P=0.000; and β=0.228, P=0.162, respectively). Even if a relatively low score of 12 is taken as a threshold level of acceptable knowledge (defined as a pass), the pass rate of all physicians was only 53.9%. Educational degree and clinical practice duration affected pass rate significantly while practice location did not (95% CI: 1.222–2.248, P=0.001; 95% CI: 1.773–3.140, P=0.000; and 95% CI: 0.993–1.758, P=0.056, respectively). Conclusions: Physicians with a clinical practice duration of more than three years knew more about secondary prevention guidelines than those with less experience. Physicians with a postgraduate degree knew more about secondary prevention guidelines than those without a postgraduate degree. However, overall knowledge of secondary prevention guidelines for CHD was poor among this group of physicians from tertiary hospitals.

Key words: Coronary heart disease, Secondary prevention, Guidelines, Survey
doi:10.1631/jzus.B1100299 **Document code:** A **CLC number:** R541.4

1 Introduction

Coronary heart disease (CHD) is the product of multiple risk factors, such as dyslipidemia, high blood pressure, smoking, diabetes, and obesity. As almost all of these risk factors are modifiable, it is believed

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* Project (No. 2006BAI01A02) supported by the 11th 5-Year National Key Technologies R&D Program for Coronary Heart Disease (CHD) from the Ministry of Science and Technology of China

that most CHD is preventable. Numerous studies have confirmed the benefits of secondary prevention, but in clinical practice, the standard of risk factor management is quite disappointing in China (Liu *et al*., 2008; Niu *et al*., 2009).

A shortage of knowledge among physicians is one of the most important reasons for the inadequate and delayed translation of guidelines into clinical practice. It is unknown whether the physicians' specific characteristics, including their education and work experience, affect the status of their knowledge about the clinical guidelines. The objective of this survey was to explore the physicians' knowledge of secondary prevention guidelines for CHD and to try to identify the underlying factors influencing their levels of knowledge.

2 Subjects and methods

2.1 Study population

During 2007, we conducted a cross-sectional questionnaire survey in 35 tertiary hospitals in China. These hospitals are a part of a research network established for the 11th 5-Year National Key Technologies R&D Program for CHD of China. All the hospitals are located in urban areas of central cities in different provinces. All attending physicians and residents of the cardiology departments in these hospitals (1 004 in total) were invited to participate in the questionnaire. They were front-line physicians, involved in direct patient care in the cardiology departments of these hospitals.

2.2 Survey design

The survey was a self-administered questionnaire conducted anonymously. Physicians were not reimbursed for their time in completing the survey. No specific training was provided before completion of the questionnaire.

Basic information about each hospital (its official class, whether it is a teaching hospital, and its geographic location) and each physician (educational degree and duration of clinical practice experience) was collected. The physicians' knowledge of secondary prevention guidelines for CHD was tested by their responses to 19 questions focusing on cardiovascular risk factor control (4 single-choice questions and 1 multiple-choice question), lifestyle modification (3 single-choice questions and 2 multiple-choice questions), and medication (7 single-choice questions and 2 multiple-choice questions). Questions and responses are listed in Table 1. Correct answers were based mainly on the contemporary American Heart Association (AHA)/American College of Cardiology (ACC) guidelines for secondary prevention for patients with coronary and atherosclerotic vascular disease 2006 (Smith *et al*., 2006). Before the formal start of the survey, we performed a pilot study to verify the validity of the questionnaire. Based on the responses, some unclear questions were modified. Hospital locations were divided into eastern and mid/western areas based mainly on the economic status of the areas, with those classed as eastern having a relatively high economic level.

2.3 Data analysis

Correct response rates sorted by the physicians' characteristics (educational degree, clinical practice duration, and geographic location) were calculated for each question. Data were expressed as percentages. Chi-square statistics were used to compare the correct response rate for each question between physicians with different characteristics.

A single point was given for each correct answer to the questionnaire. Data on average total scores, and scores for each of the three sets (cardiovascular risk factor control, lifestyle modification, and medication) in relation to the physicians' characteristics were described by mean±standard deviation (SD). An independent t test was used to assess the significance of differences. Multivariate linear regression analysis was performed with the score as the dependent variable, and educational degree, clinical practice duration, and geographic location as the independent variables. Guideline knowledge was defined as a "pass" if 12 (an arbitrary cutoff) out of 19 questions were answered correctly. This cutoff represents a correct response rate to >60% of the questions and has also been used as an index of adequate knowledge in other surveys (Hagemeister *et al*., 2001; Cuspidi *et al*., 2003). Chi-square tests were used to compare the pass

Table 1 Questions and responses in the questionnaire

No.	Question	Type	Response	Correct answer
Cardiovascular risk factor control				
Q1	Treatment target of hypertension in common population is __ mmHg?	S	A: 160/90; B: 140/90; C: 120/80; D: 140/80	B
Q2	In patients with coronary heart disease, life style modification should be started at LDL-C level of __mmol/L, drug therapy should be started at LDL-C level of __mmol/L, target of LDL-C level is __mmol/L.	S	A: 110, 130, 110; B: 110, 110, 110; C: 100, 100, 100; D: 100, 130, 100; E: 100, 110, 100	C
Q3	In coronary disease patients with diabetes mellitus, treatment target of HbA1c is __%.	S	A: 4; B: 6; C: 7; D: 8	C
Q4	In which of the following populations should we target the blood pressure at 130/80 mmHg?	M	A: coronary disease; B: diabetic mellitus; C: hemorrhagic stroke; D: ischemic stroke; E: chronic renal disease	BE
Q5	In patients with acute coronary events, evaluation of lipid profile should be done within __h after admission to hospital.	S	A: 6; B: 12; C: 24; D: 48	C
Life style modification				
Q6	Target for body weight control in coronary disease patients is: BMI<__kg/m^2, male waistline <__cm, woman waistline <__cm.	S	A: 25, 90, 80; B: 28, 102, 88; C[#]: 25, 102, 88; D: 28, 90, 80	A
Q7	Target populations for diet therapy are __.	M	A: CHD patients with obese; B: CHD patients with hyperlipidemia; C: all patients with atherosclerotic diseases; D: CHD patients with diabetes mellitus	either C or ABCD
Q8	Patients with coronary diseases should have aerobic exercise for at least __ times per week and __min each time.	S	A: 3, 10; B: 5, 30; C: 3, 30; D: 5, 10	B
Q9	Patients with coronary diseases should limit their intake of __.	M	A: total calorie; B: saturated fatty acids; C: unsaturated fatty acids; D: cholesterol; E: trans-fatty acids	ABDE
Q10	Cholesterol intake in patients with coronary heart disease should not exceed __mg/d.	S	A: 500; B: 100; C: 200; D: 300; E: 400	C
Medications				
Q11	Should all patients with coronary heart disease take aspirin for secondary prevention if they have no contraindication?	S	A: yes; B: no	A
Q12	We should use __ to control LDL-C in coronary disease patients.	S	A: statins; B: fibrates; C: niacin; D: herbs	A
Q13	Should all patients with myocardial infarction take ACEI for secondary prevention if they have no contraindication?	S	A: yes; B: no	A
Q14	Should all patients with the history of myocardial infarction and no symptom of heart failure take β-bloker?	S	A: yes; B: no	A
Q15	In patients with stable coronary disease, the recommended dose of aspirin is __mg/d.	S	A: 25–50; B: 50–75; C: 75–150; D: 300–500	C
Q16	In patients with coronary disease who should take clopidogrel, the recommended dose is __mg/d.	S	A: 37.5; B: 75; C: 150; D: 300	B
Q17	Which groups of coronary disease patients should use ACE inhibitor?	M	A: diabetic mellitus; B: chronic renal disease; C: heart failure; D: myocardial infarction; E: all CHD patients without contraindication	Either C or ABCD
Q18	Indications for dual anti-platelet therapy with aspirin and clopidogrel in coronary disease patients are __.	M	A: stable angina; B: acute coronary syndrome; C: post CABG; D: post PCI; E: ventricular thrombosis	BD
Q19	Recommended duration of dual anti-platelet therapy post acute coronary syndrome is __ months.	S	A: 1; B: 3; C: 6; D: 12; E: 24	D

[#] Correct response according to ACC/AHA guidelines. The Chinese and US guidelines differ in regard to waistline targets, and this response is the suggestion in the US guideline. We used the Chinese target as the correct response here. S: single; M: multiple; LDL-C: low density lipoprotein-cholesterol; BMI: body mass index; ACEI: angiotensin converting enzyme inhibitor; CHD: coronary heart disease; CABG: coronary artery bypass grafting; PCI: percutaneous coronary intervention

rates between physicians with different characteristics. Logistic regression analysis was performed with "pass" as the dependent variable, and educational degree, clinical practice duration, and geographic location as the independent variables.

A two-sided $P<0.05$ was considered statistically significant. All statistical analyses were carried out using the SPSS 17.0 statistical package.

3 Results

In total, 864 physicians participated in the survey, representing 86.0% of all attending physicians and residents in the cardiology departments of the 35 hospitals. Twenty-seven physicians were excluded because their questionnaires were not completed. Thus, 837 completed questionnaires were analyzed.

3.1 Characteristics of the physicians

Among the respondent physicians, 554 (66.2%) had a postgraduate medical education degree, and 403 (48.1%) had been practicing clinical cardiology for more than three years. Four hundred and fourteen (49.5%) were from eastern areas and 423 (50.5%) were from mid/western areas.

3.2 Differences among groups in the rate of correct response to each question

Table 2 shows the percentage of physicians who answered the questions correctly sorted by medical educational degree, clinical practice duration, and geographic location.

Physicians with a postgraduate degree were more likely to answer the following six questions correctly than those without a postgraduate degree: Q1 (83.8% vs. 74.9%, P=0.002), Q4 (40.6% vs. 33.2%, P=0.037), Q7 (71.7% vs. 60.8%, P=0.001), Q13 (94.6% vs. 90.1%, P=0.016), Q15 (96.2% vs. 91.2%, P=0.002), and Q17 (58.8% vs. 47.7%, P=0.002).

Physicians with more than three years in clinical practice were more likely to correctly answer the following 11 questions than those with less experience: Q2 (13.6% vs. 8.1%, P=0.009), Q3 (40.4% vs. 32.3%, P=0.014), Q4 (43.2% vs. 33.4%, P=0.004), Q5 (63.8% vs. 51.2%, P=0.000), Q7 (72.7% vs. 63.6%, P=0.005), Q8 (41.9% vs. 31.8%, P=0.002), Q10 (40.7% vs. 33.2%, P=0.024), Q13 (95.0% vs. 91.2%, P=0.031), Q14 (97.8% vs. 95.2%, P=0.043), Q15 (97.3% vs. 91.9%, P=0.001), and Q18 (40.4% vs. 30.9%, P=0.004).

Physicians from eastern areas were more likely to answer the following five questions correctly than those from mid/western areas: Q3 (39.6% vs. 32.9%, P=0.042), Q4 (44.2% vs. 32.2%, P=0.000), Q7 (72.5% vs. 63.6%, P=0.006), Q17 (60.1% vs. 50.1%, P=0.004), and Q18 (39.4% vs. 31.7%, P=0.020).

3.3 Associations between physicians' characteristics and their questionnaire responses

The mean total score of correct answers to the questionnaire was 11.69 points. Physicians with a postgraduate degree, working more than three years, or working in eastern areas scored more highly than those without these characteristics. When the questions were separated into three sets, the same trend remained in the cardiovascular risk factor control set and medication set, but in the lifestyle modification set, only the duration of clinical practice gave a significant result, with physicians who had worked for more than three years achieving significantly higher scores than those with less experience (Table 3). Multivariate linear regression showed that only educational degree and the duration of clinical practice affected total scores significantly (Table 4).

3.4 Associations between physicians' characteristics and pass rates of the questionnaire

Even if the relatively low score of 12 is taken as a threshold level of acceptable knowledge (defined as a pass), analysis of the questionnaire showed that only 53.9% of the physicians had an acceptable knowledge of the secondary prevention guidelines. Physicians with a postgraduate degree had higher pass rates than those without such a degree (57.9% vs. 47.0%, P=0.003). Physicians with three or more years' work experience had higher pass rates than those with less experience (64.5% vs. 44.7%, P=0.000). Physicians working in eastern areas achieved higher pass rates than those working in mid/western areas (59.4% vs. 49.2%, P=0.003). Logistic regression showed that educational degree and duration of clinical practice had a significant effect on pass rates while practice location did not (Table 5).

Table 2 Differences in knowledge of secondary prevention guidelines among groups of physicians with different characteristics

No.	Number of physicians correctly answer to each question					
	Postgraduate degree (n=554)	No postgraduate degree (n=283)	Working duration ≥3 years (n=403)	Working duration <3 years (n=434)	Eastern location (n=414)	Mid/western location (n=423)
Q1	464 (83.8%)	212 (74.9%)*	319 (79.2%)	357 (82.3%)	340 (82.1%)	336 (79.4%)
Q2	62 (11.2%)	28 (9.9%)	55 (13.6%)	35 (8.1%)*	47 (11.4%)	43 (10.2%)
Q3	209 (37.7%)	94 (33.2%)	163 (40.4%)	140 (32.3%)*	164 (39.6%)	139 (32.9%)*
Q4	225 (40.6%)	94 (33.2%)*	174 (43.2%)	145 (33.4%)*	183 (44.2%)	136 (32.2%)*
Q5	309 (55.8%)	170 (60.1%)	257 (63.8%)	222 (51.2%)*	228 (55.1%)	251 (59.3%)
Q6	336 (60.6%)	187 (66.1%)	261 (64.8%)	262 (60.4%)	260 (62.8%)	263 (62.2%)
Q7	397 (71.7%)	172 (60.8%)*	293 (72.7%)	276 (63.6%)*	300 (72.5%)	269 (63.6%)*
Q8	199 (35.9%)	108 (38.2%)	169 (41.9%)	138 (31.8%)*	151 (36.5%)	156 (36.9%)
Q9	77 (13.9%)	48 (17.0%)	63 (15.6%)	62 (14.3%)	70 (16.9%)	55 (13.0%)
Q10	189 (34.1%)	119 (42.0%)*	164 (40.7%)	144 (33.2%)*	123 (29.7%)	185 (43.7%)*
Q11	532 (96.0%)	272 (96.1%)	391 (97.0%)	413 (95.2%)	396 (95.7%)	408 (96.5%)
Q12	542 (97.8%)	271 (95.8%)	392 (97.3%)	421 (97.0%)	400 (96.6%)	413 (97.6%)
Q13	524 (94.6%)	255 (90.1%)*	383 (95.0%)	396 (91.2%)*	385 (93.0%)	394 (93.1%)
Q14	538 (97.1%)	269 (95.1%)	394 (97.8%)	413 (95.2%)*	400 (96.6%)	407 (96.2%)
Q15	533 (96.2%)	258 (91.2%)*	392 (97.3%)	399 (91.9%)*	397 (95.9%)	394 (93.1%)
Q16	540 (97.5%)	270 (95.4%)	393 (97.5%)	417 (96.1%)	401 (96.9%)	409 (96.7%)
Q17	326 (58.8%)	135 (47.7%)*	229 (56.8%)	232 (53.5%)	249 (60.1%)	212 (50.1%)*
Q18	200 (36.1%)	97 (34.3%)	163 (40.4%)	134 (30.9%)*	163 (39.4%)	134 (31.7%)*
Q19	358 (64.6%)	168 (59.4%)	255 (63.3%)	271 (62.4%)	266 (64.3%)	260 (61.5%)

* Statistically significant differences between groups at $P<0.05$, using χ^2 test

Table 3 Association between physicians' characteristics and their questionnaire scores

Characteristics of physicians	Score*			
	Total	Cardiovascular risk factor control set	Lifestyle modification set	Medication set
Educational degree				
Postgraduate	11.84±2.319	2.29±1.096	2.16±1.121	7.39±1.270
Bachelor	11.40±2.438	2.11±1.089	2.24±1.126	7.05±1.499
P value	0.011	0.027	0.343	0.001
Clinical education duration				
≥3 years	12.18±2.277	2.40±1.156	2.36±1.093	7.42±1.204
<3 years	11.24±2.361	2.07±1.014	2.03±1.129	7.13±1.478
P value	0.000	0.000	0.000	0.002
Practice region				
Eastern	11.89±2.503	2.32±1.129	2.18±1.111	7.38±1.433
Mid/western	11.50±2.212	2.14±1.056	2.19±1.135	7.18±1.277
P value	0.016	0.015	0.895	0.020

* Data are expressed as mean±SD

Table 4 Multivariate linear regression analysis of the influence of physicians' characteristics on total scores

Physicians' characteristics	β coefficient	t	P value
Postgraduate degree	0.500	2.892	0.004
Clinical practice duration ≥3 years	0.979	6.071	0.000
Eastern region	0.228	1.399	0.162

Table 5 Logistic regression analysis of the influence of physicians' characteristics on pass rates

Physicians' characteristics	OR	95% CI	P value
Postgraduate degree	1.658	1.222–2.248	0.001
Clinical practice duration ≥3 years	2.360	1.773–3.140	0.000
Eastern region	1.321	0.993–1.758	0.056

4 Discussion

Cardiovascular disease (CVD) is the leading cause of death in China and most other countries (National Center for Cardiovascular Diseases, 2009; Roger *et al*., 2011). Among those who die of CVD, 72.3% have a history of CVD (Wang *et al*., 2000). It is very important to prevent the recurrence of cardiovascular events. Incontrovertible scientific evidence shows that CHD secondary prevention is markedly effective in reducing cardiovascular events, so appropriate prevention strategies are included in guidelines (Smith *et al*., 2006). However, the implementation of guidelines in clinical practice is unsatisfactory. Both in developed and developing countries, the status of guidelines-guided clinical practice is poor (Marques-Vidal and Tuomilehto, 1997; Burnier, 2002; Fox *et al*., 2002; McGlynn *et al*., 2003; Sharma *et al*., 2009) and limited data suggest that this is also the case in China (Jiang *et al*., 2002; Zhao *et al*., 2007; Liu *et al*., 2008; Niu *et al*., 2009). This unsatisfactory situation has multiple causes. There are a variety of barriers to guideline adherence. Cabana *et al*. (1999) divided these barriers into three categories: knowledge, attitude, and behavior, within which physicians' behavior and patients' compliance have received particular attention. Obviously, the physicians' knowledge of the guidelines affects their behavior. However, their knowledge of guidelines on CHD secondary prevention has never been fully investigated, especially in China. So we planned a questionnaire-based survey in China.

We assessed knowledge of recommendations about CHD secondary prevention in a clinical cardiology practice setting, using the AHA/ACC guidelines for secondary prevention for patients with coronary and atherosclerotic vascular disease 2006 as a reference. In this nationwide survey, a total of 837 physicians from tertiary hospitals participated in the questionnaire. The number of answers in agreement with the guidelines was used as an awareness measure. It was considered acceptable (pass) if correct answers to 12 out of 19 questions were provided. The mean score of correct answers was 11.69 points and only 53.9% of the study population correctly answered at least 12 of the questions. This means that currently a sufficient degree of guideline knowledge is present in only a minority of cardiology physicians in China.

This survey showed that guideline knowledge was positively related to educational level. This finding is similar to that of another survey on AMI guidelines performed with Chinese physicians (Zhao *et al*., 2007). In China, besides routine clinical practice training, postgraduate education training covers preventive medicine, literature search, review writing, professional knowledge updating, English language, etc. However, only in a few hospitals are these components included in routine continuing medical education (CME). This may explain why physicians with postgraduate degrees had a better knowledge of the guidelines.

We also found in this survey that guideline knowledge was positively related to the duration of the physicians' clinical practice. This finding was in contrast to those of some overseas studies of guideline knowledge. An Italian survey of the awareness of hypertension guidelines found a statistically significant negative relation between physicians' clinical practice duration and guideline knowledge (Cuspidi *et al*., 2003). This disagreement could be explained by differences between the selected participant populations. In the Italian survey, the mean practice duration was 22.8 years, while in our survey only residents and attending physicians were invited to participate, most of whom had less than 10 years of clinical practice experience. Physicians who have worked for more than 20 years are more likely to have formed their own practice habits and may be less likely to accept new opinions. All the physicians in our survey were front-line physicians. They were young and active thinking and receptive to new knowledge. In China, physicians whose practice duration is less than three years are mainly residents. They spend most of their working time on routine clinical work and have fewer opportunities to attend CME courses or meetings. This may partly explain why their guideline knowledge was worse than that of those who had worked for more than three years.

In general, the degree of guideline knowledge on CHD secondary prevention among physicians in China is unsatisfactory. Further efforts are needed to improve the situation. However, what can we do?

Firstly, guidelines must have easy accessibility, but currently this is not so in China. There is no public website for guidelines. In USA, the National Guideline Clearinghouse, NGC (http://www.guideline.gov)

provides a free database of clinical guidelines. Physicians can easily find guidelines of interest on this website. Because of language barriers and other reasons, most Chinese physicians do not use this resource (Zhao *et al*., 2007). A free specialized public website for Chinese clinical guidelines is badly needed. Chinese healthcare decision makers or relevant associations have the responsibility to perform this work. Also, guideline paper editions should be widely distributed to physicians because a large number of Chinese physicians are accustomed to this method of information distribution.

Secondly, we should intensify and reform traditional CME. One study showed that the doctor-patient interaction education pattern was more effective than passive education (Browner *et al*., 1994). Also, use of handheld computers in medical education can improve knowledge of guidelines (Price, 2005; Cricelli, 2006; Kho *et al*., 2006).

Thirdly, in developed countries such as USA and European countries, relevant associations have organized a series of programs to improve guideline adherence. The global registry of acute coronary events (GRACE) study (Fox *et al*., 2002), European action on secondary prevention through intervention to reduce events (EUROASPIRE) study (EUROASPIRE Study Group, 1997), get with the guideline (GWTG) program (LaBresh *et al*., 2004), and the reduction of atherothrombosis for continued health (REACH) study (Wu *et al*., 2002) are well known programs for this purpose and have achieved some satisfactory results. In China we can draw on their experience. The clinic pathway of acute coronary syndrome (CPACS) program is a similar quality of care program in China and we hope that this program can improve the implementation of CHD guidelines. In some developed countries, pay-for-performance initiatives have been implemented to improve guideline adherence. This strategy may be feasible in the future in China.

There were several limitations in our survey. Firstly, the questionnaire was not completed in face-to-face interviews by trained data collectors, and so we cannot exclude collaboration among some physicians. Secondly, it was conducted only in tertiary hospitals in main cities in mostly economically developed areas and therefore it is not representative of all hospitals in China. Previous Chinese studies showed that physicians from tertiary hospitals have a better knowledge of clinical guidelines than those from lower level hospitals (Cheng *et al*., 2002; Zhao *et al*., 2007). It could be that this group of physicians has relatively high levels of knowledge. Thirdly, only residents and attending physicians were invited to participate in this survey and they may not represent physicians who have been practicing for many years. Further research is needed to address the gap between knowledge of the guidelines and their implementation.

Acknowledgements

We are grateful to all physicians who participated in the survey. We would like to thank Ruodong WANG and Gang ZHAO (China Cardiocerebrovascular Diseases, http://www.ccvd.net) for data management.

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