Multi-center survey on the training status of staff working in pharmacy intravenous admixture services (PIVAS) in mainland China

Perspectives of PIVAS staff

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Abstract

The technical level and comprehensive quality of pharmacy intravenous admixture services (PIVAS) staff are central to ensure the safety and effectiveness of intravenous infusions. However, these aspects are lacking in traditional pharmacy education. This study aimed to investigate the training status of staff working in PIVAS and explore factors that affected training status, which might contribute to the establishment of a comprehensive, standardized training system.

A multi-center cross-sectional survey was conducted via a WeChat Group targeting PIVAS staff in hospitals to investigate the differences of current training status between different regions, hospital levels, genders, job titles, educational degrees, employment types, and working years.

In total, 501 participants completed the questionnaires. The main contents of training for PIVAS staff included: professional theoretical knowledge (99.40%, 498/501), practical operation abilities (97.01%, 486/501), pre-job training (92.61%, 464/501), and standard operating procedures (90.22%, 452/501). The most common frequency of staff training was 1–2 times a month (51.9%, 260/501). Overall, 56.5% (283/501) of participants thought staff training was sufficient and 60.1% (301/501) of participants thought PIVAS attached importance to staff training. However, only 45.7% (229/501) of the participants were satisfied with the training modes.

The contents of training for PIVAS staff in mainland China were relatively rich, but the aspects of management tools, comprehensive ability development, and career development planning tend to be relatively weak. It is necessary to develop training standards for PIVAS staff to improve employee capabilities and job satisfaction.

Abbreviation: PIVAS = pharmacy intravenous admixture services.

Keywords: China, education, hospital administration, pharmacy intravenous admixture service, survey

1. Introduction

Pharmacy intravenous admixture services (PIVAS) is a hospital-based comprehensive and technical pharmaceutical department. Pharmacists review medical orders and conduct centralized admixture of intravenous drugs (eg, general drugs, cytotoxic drugs, antibiotics, and total parenteral nutrition) in accordance with sterile operation standards and under clean environment conditions to provide intravenous infusions for patients.\textsuperscript{[1]} With the rapid growth of intravenous infusion therapy in recent years, the emergence of new drugs and the increasing types of
Intravenous drug compatibility means that the complexity of intravenous admixture services is augmenting. The technical level and comprehensive quality of PIVAS staff are central to ensure the safety and effectiveness of intravenous infusions. Intravenous admixture service requires pharmaceutical and medical expertise, as well as aseptic operation technology and intravenous admixture technology. However, these aspects are lacking in traditional pharmacy education. Therefore, staff training might be a new opportunity for PIVAS staff.

In 2019, Yang et al. conducted a systematic review about the training situation of PIVAS staff in mainland China. After a comprehensive literature search and screening, they included 5 related studies that reported training objectives included: the comprehensive quality training, the level of clinical rational use of drugs, the training pathways of pharmacy staff, and the professional service abilities. However, they found the specific training contents of training modes varied, with the main components including professional theoretical knowledge, practical operation ability, pre-job training, professional psychological quality, professional ethics and laws and regulations, continuing education learning ability, career development planning, and teaching ability. There were also great differences in the evaluation indicators of training effectiveness, which were mainly reflected in team execution motivation and creativity, the discovery rate of unreasonable doctor’s advice, work efficiency, service quality, drug treatment level, satisfaction of PIVAS, etc. However, that review included early studies and single-center studies were not well-represented, meaning those articles could not reflect the overall training status of PIVAS staff in China. In addition, it was uncertain whether there were differences in training content and modes between different hospital levels and regions of China.

We proposed a hypothesis that the training status of staff working in PIVAS needs urgent attention and certain factors are closely related to the training status. To make up for the shortcomings of previous studies, we conducted a multi-center cross-sectional survey to investigate the training status of staff working in PIVAS, and explored factors that affected training status. Our findings will provide reference information for the comprehensive and standardized training system of PIVAS staff in mainland China.

2. Methods

2.1. Study design

This multi-center cross-sectional survey was conducted in mainland China from March to April 2019. Pharmacists or nurses working in PIVAS of hospitals across mainland China were selected as participants.

This study used a self-designed questionnaire. First, the questionnaire was preliminarily designed by referring to the results of the system review we completed earlier. Then, the questionnaire was discussed together by PIVAS experienced staff, leaders, and methodologists. Finally, the deficiencies of contents were improved through a pre-experiment. The content of the final questionnaire included: 1) basic participant information: region, hospital level, gender, job title, education degree, employment type, and working years and 2) current status of staff training: the frequency of staff training, whether training for PIVAS staff was sufficient, whether PIVAS attached importance to staff training, whether PIVAS staff had opportunities to attend academic conferences, the training modes of PIVAS staff, and the degrees of satisfaction with PIVAS training.

The electronic questionnaire was made, distributed, and collected through the questionnaire platform powered by www.wjx.cn. The questionnaires were distributed to the WeChat group named the Intravenous Dispensing Management and Application Branch of the China Medical Education Association, all members of which were engaged in PIVAS related work. We set up a lottery at the end of the survey to improve the enthusiasm of participants and the effectiveness of the questionnaire. This is an anonymous survey, and each internet protocol address could only be filled the questionnaire in once. The original data can be exported and analyzed through the questionnaire platform.

2.2. Statistical methods

We used t tests or analysis of variance for continuous variables with normally distributed data, and expressed the results as x ± s. If the data were not normally distributed, we used the rank-sum test. Chi-squared tests were used for categorical variables. The difference was considered statistically significant at P < .05. We used SPSS version 21.0 (SPSS Inc., Chicago, IL) for the data analyses.

3. Results

3.1. Basic information about participants

In total, we received 501 questionnaires. Participants came from 24 provinces, with 56.1% (281/501) from eastern China, 27.5% (138/501) from western China, and 16.4% (82/501) from central China. Most (91.0%, 456/501) participants worked in Level III hospitals, and the remainder (9.0%, 45/501) worked in Level II hospitals. Most (75.8%, 380/501) participants were female. Participants’ job titles included: the senior title (1.6%, 8/501), the deputy title (5.0%, 25/501), the intermediate title (22.2%, 111/501), the junior title (49.5%, 248/501), the pre-junior title (19.0%, 95/501), and none (2.8%, 14/501). Few participants (0.8%, 4/501) had a doctor’s degree, 6.2% (31/501) had a master’s degree, 72.5% (363/501) had a bachelor’s degree, and 20.6% (103/501) had a junior college’s degree or below. The employment types were permanent staff (21.4%, 107/501), agency personnel (11.4%, 57/501), contract labors (49.1%, 246/501), labor dispatch personnel from the third party (17.4%, 87/501), and personnel in standardized training (0.8%, 4/501). The length of working years in PIVAS ranged from 0.08 to 35 years (4.26 ± 3.36 years), with a median of 3 years.

3.2. Basic information about staff training

The contents of PIVAS staff training included: professional theoretical knowledge (99.40%, 498/501), practical operation ability (97.01%, 486/501), pre-job training (92.61%, 464/501), standard operating procedures (90.22%, 452/501), scientific research capacity (79.24%, 397/501), emergency management planning (75.65%, 379/501), occupational mental health, work ethics and laws/regulations (72.46%, 363/501), management systems (62.48%, 313/501), communication skills (48.90%, 245/501), teaching ability (47.31%, 237/501), management ability (44.91%, 225/501), management tools (35.73%, 179/501), comprehensive ability development (32.73%, 164/501), and career development planning (20.96%, 105/501).
The training modes of PIVAS included: lectures (85.83%, 430/501), practical operations (75.85%, 380/501), seminars (35.93%, 180/501), online teaching (19.76%, 99/501), continuing education training (26.95%, 133/501), and other (1.60%, 8/501).

The most common frequency of staff training was 1–2 times a month (51.9%, 260/501), followed by 3–4 times a month (25.5%, 128/501). Overall, 56.3% (283/501) of the participants thought PIVAS training was sufficient, and 60.1% (301/501) of the participants thought PIVAS attached importance to staff training. Most (93.4%, 468/501) participants had opportunities to participate in out-of-hospital training, of which 22.2% (111/501) thought the opportunities were sufficient. The main modes for out-of-hospital training were academic conferences (62.8%, 294/468) and continuing education (18.8%, 88/468). However, only 45.7% (229/501) of the participants were satisfied with the training modes (see Table 1).

### 3.3. Factors affecting staff training

The chi-squared test compared the training status in different regions, showing that more staff in eastern China thought the training was sufficient compared with those in western China, with a significant difference ($\chi^2 = 9.910, P = .042$). Staff in eastern China had more opportunities for out-of-hospital training than those in central China, while those in central China had more learning opportunities than those in western China, with a significant difference ($\chi^2 = 14.658, P = .023$). The frequency of academic conferences in central China was higher than that in the eastern region, while that in eastern China was higher than that in western China ($\chi^2 = 41.045, P = .000$) (see Table 2).

The chi-squared test compared the training status in hospitals with different levels, showing there was a significant difference in the frequency of staff training between Level III hospitals and Level II hospitals ($\chi^2 = 14.077, P = .007$) (see Table 2).

The chi-squared test compared the training status in different genders, showing there was a significant difference between different genders in the training modes ($\chi^2 = 15.971, P = .001$) (see Table 3).

The chi-squared test compared the training status of PIVAS staff with different job titles, showing that more PIVAS staff with intermediate and junior titles thought PIVAS training was sufficient than those with senior titles, with a significant difference ($\chi^2 = 35.846, P = .000$). In addition, more PIVAS staff with intermediate and junior titles had more opportunities to attend academic conferences than those with senior titles ($\chi^2 = 32.326, P = .006$). There was a significant difference between different job titles in the training modes ($\chi^2 = 49.398, P = .000$). PIVAS staff with senior titles were more satisfied with the training than those with intermediate and junior titles, and the difference was significant ($\chi^2 = 35.504, P = .000$) (see Table 3).

The chi-squared test compared the training status of PIVAS staff with different education degrees, showing that PIVAS staff with a master’s degree had significantly more opportunities to academic conferences than those with a bachelor’s degree and below ($\chi^2 = 17.983, P = .035$). There was a significant difference between different education degrees in the training modes ($\chi^2 = 37.460, P = .000$). PIVAS staff with doctor and master’s degrees were more satisfied with the PIVAS training than those with a bachelor’s degree and below ($\chi^2 = 16.748, P = .010$) (see Table 4).

The chi-squared test compared the training status of PIVAS staff with different employment types, showing that more contract labors, labor dispatch personnel from the third party, and personnel in standardized training thought PIVAS training was sufficient than permanent staff and agency personnel ($\chi^2 = 41.283, P = .000$). There was a significant difference between different employment types in the training modes ($\chi^2 = 29.103, P = .004$) (see Table 4).

The rank-sum test compared the training status of PIVAS staff with different working years, showing there was a significant difference between PIVAS staff with different working years in the frequency of staff training, whether PIVAS training was sufficient, whether PIVAS attached importance to staff training, whether PIVAS staff had opportunities to attend academic conferences, and satisfaction with PIVAS training. The frequency of staff training appeared to be lower among PIVAS staff with longer working years ($F = 9.519, P = .049$). More participants with longer working years thought that the PIVAS training was sufficient compared with those with shorter working years, with a significant difference ($F = 14.987, P = .001$). PIVAS staff with shorter working years thought PIVAS attached more importance to staff training ($F = 11.142, P = .004$). PIVAS staff with shorter working years also had more opportunities to attend academic conferences ($F = 2.687, P = .046$) and were more satisfied with PIVAS training ($F = 5.507, P = .004$) than other participants. There was a significant difference between PIVAS staff with different work years in the training modes ($F = 16.048, P = .001$) (see Table 5).

### Table 1

| Item                                | Option         | Percentage (frequency/total) |
|-------------------------------------|----------------|-------------------------------|
| Frequency of staff training          |                |                               |
|                                      | <1 time a month| 13.8% (69/501)               |
|                                      | 1–2 times a month| 51.9% (260/501)            |
|                                      | 3–4 times a month| 25.5% (128/501)             |
|                                      | ≥5 times a month| 8.0% (40/501)               |
|                                      | Other          | 0.8% (4/501)                 |
| Whether training in PIVAS was        |                |                               |
| sufficient                          | Insufficient   | 12.2% (61/501)               |
|                                      | General        | 31.3% (157/501)              |
|                                      | Sufficient     | 56.5% (283/501)              |
| Whether PIVAS attached importance   |                |                               |
| to staff training                    | Not important  | 10.6% (53/501)               |
|                                      | General        | 29.3% (147/501)              |
|                                      | Important      | 60.1% (301/501)              |
| Whether PIVAS staff had opportunities|                |                               |
| to attend academic conferences       | Less           | 37.7% (189/501)              |
|                                      | General        | 33.5% (168/501)              |
|                                      | Many           | 22.2% (111/501)              |
| Mode of training for PIVAS staff     |                |                               |
|                                      | Academic       | 62.8% (294/468)              |
|                                      | Continuing     | 18.8% (88/468)               |
|                                      | Professional   | 17.1% (80/468)               |
|                                      | Others         | 1.3% (6/468)                 |
| Satisfaction with PIVAS training     |                |                               |
|                                      | Unsatisfied    | 6.2% (31/501)                |
|                                      | General        | 48.1% (241/501)              |
|                                      | Satisfied      | 45.7% (229/501)              |
Table 2
The effect of regions and hospital levels on PIVAS staff training status.

| Item                                      | Option                          | Eastern China | Western China | Central China | $\chi^2$ | $P$ | Level III Grade A | Level II Grade A | $\chi^2$ | $P$ |
|-------------------------------------------|--------------------------------|---------------|---------------|---------------|---------|----|------------------|------------------|---------|----|
| Frequency of staff training               | <1 time a month                 | 35            | 25            | 9             | 8.042   | .429| 66               | 3                | 14.077  | .007|
|                                           | 1–2 times a month               | 150           | 63            | 47            | 226     | .34 | 226              | 6                | 34      |    |
|                                           | 3–4 times a month               | 74            | 33            | 21            | 122     | .6   | 122              | 6                | 6       |    |
|                                           | ≥5 times a month                | 20            | 16            | 4             | 39      | 1   | 39               | 1                | 1       |    |
|                                           | Other                           | 2             | 1             | 1             | 3       | 1   | 3                | 1                | 1       |    |
| Whether training in PIVAS was sufficient  | Insufficient                    | 31            | 21            | 9             | 9.910   | .042| 51               | 10               | 4.263   | .119|
|                                           | General                         | 75            | 52            | 30            | 143     | 1   | 143              | 1                | 1       |    |
|                                           | Sufficient                      | 175           | 65            | 43            | 262     | 21  | 262              | 21               | 21      |    |
| Whether PIVAS attached importance to staff training | Not important                  | 30            | 15            | 8             | 0.370   | .985| 48               | 5                | 2.844   | .241|
|                                           | General                         | 80            | 41            | 26            | 129     | 18  | 129              | 18               | 18      |    |
|                                           | Important                        | 171           | 82            | 48            | 279     | 22  | 279              | 22               | 22      |    |
| Whether PIVAS staff had opportunities to attend academic conferences | Less                            | 103           | 50            | 36            | 170     | 19  | 170              | 19               | 19      |    |
|                                           | General                         | 84            | 56            | 28            | 150     | 18  | 150              | 18               | 18      |    |
|                                           | Many                            | 68            | 26            | 17            | 107     | 4   | 107              | 4                | 4       |    |
| Mode of training for PIVAS staff          | Academic conference             | 160           | 69            | 65            | 41.045  | .000| 275              | 19               | 7.155   | .067|
|                                           | Continuing education             | 55            | 17            | 8             | 71      | 9   | 71               | 9                | 9       |    |
|                                           | Professional training            | 39            | 44            | 5             | 75      | 13  | 75               | 13               | 13      |    |
|                                           | Others                          | 1             | 2             | 3             | 6       | 0   | 6                | 0                | 0       |    |
| Satisfaction with PIVAS training          | Unsatisfied                     | 14            | 7             | 10            | 5.951   | .203| 29               | 2                | 0.674   | .714|
|                                           | General                         | 132           | 70            | 39            | 217     | 24  | 217              | 24               | 24      |    |
|                                           | Satisfied                       | 135           | 61            | 33            | 210     | 19  | 210              | 19               | 19      |    |

Table 3
The effect of genders and job titles on PIVAS staff training status.

| Training Item                          | Option                  | Male | Female | $\chi^2$ | $P$ | Senior title | Deputy title | Intermediate title | Junior title | Pre-Junior title | None | $\chi^2$ | $P$ |
|----------------------------------------|-------------------------|------|--------|---------|----|--------------|--------------|-------------------|-------------|------------------|------|---------|----|
| Frequency of staff training            | 1 time a month          | 16   | 53     | 3.983   | .408| 1            | 4            | 17                | 38          | 7                | 2    | 17.332  | .007|
|                                       | 1–2 times a month       | 67   | 193    | 4.620   | .304| 2            | 5            | 18                | 36          | 3                | 1    | 3.940   | .047|
|                                       | 3–4 times a month       | 24   | 104    | 3.620   | .057| 2            | 5            | 23                | 54          | 9                | 2    | 10.620  | .001|
|                                       | ≥5 times a month        | 13   | 27     | 4.620   | .304| 2            | 5            | 16                | 21          | 7                | 0    | 16.620  | .001|
|                                       | Other                   | 1    | 3      | 3.620   | .057| 0            | 0            | 0                 | 0           | 0                | 0    | 0.057   | .812|
| Whether training in PIVAS was sufficient | Insufficient          | 14   | 47     | 1.854   | .386| 3            | 6            | 19                | 27          | 6                | 0    | 35.846  | .000|
|                                       | General                 | 44   | 113    | 3.342   | .069| 3            | 10           | 36                | 84          | 24               | 0    | 0.000   | 1.000|
|                                       | Sufficient              | 63   | 220    | 3.148   | .075| 2            | 9            | 56                | 137         | 65               | 14   | 25.657  | .004|
| Whether PIVAS attached importance to staff training | Not important      | 14   | 39     | 0.163   | .693| 1            | 5            | 8                 | 28          | 11               | 0    | 25.657  | .004|
|                                       | General                 | 35   | 112    | 3.342   | .069| 3            | 7            | 42                | 76          | 19               | 0    | 0.000   | 1.000|
|                                       | Important               | 72   | 229    | 3.148   | .075| 4            | 13           | 61                | 144         | 65               | 14   | 25.657  | .004|
| Whether PIVAS staff had opportunities to attend academic conferences | Less                   | 50   | 139    | 2.133   | .144| 2            | 13           | 42                | 100         | 31               | 1    | 0.000   | 1.000|
|                                       | General                 | 41   | 127    | 3.133   | .075| 3            | 8            | 38                | 82          | 35               | 2    | 0.000   | 1.000|
|                                       | Many                    | 24   | 87     | 3.133   | .075| 3            | 4            | 24                | 50          | 19               | 11   | 0.000   | 1.000|
| Mode of training for PIVAS staff       | Academic conference     | 89   | 205    | 15.971  | .001| 6            | 23           | 79                | 148         | 30               | 8    | 49.398  | .000|
|                                       | Continuing education     | 11   | 69     | 1.623   | .202| 1            | 1             | 12                | 40          | 24               | 2    | 0.000   | 1.000|
|                                       | Professional training    | 13   | 75     | 1.623   | .202| 1            | 1             | 12                | 40          | 30               | 4    | 0.000   | 1.000|
|                                       | Others                  | 2    | 4      | 0.623   | .433| 0            | 0             | 1                 | 1           | 0                | 0    | 0.000   | 1.000|
| Satisfaction with PIVAS training       | Unsatisfied             | 9    | 22     | 0.723   | .696| 2            | 2             | 4                 | 17          | 6                | 0    | 35.504  | .000|
|                                       | General                 | 60   | 181    | 1.123   | .290| 1            | 12            | 65                | 129         | 33               | 1    | 31.123  | .001|
|                                       | Satisfied               | 52   | 177    | 1.123   | .290| 5            | 11            | 42                | 102         | 56               | 13   | 0.000   | 1.000|
Table 4
The effect of education degrees and employment types on PIVAS staff training status.

| Item | Option | Doctor's degree | Master's degree | Bachelor's degree and below | $\chi^2$/$F$ | $P$ | Permanent staff | Agency personnel | Contract labors | Labor dispatch personnel from the third party | Personnel in standardized training | $\chi^2$/$F$ | $P$ |
|------|--------|----------------|-----------------|-----------------------------|--------------|-----|----------------|-----------------|--------------|--------------------------------------------|----------------------------------|--------------|-----|
| Frequency of staff training | <1 time a month | 0 | 3 | 58 | 8 | 12.338 | .419 | 17 | 6 | 39 | 6 | 1 | 26.005 | .054 |
| | 1–2 times a month | 3 | 18 | 186 | 53 | 57 | 22 | 126 | 55 | 0 |
| | 3–4 times a month | 1 | 7 | 89 | 31 | 25 | 23 | 56 | 22 | 2 |
| | ≥5 times a month | 0 | 2 | 27 | 11 | 7 | 5 | 24 | 3 | 1 |
| | Other | 0 | 1 | 3 | 0 | 1 | 1 | 1 | 1 | 0 |
| Whether training in PIVAS was sufficient | Insufficient | 1 | 6 | 46 | 8 | 7.821 | .251 | 26 | 5 | 26 | 4 | 0 | 41.283 | .000 |
| | General | 1 | 10 | 120 | 26 | 44 | 20 | 73 | 20 | 0 |
| | Sufficient | 2 | 15 | 197 | 69 | 37 | 32 | 147 | 63 | 4 |
| Whether PIVAS attached importance to staff training | Not important | 1 | 0 | 43 | 9 | 10.993 | .089 | 12 | 9 | 22 | 10 | 0 | 13.260 | .103 |
| | General | 1 | 12 | 109 | 9 | 41 | 16 | 63 | 27 | 0 |
| | Important | 2 | 19 | 211 | 69 | 54 | 32 | 161 | 50 | 4 |
| Whether PIVAS staff had opportunities to attend academic conferences | No | 0 | 0 | 25 | 8 | 17.983 | .035 | 6 | 6 | 10 | 11 | 0 | 17.325 | .138 |
| | Less | 2 | 8 | 147 | 32 | 49 | 17 | 90 | 31 | 2 |
| | General | 2 | 10 | 122 | 34 | 35 | 19 | 87 | 25 | 2 |
| | Many | 0 | 13 | 69 | 29 | 17 | 15 | 59 | 20 | 0 |
| Mode of training for PIVAS staff | Academic conference | 3 | 24 | 232 | 35 | 37.460 | .000 | 73 | 35 | 151 | 35 | 0 | 29.103 | .004 |
| | Continuing education | 1 | 4 | 50 | 25 | 12 | 8 | 35 | 24 | 1 |
| | Professional training | 0 | 3 | 52 | 33 | 16 | 7 | 46 | 16 | 3 |
| | Others | 0 | 0 | 4 | 2 | 0 | 1 | 4 | 1 | 0 |
| Satisfaction with PIVAS training | Unsatisfied | 1 | 1 | 24 | 5 | 16.748 | .010 | 9 | 3 | 17 | 2 | 0 | 13.293 | .102 |
| | General | 0 | 15 | 189 | 37 | 56 | 29 | 118 | 38 | 0 |
| | Satisfied | 3 | 15 | 150 | 61 | 42 | 25 | 111 | 47 | 4 |
The effect of working years on PIVAS staff training status.

| Item                                      | Option                  | working years | F     | P   |
|-------------------------------------------|-------------------------|---------------|-------|-----|
| Frequency of staff training               | <1 time a month         | 5.017 ± 3.590 | 9.519 | .049|
|                                           | 1–2 times a month       | 4.327 ± 4.038 |       |     |
|                                           | 3–4 times a month       | 4.059 ± 2.704 |       |     |
|                                           | ≥5 times a month        | 2.992 ± 2.084 |       |     |
|                                           | Other                   | 5.500 ± 2.887 |       |     |
| Whether training in PIVAS was sufficient  | Insufficient            | 3.432 ± 0.439 | 14.987| .001|
|                                           | General                 | 5.089 ± 4.255 |       |     |
|                                           | Sufficient              | 3.754 ± 3.052 |       |     |
| Whether PIVAS attached importance to staff training | Not important          | 4.249 ± 3.476 | 11.142| .004|
|                                           | General                 | 5.037 ± 4.244 |       |     |
|                                           | Important               | 3.876 ± 3.133 |       |     |
| Whether PIVAS staff had opportunities to attend academic conferences | No                      | 4.126 ± 2.773 | 2.687 | .046|
|                                           | Less                    | 4.500 ± 3.374 |       |     |
|                                           | General                 | 5.458 ± 4.005 |       |     |
|                                           | Many                    | 3.340 ± 3.257 |       |     |
| Mode of training for PIVAS staff           | Academic conference     | 4.781 ± 3.980 | 16.048| .001|
|                                           | Continuing education    | 4.221 ± 2.880 |       |     |
|                                           | Professional training   | 4.849 ± 2.482 |       |     |
|                                           | Others                  | 4.383 ± 3.250 |       |     |
| Satisfaction with PIVAS training           | Unsatisfied             | 4.612 ± 2.904 | 5.507 | .004|
|                                           | General                 | 4.750 ± 3.396 |       |     |
|                                           | Satisfied               | 3.685 ± 3.734 |       |     |

4. Discussion

This was a multi-center cross-sectional survey of PIVAS staff training in mainland China. A total of 501 PIVAS staff from western, central, and eastern China participated in this survey. The content of staff training in PIVAS included professional theoretical knowledge, practical operation ability, pre-job training, and standard operating procedures. However, some aspects of the training content were considered insufficient, including communication skills, teaching ability, management ability, management tools, comprehensive ability development, and career development planning. The main modes of PIVAS training were lectures and practical operations, and the most common frequency of staff training was 1–2 times a month. More than half of the participants thought that PIVAS training was sufficient and thought PIVAS attached importance to staff training. The majority of PIVAS staff had opportunities to attend academic conferences to learn, but less than half were satisfied with the modes of PIVAS training.

PIVAS has become a new model of pharmacy services with modern equipment and advanced management concepts; however, higher requirements are put forward for the knowledge structure and skill level of PIVAS staff. The “Regulations on the Quality Management of Centralized Dispensing of Intravenous Drugs” published by the Ministry of Health of China stated that PIVAS staff must receive professional knowledge training, and must pass the exam before they can engage in PIVAS, and must regularly receive continuing education in pharmacy. Therefore, the main content of staff training in this survey was to meet the national policy’s requirements and the needs of actual work; however, the training frequency was low and the training modes and contents were simple, which may be directly related to PIVAS staff’s heavy workload and high work pressure.

Factors affecting PIVAS staff training in this survey showed that more participants in eastern China and in Level III hospitals thought the frequency of PIVAS training was sufficient, compared with participants in central and western China and in Level II hospitals. Staff in eastern China also had more opportunities to attend academic conferences than staff in other regions, which may be related to the economic level of different regions and hospital levels. PIVAS located in regions with higher economic levels and higher-level hospitals may have more learning resources and sufficient funds to support staff to attend professional training and other learning opportunities. The proportion of adequate training, the importance attached to training, and the opportunities for study outside among PIVAS staff with junior and intermediate titles were more than those with senior titles. It may be due to the fact that PIVAS staff with junior and intermediate titles have less accumulated experience and knowledge than those with senior titles, so they need more training and learning opportunities. Staff with higher job titles were also more satisfied with PIVAS training than other staff. PIVAS staff with master’s degrees had more opportunities to attend academic conferences than those with lower academic qualifications. Staff with doctor or master’s degrees were more satisfied with PIVAS training than other staff. It may be due to the fact that staff with doctor or master’s degrees have better scientific research consciousness, stronger scientific research abilities, and more scientific research output, meaning they may have more opportunities to attend academic conferences.

As the time of working in PIVAS grows, PIVAS staff may become more proficient in the basic skills and gain rich clinical experience, meaning their desire and demand for learning may decline. Staff with shorter working years may need to acquire more knowledge and be required to participate in more training, meaning they may be more satisfied with PIVAS training.

This study had some limitations in terms of methodology. First, we used a cross-sectional design, which failed to make causal inferences. It is necessary to conduct a prospective study to explore the training effect of PIVAS and factors that affect staff
training. Second, we could not use random sampling to recruit PIVAS staff, because no complete list of PIVAS staff is available. However, our study included more than 500 participants from eastern, western, and central China, which means that the results are representative to some extent. Further research should be designed to overcome these limitations.

5. Conclusion
The training content of PIVAS staff in China is relatively rich and sufficient, but management tools, comprehensive ability development, and career development planning are relatively weak. Overall, the training modes are simple, and satisfaction with training is not high. It is necessary to develop PIVAS staff training standards to improve employee capabilities and job satisfaction.

Acknowledgment
We are grateful to the participants who took part in the study. And we are grateful to Benjamin Knight, MSc., from Liwen Bianji, Edanz Editing China (www.liwenbianji.cn/ac), for editing the English text of a draft of this manuscript.

Author contributions
XN and CY designed the study, collected data, carried out analysis and interpretation of the data, and wrote the article. WM and LZ designed the study, collected data, checked the data, and wrote the article.
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