

ERCP practitioners in China: results from national surveys in 2007 and 2013

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Background and study aims: The endoscopist performing endoscopic retrograde cholangiopancreatography (ERCP) has an essential role in the development of that procedure. Given that the practice status and training background of Chinese ERCP practitioners (ERCPists) were largely unknown, two surveys were conducted to determine the status and development of this professional group.

Methods: National surveys were conducted by the Chinese Society of Digestive Endoscopy in 2007 and 2013. Information regarding numbers, demographic characteristics, practice status, and training background of ERCPists was collected.

Results: Total numbers of ERCPists in mainland China increased from 1155 to 3345 (0.88 to 2.47 per million inhabitants) between 2006 and 2012. Regional distribution of ERCPists showed significant imbalance, and the ERCPist – population ra-

tio correlated with gross domestic product per capita (2006, $r=0.871$, $P<0.001$; 2012, $r=0.452$, $P=0.005$). The mean (standard deviation) age of ERCPists decreased from 42.5 (6.1) years to 37.4 (5.4) years; the proportion of female ERCPists increased from 11.1% to 16.8%. In 2006 and 2012, annual ERCP volumes per endoscopist were 55.2 and 58.5, respectively, similar to that in most Western countries. The most common training pathway was participation in a training program in an ERCP center within China (2006, 51.1%; 2012, 73.4%); the proportion of ERCPists with no standard training decreased from 20.8% to 8.0%.

Conclusions: Between 2006 and 2012 in China there has been significant development in ERCP personnel and training. However, the shortage and regional imbalances are still obvious and a higher ERCP volume per endoscopist is needed.

Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) was first introduced in 1968 and has been an effective tool in the diagnosis and treatment of biliary and pancreatic diseases [1,2]. The first ERCP in mainland China was performed in 1973 [3]. After four decades of development, ERCP services have been provided throughout China. However, a national survey showed that only 63 787 ERCP procedures were performed in 2006 in 470 hospitals across mainland China, with an estimated annual ERCP rate of 4.87 per 100 000 inhabitants, which was much lower than those of developed countries [4]. In that survey, shortage of ERCP endoscopists (ERCPists) was suggested to be a main factor restricting the development of the ERCP service. Moreover, in most developed countries, endoscopists intending to perform ERCP are required to undergo a

standardized advanced endoscopic training program to obtain technical competence [5,6], whereas China has no national standard for ERCPists or trainees, and the training pathway of ERCPists is unknown. Therefore, a survey to investigate the status of Chinese ERCPists would be beneficial for development of the ERCP service and the establishment of a standard training program. To address these issues, the Chinese Society of Digestive Endoscopy (CSDE) conducted a national survey of ERCPists in 2007 to determine the number, regional distribution, demographic characteristics, practice status, and training background of Chinese ERCPists. In 2013, the CSDE conducted another survey with a similar design to investigate the development of ERCPists in China.

License terms



* These authors contributed equally to this study.

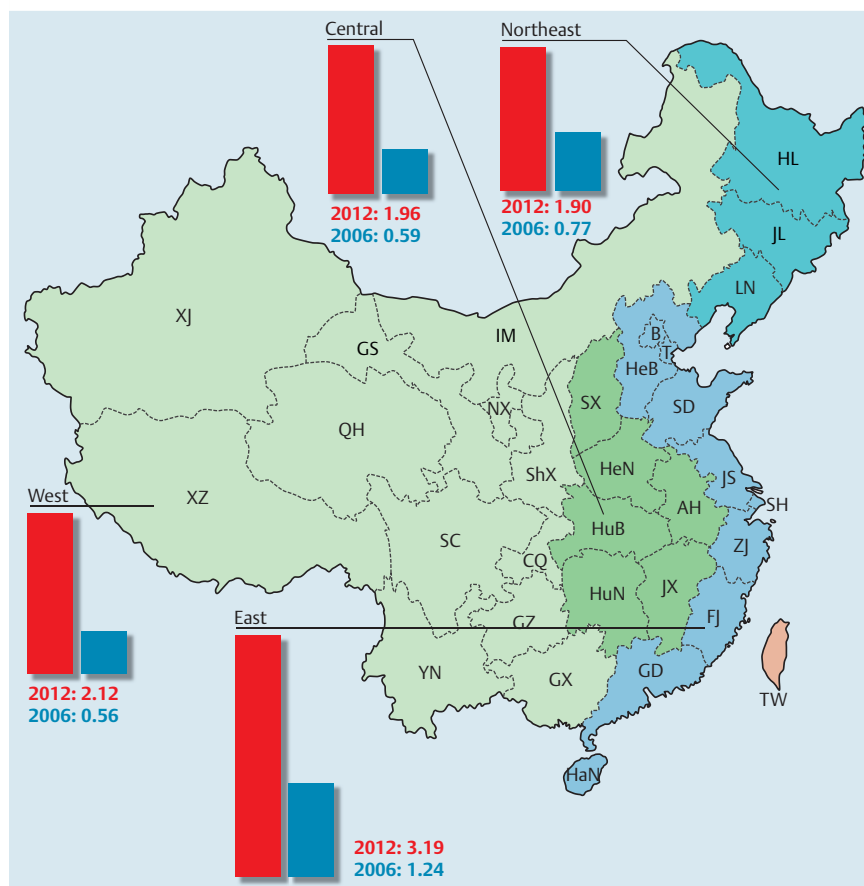


Fig. 1 Increase in the number of practitioners of endoscopic retrograde cholangiopancreatography (ERCP) per 1 000 000 inhabitants (ERCPIst-to-population ratio) in mainland China between 2006 and 2012. (Northeast region: HL, Heilongjiang; JL, Jilin; LN, Liaoning. East region: BJ, Beijing; FJ, Fujian; GD, Guangdong; HaN, Hainan; HeB, Hebei; JS, Jiangsu; SD, Shandong; SH, Shanghai; TJ, Tianjin; ZJ, Zhejiang. Central region: AH, Anhui; HeN, Henan; HuB, Hubei; HuN, Hunan; JX, Jiangxi; SX, Shanxi. West region: GS, Gansu; GX, Guangxi; GZ, Guizhou; IM, Inner Mongolia; NX, Ningxia; QH, Qinghai; ShX, Shaanxi; SC, Sichuan; XZ, Tibet; XJ, Xinjiang; YN, Yunnan; CQ, Chongqing. HK, Hong Kong; MAC, Macau; TW, Taiwan. This map does not show the complete territory of China.

Methods

The surveys

The first and second surveys were conducted from October 2007 to March 2008 and from August 2013 to January 2014, respectively. The CSDE organized this study, and all of the 31 provincial branches in mainland China participated. Information on which hospitals could provide an ERCP service was retrieved by the CSDE branches through the local health authorities. The numbers and names of the ERCPIsts at the hospitals were retrieved from their designated senior endoscopists. In the first survey, pre-designed structured questionnaires were sent to each senior endoscopist and were completed by each ERCPIst. The senior ERCPIst then collected and returned the questionnaires by mail to the CSDE headquarters in Shanghai for analysis. The second survey was conducted through online questionnaires.

After the questionnaires had been collected, approximately one-fifth of the ERCPIsts involved were selected for data checking via simple random sampling. The involved CSDE branches collected the medical records or other official records from hospitals and carefully checked the data in the questionnaires. The results of the data check were then sent back to the organizer. When significant discrepancies were found between the checked data and the questionnaire, the questionnaire was considered invalid and was not included in the analysis. The data checks were finished in June 2008 and March 2014, respectively.

Questionnaire items

The items were completed according to the data in 2006 and 2012, respectively. Both questionnaires included information about: (i) demographic details and educational background of

the ERCPIst; (ii) duration of ERCP practice; and (iii) other endoscopic skills (e.g., colonoscopy, small-bowel endoscopy, endoscopic ultrasonography [EUS], and endoscopic submucosal dissection [ESD]). The first survey questionnaire included ERCP training background items, but the second survey questionnaire did not initially have this content. Therefore, to enable comparison, for the second survey this information was subsequently obtained from one-fifth of ERCPIsts nationwide who had been selected randomly.

In mainland China, three educational degrees are granted by medical schools. A bachelor's degree in medicine can be obtained after a 5-year full-time undergraduate course. A master's degree in medicine can be obtained after 3 or 4 years of postgraduate study, and another 3 or 4 years of study is required to obtain the doctorate degree in medicine. An individual with any of the three aforementioned degrees can apply for a license to practice medicine.

Fellowship positions are not available in China, and resident, attending, and chief physicians are the three titles (from the lowest to the highest rank) given to such medical practitioners. In high grade hospitals, a medical team consists of several physicians at the three levels. The chief physician is the leader of a medical team and the attending physician is the assistant, which is quite different from the role in Western countries.

The following pathways are available for Chinese endoscopists to learn ERCP: (i) participation in a standardized training program at an ERCP training center within China (always in a teaching hospital); (ii) learning from senior ERCPIsts in their own hospital (like the mentor – mentee relationship); (iii) participation in a standard training program at an overseas ERCP training center; and (iv) other nonstandard trainings.

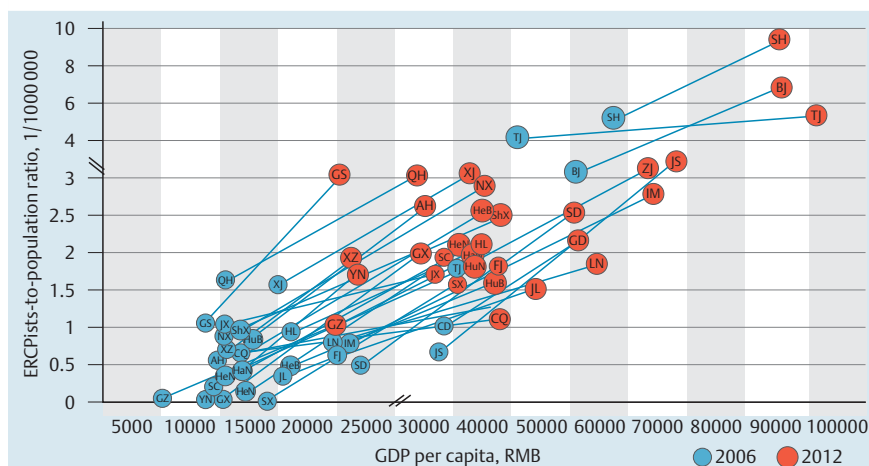


Fig. 2 Relationship between numbers of ERCP practitioners and gross domestic product (GDP) per capita (in renminbi [RMB]) in different regions in mainland China (2006, $r=0.871$, $P<0.001$; 2012, $r=0.452$, $P=0.005$). The points represent the ERC-Pist-to-population ratios of various provinces in 2006 (blue points) and 2012 (red points). Both the x- and y-axes of the graph have a different scale after the breaks (// and \\\) in order to include the information more compactly. See **Fig. 1** legend for the key to the abbreviations.

Data collection and synthesis

Data from the returned questionnaires were extracted and summarized in a database for further analysis. If a hospital provided an ERCP service but the senior endoscopist failed to return the relevant data then the number of ERCPs was retrieved from local health authorities by the corresponding CSDE branch.

The total number of ERCPists in mainland China was accumulated, and the ERCPist-to-population ratio (the number of ERCPists per 1 million inhabitants) was used as an index to reflect the adequacy of ERCPist numbers in a region (the population of a middle-sized town in China is approximately 1 million). In the analysis of ERCPist personnel development in various regions, we divided China into northeast, east, central, and western regions, reflecting the divisions used for socioeconomic analysis by the Chinese government.

The average ERCP procedure volume per endoscopist per annum was estimated and compared with data from the UK, Canada (using Alberta province as representative), Austria, Norway, the Netherlands, and Sweden, which were retrieved or calculated through published data resources [6–11].

To determine the correlation between the adequacy of numbers of ERCPists and the economic development in a provincial region, the ERCPist-to-population ratio and the gross domestic product (GDP) per capita were used as the main indexes. The GDP per capita of the 31 provincial regions of mainland China was retrieved from the China Statistical Yearbook [12, 13].

Statistical analysis

Categorical data are shown as percentages. A nonparametric correlation statistical test (one-sided Spearman's test) was used to analyze the correlations between the regional GDP per capita and the ERCPist-to-population ratio. Simple random sampling and statistical analyses were performed using SPSS version 13.0 for Windows (SPSS, Chicago, Illinois, USA). A two-sided *P* value of <0.05 was considered to be statistically significant.

Results

Total number and regional distribution of ERCPists

In mainland China, 1130 ERCPists practiced in 470 hospitals in 2006, and 3345 ERCPists practiced in 1156 hospitals in 2012. The ERCPist-to-population ratio increased from 0.88 to 2.47 per 1 000 000 inhabitants between 2006 and 2012.

Fig. 1 shows the development of the ERCPist-to-population ratio in various regions between 2006 and 2012. Fig. 2 shows the ERCPist-to-population ratio of each provincial region in 2012. An imbalanced regional distribution of ERCPists was found, and the ERCPist-to-population ratio correlated significantly with the GDP per capita (2006, $r=0.871$, $P<0.001$; 2012, $r=0.452$, $P=0.005$).

Response, demographic characteristics, and educational background

In 2007, 584 (50.6%) ERCPists returned the questionnaire and 577 ERCPists were qualified for further analysis after data checking, with an effective return rate of 50.0%. In 2013, all of the 3345 ERCPists returned the questionnaire (this survey was supervised by the National Ministry of Health as part of the Chinese Digestive Endoscopy Census 2012), among whom 3328 were included for further analysis, with an effective return rate of 99.5%.

In 2006, the proportion of female ERCPists was 11.1% (n=64), and this proportion increased to 16.8% (n=558) in 2012. The mean (SD) ages of ERCPists were 42.5 (6.1) years and 37.4 (5.4) years in 2006 and 2012, respectively. The clinical titles and educational backgrounds of Chinese ERCPists are shown in [Table 1](#).

ERCP case volume and length of experience

The total ERCP volume per annum in mainland China increased from 63 787 to 195 643 between 2006 and 2012 (from a study published in Chinese), and the estimated annual mean ERCP volume of an endoscopist in mainland China increased from 55.2 (63 787/1155) to 58.5 (195 643/3345). This result is similar to those in most Western countries (● Fig. 3). The annual ERCP volume of male ERCPists was higher than that of female ERCPists (male/female: 2006, 58.0/33.0; 2012 63.4/35.7). In 2012, about two-thirds of the endoscopists (n=2213, 66.5%) performed <50 ERCP procedures, 869 ERCPists (26.1%) performed 50–200 ERCPs, and 246 (7.4%) performed >200 ERCPs.

In 2006, 48.5% of Chinese ERCPists (n=280) had practiced ERCP for ≤ 5 years; 32.4% (n=187) for 6–10 years; 16.7% (n=96) for 11–20 years; and 2.4% (n=14) for >20 years. In 2012, the corresponding proportions were: ≤ 5 years, 60.1% (n=1999); 6–10 years, 26.8% (n=891); 11–20 years, 11.5% (n=383); and >20 years, 1.7% (n=55).

	Proportion in 2006, %* (Responders, n=577)	Proportion in 2012, %* (Responders, n=3328)
Gender ratio, male:female	8:1	5:1
Age, years		
Mean (SD)	42.5 (6.1)	37.4 (5.4)
By age range		
≤ 30	1.7 %	1.8 %
31 to 40	34.3 %	50.4 %
41 to 50	54.9 %	34.6 %
51 to 60	7.3 %	12.1 %
> 60	1.7 %	1.1 %
Clinical level		
Resident	9.9 %	3.6 %
Attending physician	26.9 %	55.2 %
Chief physician	63.3 %	41.1 %
Degree		
Bachelor of medicine	48.9 %	47.3 %
Master of medicine	29.3 %	30.4 %
Doctor of medicine	21.8 %	22.3 %

SD, standard deviation
* Except where indicated

Table 1 Endoscopic retrograde cholangiopancreatography (ERCP) practitioners in mainland China: demographic characteristics, clinical title, and educational background.

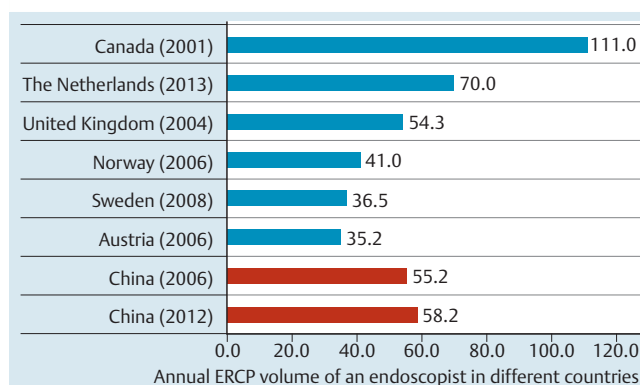


Fig. 3 Annual volume of endoscopic retrograde cholangiopancreatography (ERCP) procedures for an endoscopist in China and in Western countries.

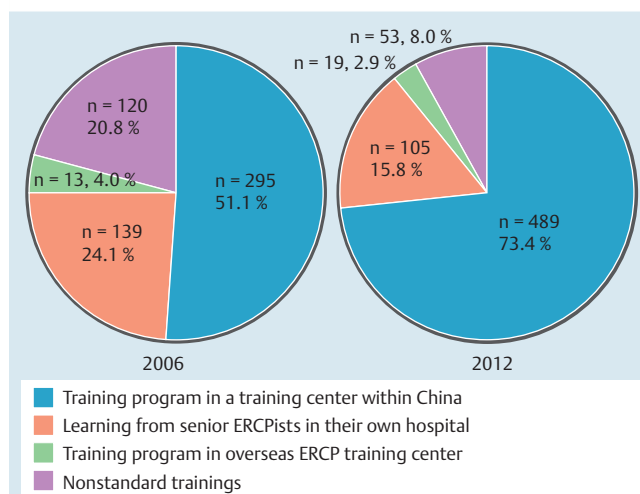


Fig. 4 Training background of endoscopic retrograde cholangiopancreatography (ERCP) practitioners (ERCPists) in mainland China. The total numbers of ERCPists who participated in this part of the survey were 577 in 2007 and 666 in 2013.

ERCP training background

In 2006 and 2012, the most common training pathways were participation in a standardized training program in an ERCP training center within China (2006, 51.1%; 2012, 73.4%), and learning from senior ERCPists in the practitioner's own hospital (2006, 24.1%; 2012, 15.8%) (Fig. 4). From 2006 to 2012, the proportion of ERCPists with no standard training decreased from 20.8% to 8.0%; this decrease was especially notable in the group of ERCPists who had been practicing ERCP for ≤ 5 years (5/195, 2.6%).

Other endoscopic skills

In 2006, 75.2% of Chinese ERCPists could perform colonoscopy (n=434); 8.3% (n=48) could perform small-bowel endoscopy; 18.4% (n=106) could perform EUS; and 1.6% (n=9) could carry out ESD. In 2012, these proportions increased to: colonoscopy, 86.3% (n=2873); small-bowel endoscopy, 11.7% (n=388); EUS, 27.6% (n=918); and ESD, 32.6% (n=1086).

Discussion

This report first showed the overall nationwide status of ERCPists in China. The findings suggest that the development and training of ERCPist personnel improved significantly in China between 2006 and 2012. In those 6 years, the ERCPist-to-population ratio almost tripled (from 0.88 to 2.47 per 1 000 000 inhabitants) and the proportion of ERCPists with a standard training background increased from 79.2% to 92.0%. However, the shortage of ERCPists and the regional imbalances are still obvious and a higher ERCP volume per endoscopist is still needed.

ERCP has been developed for more than 40 years as an important technique for the diagnosis and treatment of cholangiopancreatic disease. In recent years, the role of ERCP has gradually changed from a diagnostic modality to a therapeutic one and the total volume has even decreased in some developed countries [14–16]. However, this is not the case in China. Despite a dramatic increase in its GDP, China is still a “developing country” rather than a developed one [17], and medical resources are relatively inadequate. In our previous study, the estimated annual ERCP

rate in China was only 4.87 per 100 000 inhabitants, which was much lower than that of developed countries (70–188 per 100 000 inhabitants) [4]; thus, the ERCP service needs substantial improvement in facilities and personnel. The situation regarding personnel has been considerably improved in recent years. The present study showed that the ERCPist-to-population ratio increased from 0.88 to 2.47 per 1 000 000 inhabitants between 2006 and 2012 (from 1130 in 2006 to 3345 in 2012). This finding suggests an average increment of 368 ERCPists per year. In particular, this advance is more obvious in the less developed central and western regions, where the increase has been approximately 3.5-fold (● Fig. 2).

We consider the progress regarding ERCPists in China to be inspiring, but we also have to admit that the absolute numbers of ERCPists are far from adequate. The ERCPist-to-population ratio in 2012 was 2.47 per 1 000 000 inhabitants, suggesting that fewer than 3 ERCPists are available in a middle-sized town in China, whereas recent reports have shown that the ERCPist-to-population ratio in Sweden, the Netherlands, and Norway was around 20 per 100 000 inhabitants [9–11]. Even if Cotton's estimation is adopted, in which 1/1000 is used as the proportion of the average adult population undergoing ERCP and 150 ERCPs as the endoscopist's annual volume [18], approximately 6667 ERCPists are needed in mainland China (5.1 ERCPists per 1 000 000 inhabitants), which is almost double the current number. Moreover, the unbalanced regional distribution of ERCPists aggravates this shortage. In the two most developed regions (Shanghai and Beijing), the ERCPist proportion in 2012 was much higher than the national average (9.5 and 6.3 per 1 000 000 inhabitants), whereas in the two least developed regions (Chongqing and Guizhou), the ERCPist proportion in 2012 was less than 1.5 (1.3 and 1.1 per 1 000 000 inhabitants). In general, the more economically developed regions have higher ERCPist-to-population ratios ($r=0.452$, $P=0.005$, for 2012). Given this situation, provision of support to the central and western regions in terms of development of ERCPist personnel is still a priority.

The annual case volume of ERCPists has been a focus of study for a long time, and most studies have shown that ERCPists with a high volume of ERCPs tended to achieve greater technical success and fewer complications [19–21]. The present study showed that the estimated annual ERCP volumes of an endoscopist in China were 55.2 in 2006 and 58.5 in 2012, and nearly two-thirds (66.5%) of the ERCPists performed fewer than 50 ERCP procedures annually, which would be categorized as “low volume” according to Coté et al. [22]. Although these figures are similar to those in most Western countries (● Fig. 3) and seem acceptable for a developing country, further improvement is still necessary. As mentioned above, the number of ERCPists almost tripled from 2006 to 2012 and, in 2012, 60.1% ERCPists had been practicing ERCP for ≤5 years, which suggested that many Chinese ERCPists have only recently started their practice. As mentioned by Cotton [18], a very experienced ERCP practitioner could remain competent by performing approximately 50 ERCPs per year, but those who have only recently completed training are unlikely to perform adequately, let alone improve, without constant or increased ERCP practice. Therefore, we recommend that Chinese ERCPists should increase their annual volume to improve their performance and that those who intend to start ERCP practice should consider their potential annual volume.

Gender difference in practice has existed for a long time, but an increasing number of women are choosing gastroenterology as a profession in recent years [23–25]. In the analysis of demo-

graphic details and practice of Chinese ERCPists, we found a significant increase in the proportion of female ERCPists (from 11.1% in 2006 to 16.8% in 2012). We recognize this as a positive trend. Although the annual ERCP case volume of female ERCPists was still less than that of male ERCPists (male/female case volume ratio was 58.0/33.0 in 2006 and 63.4/35.7 in 2012), this gap may be narrowed in the future as new technology and equipment would enable decreased radiation exposure and workload.

A training program is necessary for a physician to perform ERCP in the future. However, nationwide fellowship and standard endoscopic trainings are not yet available in mainland China. As a result, endoscopists who intend to learn ERCP would select various training pathways. As shown in these two surveys, participation in a standardized training program in an ERCP training center within China (2006, 51.1%; 2012, 73.4%) was the most common pathway. Most ERCP training centers in China are located in high grade teaching hospitals, which provide 4-month to 12-month programs. The trainees usually learn ERCP through animal model/simulator practice, live demonstration, hands-on teaching, and performance of procedures under supervision, and they obtain certification through an examination. Moreover, a considerable number of ERCPists (2006, 24.1%; 2012, 15.8%) were trained by senior ERCPists at their own hospital (i.e., a mentor–mentee relationship). The teaching method, duration, and qualification are partly standard and partly individualized according to the trainer and trainee. Notably, a fifth (20.8%) of the ERCPists in 2006 claimed that they obtained ERCP skills through nonstandard training, which meant that nonstandard training practice, such as live demonstration and hands-on teaching, was the main pathway, and their qualifications were not certified by a training center or a senior trainer. We can speculate that nonstandard training would increase the risk associated with an ERCP procedure. Fortunately, amongst all ERCPists the proportion who followed this training pathway decreased to 8.0% in 2012, and the decrease was especially notable amongst those who had started their ERCP practice in the most recent 5 years (5/195, 2.6%). Overall, ERCP training has improved significantly in China, but a national standard training for new ERCPists is still the main focus of the CSDE, considering the high demand for new ERCPists nationwide. The initial proposal for nationwide training networks included the Chinese College of Digestive Endoscopy and regional training centers. The Chinese College of Digestive Endoscopy aims to train the ERCP trainer and regional training centers are responsible for training the trainees in corresponding regions. All the endoscopists intending to start ERCP practice in the future should complete a standardized training program and their competency will be assessed.

This study has several limitations. First, adverse events were not included in both surveys. Given that both surveys were retrospective and self-reported by endoscopists, the true incidence of adverse events might have been inaccurate; thus, this content was abandoned. Adverse events are an important issue in ERCP quality control, and a national prospective survey or registry is necessary for future studies. Second, the difference in the method of data collection is a limitation. The first survey was conducted through paper questionnaire and mail, which restricted the return rate. After 2013, an electronic digestive endoscopy database was created in mainland China.

In conclusion, the practice and training of ERCPists have improved significantly in China between 2006 and 2012. However, the shortage and regional imbalances of ERCPists are still obvious and a higher ERCP volume per endoscopist is still needed.

Competing interests: None

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