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*Original Research*

# Investigation on the Different Needs of Practicing Doctors for Continuing Medical Education under the Three-Level Medical System in China

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**Abstract**

**Background**: To explore the needs of obstetricians and gynecologists (OB-GYNs) for training methods and contents, under China's three-level diagnosis and treatment system. **Methods**: Epidemiological investigation was adopted, and network questionnaires were distributed in the largest academic training platform of obstetrics and gynecology in China, from April 2020 to May 2020. The investigation contents mainly included training methods and contents of continuing medical education (CME), as well as the mastery of diseases by doctors from hospitals at different levels of training. **Results**: The questionnaire received a total of 16,400 cumulative page views. 4458 questionnaires were collected in total, and 3954 questionnaires were included in the research. Doctors from hospitals at different levels chose the professional direction of gynecological endocrine diseases as the subject requiring the most strengthening of training, with ratios of 80.47%, 81.60% and 82.10%, respectively. Abnormal uterine bleeding (AUB) was the most desirable training content for doctors from primary, secondary, and other hospitals, while training of polycystic ovary syndrome (PCOS) was mostly needed by doctors from tertiary hospitals. According to the investigation, network education was the major training form favored by doctors, as well as a preferential way to acquire professional resources. The number of doctors selecting site meeting report only took up 4.70%. Based on the single-factor chi-square ($\chi^2$) analysis of the degree of mastery of 19 diseases, significant statistical differences were found among doctors from hospitals at each level, except for birth control ($p < 0.001$). After related factors were corrected, the multivariate regression analysis indicated that the degree of mastery of diseases was positively correlated to hospital levels. **Conclusions**: Doctors from hospitals at each level failed to effectively master gynecological endocrine diseases, and AUB, menopausal syndrome, and PCOS were confirmed as diseases for which the doctors had the greatest need of continuing education.

**Keywords:** continuing medical education (CME); three-level diagnosis and treatment system; internet training; professional development

## 1. Introduction

In order to address the challenges to medical fairness, Chinese government initiated a comprehensive healthcare reform in 2019 [1], and medical education became the key to the success of this healthcare reform [2]. As a crucial component of the medical education system, continuing medical education (CME) offers lifelong learning opportunities to medical workers who enters healthcare practice positions after graduating from medical colleges. This is an important approach to assure medical quality [3].

Public hospitals in China provides about 90% of medical services [4]. Currently, a three-level healthcare system is being implemented. To be specific, hospitals are classified into three levels based on indexes [5], such as hospital scale, scientific and research direction, talent and technology strength, and medical hardware, in accordance with Hospital Classified Management Standards. Primary hospi-

tals refer to primary healthcare institutions, i.e., basic-level hospitals directly providing communities with comprehensive medical services, including medical treatment, disease prevention, recovery, and healthcare. Secondary hospitals refer to regional technical centers for medical treatment and disease prevention, i.e., regional healthcare facilities which provides health services for several communities. Secondary hospitals primarily focus on the guidance of monitoring of high-risk groups. Moreover, they accept referrals from primary hospitals, and offer professional and technical guidance for primary hospitals. Additionally, secondary hospitals are capable of performing teaching and scientific research to a certain extent. Tertiary hospitals refer to healthcare facilities that provide services across cities, provinces, regions and even the whole country. Furthermore, they are medical treatment and disease prevention technical centers with comprehensive capabilities for medical treatment, teaching, and scientific research. Tertiary hospitals mainly provide specialized medical services, diagnose, treat critical, difficult and complicated diseases, accept referrals from secondary hospitals, and offer professional and technical guidance, and train talents for hospitals at lower levels. Additionally, tertiary hospitals are in charge of cultivation and the teaching of various senior medical professionals, undertaking scientific research projects at provincial level and above, and attending and guiding the disease prevention work of primary and secondary hospitals.

The current three-level healthcare system in China may influence doctors' diagnosis and treatment skills, especially doctors from primary and secondary hospitals. This can result in patients' distrust due to the perceived limitations in their current professional skills. As a consequence, a large number of urban and rural patients intend to seek medical consultation in tertiary hospitals. The improvement of the professional level of basic-level medical institutions is the key to assuring the balanced development of China's three-level healthcare system. This research executed, for the first time, a large-sample investigation on the degree of mastery of common diseases by doctors from hospitals at different levels in China. The needs for contents and methods of CME were evaluated through the distribution of network questionnaires. These efforts aim to provide scientific basis for the improvement of the continuing education in medical institutions at each level.

## 2. Materials and Methods

### *2.1 Research Design*

This research study adopted network questionnaire survey, distributing the questionnaires in the largest academic training platforms of obstetrics and gynecology in China, from April 2020 to May 2020. All of the doctors who participated in the questionnaire were volunteers. Participants to this questionnaire were provided with training videos related to obstetrics and gynecology free of charge, in order to encourage more doctors to get involved in this investigation.

The contents of the questionnaire survey mainly focused on the training contents and methods needs of obstetricians and gynecologists (OB-GYNs). Furthermore, the contents of the questionnaire were adjusted to align with the characteristics of China's medical institutions and subject settings, ensuring relevance to the actual conditions of these institutions. The contents and design of the questionnaire were discussed and corrected by expert groups, then verified among a small scale of OB-GYNs, and finally released on the network platform.

In the questionnaire, hospitals of different natures refer to comprehensive hospitals, maternity and children's hospital, or reproductive hospitals based on their level of comprehensiveness. Other hospitals in this context refer to medical institutions beyond the aforementioned two types, e.g., primary healthcare centers, and nursing center [6].

This nationwide online survey was approved by the Ethics Review Committee of the Peking Union Medical College Hospital, Chinese Academy of Medical Sciences, on June 8, 2020 (No. S-K 1206).

### *2.2 Participants*

Chinese OB-GYNs participated in this investigation. Inclusion criteria: obstetricians, gynecologists, OB-GYNs, gynecological endocrinologists and fertility doctors. Exclusion criteria: non-OB-GYN and fertility doctor; the questionnaire content included incomplete basic information, investigation contents incompletely filled out, obvious logical errors, and self-contradiction of contents filled out.

### *2.3 Investigation Contents*

#### 2.3.1 Formulation of Questionnaire

The questionnaire's contents evaluated the proficiency of OB-GYNs in managing diseases, as well as their expected training methods, mainly focusing on common clinical diseases. This questionnaire was formulated and reviewed by 4 experts specialized in reproductive endocrinology of gynecology and obstetrics. Initially, 30 OB-GYNs were invited to complete the designed questionnaire. After confirming the questionnaire was then distributed on the internet.

#### 2.3.2 Contents of Questionnaire

The basic demographic data mainly included age, gender, hospital grades and type, years of work and specialist departments.

The investigation of training contents mainly included the most desirable professional direction for strengthening of training, using multiple-response options: common gynecological endocrine diseases, common obstetric diseases, common gynecological diseases, surgical skills, and others. The favorable training contents included: abnormal uterine bleeding (AUB), polycystic ovary syndrome

(PCOS), menopausal syndrome, infertility, adenomyoma, endometriosis, leiomyoma, ovarian cyst, cervical lesions, and obstetrics related diseases.

The investigation of training forms mainly included: favorite training forms (online, site meeting report, online combined with site training); training models with greatest gains (traditional lecturing, problem-based learning (PBL) model and scenario simulation); methods expected to acquire relevant professional resources and support (multiple response). With student discussion as main body, the core of PBL refers to a problem-centered process in which problems are raised, discussed, and learned in form of group discussion, relying on tutor's participation and guidance, and centering on a certain complicated, multi-scenario, and actual problem-based special subject or case [7].

The investigation of mastery of knowledge related to disease diagnosis and treatment included 19 common diseases related to AUB, PCOS, amenorrhea, menopausal syndrome, leiomyoma, infertility, endometriosis, and obstetrics diseases. The knowledge mastery was classified into four grades, namely, 'Know almost nothing', 'Know a small part', 'Familiar with the most parts' and 'Comprehensively mastered'.

### *2.4 Statistical Methods*

SPSS 22.0 software (IBM Corp., Armonk, NY, USA) was utilized to conduct the statistical analysis of the data. This investigation included general demographic data, doctors' needs for training contents, training forms, and methods to acquire professional support. The count data was expressed using percentage or n (%). Chi-square ($\chi^2$) test was adopted for single-factor analysis with test level of $\alpha = 0.05$. $p < 0.05$ is determined as significance difference, while $p < 0.001$ is determined as extremely significant difference. Ordinal multi-classification logistic regression analysis was adopted for multi-factor analysis. Degree of cognition of diseases, different hospital levels, professional direction, age, years of work and hospital nature were determined as dependent variable, independent variable, and concomitant variable adjustment factors respectively. Primary hospital as independent variable was used as a reference, test level of $\alpha = 0.05$.

## 3. Results

### *3.1 Basic Information*

The questionnaire received a total of 16,400 cumulative page views, was collected 4458 times in total, and a the response rate of 27.18%. Out of them, 3954 questionnaires met the inclusion and elimination criteria, and were later included in the research report. The eliminated questionnaires were mainly collected from those who were not OB-GYNs, such as nurses, teachers, healthcare providers, administrative staff, ultrasonic doctors. Furthermore, questionnaires in which identical answers were selected for all questions were also eliminated.

The demographic data, including specialty departments of hospitals at each level where the doctors participating in the investigation worked, as well as gender, age, years of work, hospital nature, and professional department are shown in Table 1. Among the participants of this investigation, doctors from secondary and tertiary hospitals constitute the largest ratio.

### *3.2 Investigation Results Regarding Training Contents and Training Forms*

In terms of professional direction expected for strengthening of training, doctors from hospitals at each level took gynecological endocrine diseases as their first choice. Common gynecological diseases were the second choice for doctors from primary and other hospitals, while the training of surgical skills was the second choice for doctors from secondary and tertiary hospitals. As for the favorite training contents, doctors from primary and other hospitals ranked AUB, menopausal syndrome, and cervical lesions were the top three choices. Accordingly, AUB and menopause were also included in the top three choices for doctors from both secondary and tertiary hospitals. However, PCOS was the third favorable training content for doctors from secondary hospitals, whereas it was the top choices training content for doctors from tertiary hospitals. Network combined with site training was the first choice of training form for doctors from hospitals at each level. Very few doctors chose the training form of site meeting report. As for training model with the greatest gains, scenario simulation was chosen by all doctors from hospitals at each level, while PBL model was seldom selected. As for ways to acquire professional resources and support, network online courses and specialized websites were the top two choices for doctors from hospitals at each level. The investigation of needs of OB-GYNs for training contents, training forms, and ways to acquire professional support under the three-level healthcare system is shown in Table 2. The professional direction expected by OB-GYNs for strengthening of training and their favorable training contents are shown in Figs. 1,2, respectively.

### *3.3 Investigation Results of Degree of Mastery of 19 Diseases by OB-GYNs under the Three-Level Healthcare System*

The degree of mastery of diseases was classified into two types: low cognition ('Know almost nothing' and 'Know a small part'), and high cognition ('Familiar with the most parts' and 'Comprehensively mastered'). Single-factor analysis was adopted and high cognition ratio >50% was deemed as a relatively good mastery of diseases, according to the criteria.

Doctors from hospitals at each level demonstrated the highest mastery in birth control without significant statistical difference. However, the degree of mastery of gynecological endocrine diseases was generally lower than that

**Table 1. Demographic characteristics of the participants in different hospital departments and types [n, (%)].**

| | Number, n (%) | Primary | Secondary | Tertiary | Others |
|---|---|---|---|---|---|
| Gender | | | | | |
| Female | 3860 (97.62) | 423 (99.53) | 2005 (97.85) | 1035 (96.01) | 397 (98.76) |
| Male | 94 (2.38) | 2 (0.47) | 44 (2.15) | 43 (3.99) | 5 (1.24) |
| Age (years) | | | | | |
| 18–25 | 39 (0.99) | 3 (0.71) | 20 (0.98) | 3 (0.28) | 13 (3.23) |
| 26–35 | 701 (17.73) | 56 (13.18) | 359 (17.52) | 242 (22.45) | 44 (10.95) |
| 36–45 | 1677 (42.41) | 205 (48.24) | 866 (42.26) | 437 (40.54) | 169 (42.04) |
| 46–55 | 1357 (34.32) | 156 (36.71) | 701 (34.21) | 345 (32.00) | 155 (38.56) |
| ≥56 | 180 (4.55) | 5 (1.18) | 103 (5.03) | 51 (4.73) | 21 (5.22) |
| Years in post (years) | | | | | |
| ≤5 | 274 (6.93) | 20 (4.71) | 134 (6.54) | 89 (8.26) | 31 (7.71) |
| 6–10 | 524 (13.25) | 46 (10.82) | 250 (12.20) | 178 (16.51) | 50 (12.44) |
| 11–20 | 1205 (30.48) | 131 (30.82) | 637 (31.09) | 342 (31.73) | 95 (23.63) |
| >20 | 1951 (49.34) | 228 (53.65) | 1028 (50.17) | 469 (43.51) | 226 (56.22) |
| Professional department | | | | | |
| Obstetrician | 337 (8.52) | 13 (3.06) | 160 (7.81) | 142 (13.17) | 22 (5.47) |
| Gynecologist | 1164 (29.44) | 112 (26.35) | 483 (23.57) | 468 (43.41) | 101 (25.12) |
| OB-GYN | 2289 (57.89) | 299 (70.35) | 1359 (66.33) | 367 (34.04) | 264 (65.67) |
| Gynecological endocrinologist and fertility doctor | 164 (4.15) | 1 (0.24) | 47 (2.29) | 101 (9.37) | 15 (3.73) |
| Hospital type | | | | | |
| Maternity and children hospital or reproductive hospital | 1593 (40.29) | 77 (18.12) | 893 (43.58) | 392 (36.36) | 231 (57.46) |
| General hospital | 2210 (55.89) | 274 (64.47) | 1139 (55.59) | 673 (62.43) | 124 (30.85) |
| Others | 151 (3.82) | 74 (17.41) | 17 (0.83) | 13 (1.21) | 47 (11.69) |

OB-GYN, obstetricians and gynecologists.

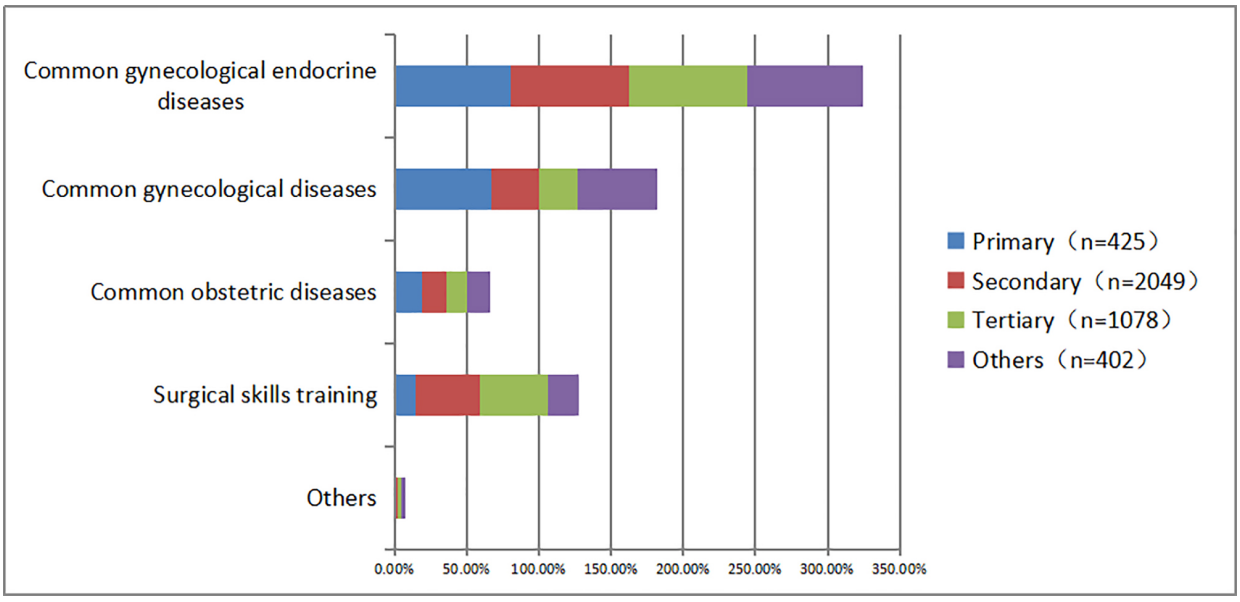


**Fig. 1. The professional direction expected by OB-GYNs for strengthening of training under the three-level health system.** OB-GYNs, obstetricians and gynecologists.

of common gynecological and obstetric diseases. The degree of cognition of common gynecological and obstetric diseases by doctors from secondary and tertiary hospitals was significantly higher than that by doctors from primary and other hospitals. Doctors from secondary and other hospitals had a similar cognition degree of common gynecological and obstetric diseases. Doctors from tertiary hospitals had the highest degree of mastery of relevant gynecological endocrine diseases, presenting positive correlation with the hospital level. Doctors from hospitals at each level demonstrated the highest mastery in AUB, a gynecological endocrine disease. The ratio of high cognition for infertility, precocious puberty/delayed puberty, premature ovarian failure (POF), and hyperprolactinemia was lower than 50% among hospitals at each level. The single-factor $\chi^2$ analysis of degree of mastery (high cognition) of 19 diseases by OB-GYN sunder three-level healthcare system is sown in Table 3 and Fig. 3.

**Table 2. The investigation of demands of OB-GYNsfor training contents, training forms, and ways to acquire professional support under the three-level health system [n, (%)].**

| | Number, n (%) | Primary (n = 425) | Secondary (n = 2049) | Tertiary (n = 1078) | Others (n = 402) |
|---|---|---|---|---|---|
| The most desirable professional direction for strengthening of training | | | | | |
| Common gynecological endocrine diseases | 3221 (81.46) | 342 (80.47) | 1672 (81.60) | 885 (82.10) | 322 (80.10) |
| Common gynecological diseases | 1474 (37.28) | 283 (66.59) | 680 (33.19) | 288 (26.72) | 223 (55.47) |
| Common obstetric diseases | 650 (16.44) | 79 (18.59) | 351 (17.13) | 154 (14.29) | 66 (16.42) |
| Surgical skills | 1570 (39.71) | 62 (14.59) | 916 (44.70) | 509 (47.22) | 83 (20.65) |
| Others | 71 (1.80) | 3 (0.71) | 26 (1.27) | 32 (2.97) | 10 (2.49) |
| The favorable training contents | | | | | |
| AUB | 3359 (84.95) | 379 (89.18) | 1764 (86.09) | 860 (79.78) | 356 (88.56) |
| Menopausal syndrome | 2849 (72.05) | 360 (84.71) | 1444 (70.47) | 743 (68.92) | 302 (75.12) |
| PCOS | 2508 (63.43) | 258 (60.71) | 1292 (63.06) | 714 (66.2) | 244 (60.70) |
| Infertility | 2318 (58.62) | 220 (51.76) | 1235 (60.27) | 631 (58.53) | 232 (57.71) |
| Adenomyoma and endometriosis | 2053 (51.92) | 219 (51.53) | 1059 (51.68) | 551 (51.11) | 224 (55.72) |
| Leiomyoma and ovarian cyst | 1493 (37.76) | 185 (43.53) | 768 (37.48) | 374 (34.69) | 166 (41.29) |
| Cervical lesions | 2306 (58.32) | 292 (68.71) | 1194 (58.27) | 548 (50.83) | 272 (67.66) |
| Obstetrics | 1476 (37.33) | 138 (32.47) | 844 (41.19) | 346 (32.10) | 148 (36.82) |
| Favorite training forms | | | | | |
| Online | 1827 (46.21) | 195 (45.88) | 942 (45.97) | 504 (46.75) | 186 (46.27) |
| Site meeting report | 186 (4.70) | 16 (3.76) | 105 (5.12) | 46 (4.27) | 19 (4.73) |
| Online combined with site training | 1941 (49.09) | 214 (50.35) | 1002 (48.90) | 528 (48.98) | 197 (49.00) |
| Training models with greatest gains | | | | | |
| Traditional lecturing | 1266 (32.02) | 161 (37.88) | 604 (29.48) | 347 (32.19) | 154 (38.31) |
| PBL model | 889 (22.48) | 85 (20.00) | 438 (21.38) | 297 (27.55) | 69 (17.16) |
| Scenario simulation | 1799 (45.50) | 179 (42.12) | 1007 (49.15) | 434 (40.26) | 179 (44.53) |
| The methods expected to acquire relevant professional resources and support | | | | | |
| WeChat | 3225 (81.56) | 371 (87.29) | 1651 (80.58) | 879 (81.54) | 324 (80.60) |
| Professional website | 2034 (51.44) | 213 (50.12) | 1044 (50.95) | 584 (54.17) | 193 (48.01) |
| Conference or forum | 1740 (44.01) | 180 (42.35) | 869 (42.41) | 534 (49.54) | 157 (39.05) |
| Online courses | 3010 (76.13) | 326 (76.71) | 1539 (75.11) | 847 (78.57) | 298 (74.13) |

OB-GYNs, obstetricians and gynecologists; AUB, abnormal uterine bleeding; PCOS, polycystic ovary syndrome; PBL, problem-based learning.

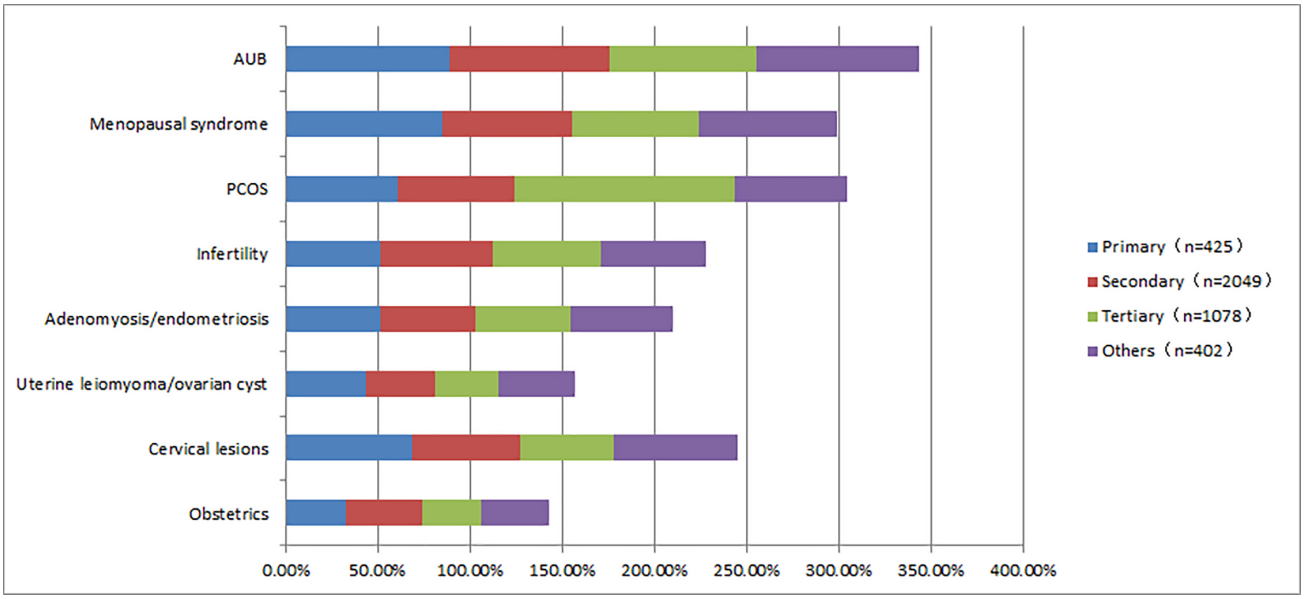


**Fig. 2. The favorable training contents expected by OB-GYNs for strengthening of training under the three-level health system.** OB-GYNs, obstetricians and gynecologists; AUB, abnormal uterine bleeding; PCOS, polycystic ovary syndrome.

Next, multivariate regression analysis was conducted after correction of factors including age, seniority, professional direction, and hospital type, with primary hospitals as a reference. Except birth control, the degree of cognition of various diseases by doctors from tertiary hospitals was significantly higher than those from primary hospitals. Ex-

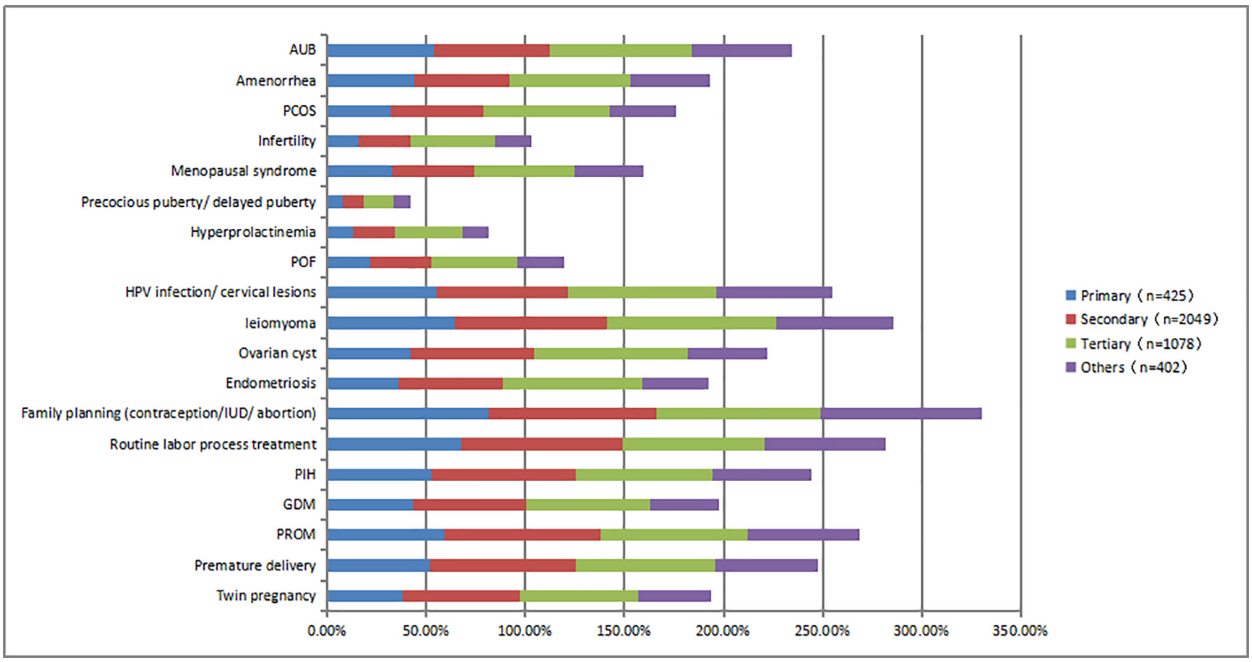


**Fig. 3. The degree of mastery of 19 diseases by OB-GYN sunder the three-level health system (high cognition).** OB-GYNs, obstetricians and gynecologists; AUB, abnormal uterine bleeding; PCOS, polycystic ovarian ovary syndrome; POF, premature ovarian failure; PIH, pregnancy-induced hypertension; GDM, gestational diabetes mellitus; PROM, premature rupture of membranes.

**Table 3. The single-factor $\chi^2$ analysis of degree of mastery of 19 diseases by OB-GYN sunder the three-level health system (high cognition) [n, (%)].**

| | Primary (n = 425) | Secondary (n = 2049) | Tertiary (n = 1078) | Others (n = 402) | $\chi^2$ | *p*-value |
|---|---|---|---|---|---|---|
| AUB | 230 (54.12) | 1189 (58.03) | 776 (71.99) | 201 (50.00) | 90.59 | <0.001 |
| Amenorrhea | 186 (43.76) | 989 (48.27) | 654 (60.67) | 162 (40.30) | 73.08 | <0.001 |
| PCOS | 136 (32.00) | 955 (46.61) | 691 (64.10) | 134 (33.33) | 191.32 | <0.001 |
| Infertility | 68 (16.00) | 526 (25.67) | 462 (42.86) | 75 (18.66) | 168.40 | <0.001 |
| Menopausal syndrome | 138 (32.47) | 849 (41.43) | 546 (50.65) | 141 (35.07) | 56.83 | <0.001 |
| Precocious puberty/delayed puberty | 34 (8.00) | 213 (10.40) | 162 (15.03) | 34 (8.46) | 24.62 | <0.001 |
| Hyperprolactinemia | 55 (12.94) | 436 (21.28) | 370 (34.30) | 53 (13.18) | 127.14 | <0.001 |
| POF | 93 (21.88) | 622 (30.36) | 473 (43.88) | 95 (23.60) | 104.24 | <0.001 |
| HPV infection/cervical lesions | 235 (55.29) | 1362 (66.47) | 802 (74.40) | 235 (58.46) | 65.90 | <0.001 |
| Uterine leiomyomas | 273 (64.24) | 1570 (76.62) | 922 (85.53) | 237 (58.96) | 150.04 | <0.001 |
| Ovarian cyst | 178 (41.88) | 1275 (62.23) | 836 (77.55) | 161 (40.05) | 265.81 | <0.001 |
| Endometriosis | 153 (36.00) | 1075 (52.46) | 759 (70.41) | 136 (33.83) | 239.67 | <0.001 |
| Family planning (contraception/IUD/abortion) | 345 (81.18) | 1743 (85.07) | 894 (82.93) | 327 (81.34) | 6.88 | 0.076 |
| Routine labor process treatment | 286 (67.29) | 1671 (81.55) | 773 (71.71) | 245 (60.95) | 109.54 | <0.001 |
| PIH | 223 (52.47) | 1491 (72.77) | 743 (68.92) | 202 (50.25) | 124.60 | <0.001 |
| GDM | 184 (43.29) | 1168 (57.00) | 674 (62.52) | 140 (34.83) | 117.43 | <0.001 |
| PROM | 251 (59.06) | 1612 (78.67) | 800 (74.21) | 228 (56.72) | 130.57 | <0.001 |
| Premature delivery | 220 (51.76) | 1509 (73.65) | 758 (70.32) | 209 (51.99) | 131.85 | <0.001 |
| Twin pregnancy | 163 (38.35) | 1204 (58.76) | 642 (59.55) | 149 (37.06) | 120.10 | <0.001 |

AUB, abnormal uterine bleeding; PCOS, polycystic ovary syndrome; HPV, human papillomavirus; IUD, intrauterine device; PIH, pregnancy-induced hypertension; GDM, gestational diabetes mellitus; PROM, premature rupture of membranes; POF, premature ovarian failure.

cept for the degree of cognition of AUB, amenorrhea, precocious puberty/delayed puberty, and birth control, which presented no significant statistical difference, the degree of cognition for the other 15 diseases among doctors from primary and secondary hospitals was significantly higher than that of doctors from primary hospitals. The degree of cognition of diseases by doctors from primary hospitals was similar to that of other hospitals. Except for gestational diabetes mellitus (GDM), which presented no significant statistical difference, the difference analysis of degree of mastery of 19 diseases by OB-GYNs under the three-level healthcare system, after correction of multiple factors, is shown in Table 4.

**Table 4. The difference analysis of degree of mastery of 19 diseases by OB-GYN sunder the three-level health system, after correction of multiple factors.**

| Diseases | Primary | Secondary | Tertiary | Others |
|---|---|---|---|---|
| AUB | | | | |
| Exp (B) (95% CI) | 1.00 | 1.23 (0.98–1.54) | 2.74 (2.13–3.53) | 0.83 (0.63–1.11) |
| *p* | | 0.78 | 0.00 | 0.21 |
| Amenorrhea | | | | |
| Exp (B) (95% CI) | 1.00 | 1.24 (0.99–1.56) | 2.48 (1.93–3.18) | 0.84 (0.63–1.12) |
| *p* | | 0.06 | 0.00 | 0.23 |
| PCOS | | | | |
| Exp (B) (95% CI) | 1.00 | 2.00 (1.58–2.54) | 4.83 (3.73–6.25) | 1.06 (0.79–1.43) |
| *p* | | 0.00 | 0.00 | 0.71 |
| Infertility | | | | |
| Exp (B) (95% CI) | 1.00 | 1.91 (1.43–2.56) | 5.06 (3.73–6.86) | 1.18 (0.82–1.71) |
| *p* | | 0.00 | 0.00 | 0.38 |
| Menopausal syndrome | | | | |
| Exp (B) (95% CI) | 1.00 | 1.59 (0.17–0.37) | 2.76 (2.13–3.58) | 1.09 (0.81–1.48) |
| *p* | | 0.00 | 0.00 | 0.57 |
| Precocious puberty/delayed puberty | | | | |
| Exp (B) (95% CI) | 1.00 | 1.32 (0.89–1.96) | 2.17 (1.45–3.25) | 1.03 (0.62–1.70) |
| *p* | | 0.16 | 0.00 | 0.91 |
| Hyperprolactinemia | | | | |
| Exp (B) (95% CI) | 1.00 | 1.88 (1.37–2.58) | 4.31 (3.10–5.98) | 0.99 (0.65–1.49) |
| *p* | | 0.00 | 0.00 | 0.94 |
| POF | | | | |
| Exp (B) (95% CI) | 1.00 | 1.60 (1.23–2.08) | 3.44 (2.61–4.55) | 1.07 (0.77–1.50) |
| *p* | | 0.00 | 0.00 | 0.68 |
| HPV infection/cervical lesions | | | | |
| Exp (B) (95% CI) | 1.00 | 1.69 (1.35–2.12) | 2.69 (2.09–3.45) | 1.16 (0.88–1.54) |
| *p* | | 0.00 | 0.00 | 0.29 |
| Leiomyoma | | | | |
| Exp (B) (95% CI) | 1.00 | 1.94 (1.53–2.46) | 3.93 (2.97–5.18) | 0.81 (0.60–1.07) |
| *p* | | 0.00 | 0.00 | 0.14 |
| Ovarian cyst | | | | |
| Exp (B) (95% CI) | 1.00 | 2.37 (1.89–2.96) | 5.54 (4.29–7.15) | 0.93 (0.70–1.23) |
| *p* | | 0.00 | 0.00 | 0.62 |
| Endometriosis | | | | |
| Exp (B) (95% CI) | 1.00 | 2.02 (1.61–2.54) | 4.77 (3.71–6.13) | 0.91 (0.68–1.21) |
| *p* | | 0.00 | 0.00 | 0.51 |
| Family planning (contraception/IUD/abortion) | | | | |
| Exp (B) (95% CI) | 1.00 | 1.32 (0.99–1.77) | 1.26 (0.92–1.72) | 1.03 (0.71–1.48) |
| *p* | | 0.06 | 0.16 | 0.88 |
| Routine labor process treatment | | | | |
| Exp (B) (95% CI) | 1.00 | 2.15 (1.68–2.76) | 1.38 (1.06–1.79) | 0.75 (0.56–1.01) |
| *p* | | 0.00 | 0.02 | 0.06 |
| PIH | | | | |
| Exp (B) (95% CI) | 1.00 | 2.51 (2.00–3.15) | 2.26 (1.77–2.88) | 0.92 (0.70–1.22) |
| *p* | | 0.00 | 0.00 | 0.57 |
| GDM | | | | |
| Exp (B) (95% CI) | 1.00 | 1.71 (1.37–2.13) | 2.24 (1.76–2.84) | 0.70 (0.53–0.93) |
| *p* | | 0.00 | 0.00 | 0.02 |
| PROM | | | | |
| Exp (B) (95% CI) | 1.00 | 2.66 (2.10–3.35) | 2.30 (1.78–2.95) | 0.93 (0.70–1.23) |
| *p* | | 0.00 | 0.00 | 0.61 |
| Premature delivery | | | | |
| Exp (B) (95% CI) | 1.00 | 2.70 (2.15–3.38) | 2.51 (1.96–3.20) | 1.03 (0.78–1.36) |
| *p* | | 0.00 | 0.00 | 0.86 |
| Twin pregnancy | | | | |
| Exp (B) (95% CI) | 1.00 | 2.34 (1.86–2.93) | 2.58 (2.02–3.30) | 0.94 (0.71–1.26) |
| *p* | | 0.00 | 0.00 | 0.68 |

AUB, abnormal uterine bleeding; PCOS, polycystic ovary syndrome; HPV, human papilloma virus; IUD, intrauterine device; PIH, pregnancy-induced hypertension; GDM, gestational diabetes mellitus; PROM, premature rupture of membranes; POF, premature ovarian failure; 95% CI, 95% confidence interval.

## 4. Discussion

The demographic data in our investigation have revealed that doctors from secondary hospitals have the highest need for continuing education and learning among the main groups participating in continuing education and learning. The current three-level healthcare system in China provides doctors from secondary hospitals with more opportunities than those from primary hospitals to diagnose and treat relatively complicated diseases compared to those from primary hospitals. However, they face limitations in patient resources, unlike doctors from tertiary hospitals, which restrains the improvement of their professional skills. As a result, this group of doctors exhibits the greatest need for continuing education.

In our investigation, according to the results of both single-factor analysis and regression analysis after correction of multiple factors, the degree of doctors' mastery of diseases herein presented significant positive correlation with the hospital level. In most high-income countries, doctors are a homogeneous group, receiving the same level of education and training. However, in order to quickly increase the number of doctors, multilevel medical education system has been adopted in China in order to train physicians since the 1950s. While some doctors have undergone comprehensive education and training, others have only received short-term or incomplete training, thus resulting in the heterogeneity of Chinese doctors [8]. This education system has benefited the increase of healthcare professionals in China at a lower cost. On the other hand, it has also resulted in the inequality and efficiency loss of medical treatment and healthcare, thus paying the price for the multilevel medical education. The three-level medical system of China has further resulted in the inequality of talent distribution, and doctors who have received higher learning are more likely to be hired by high-level hospitals [9]. Since a hospital-centered healthcare system is adopted in China, patients would thus chase good doctors by visiting high-level hospitals. This status quo has created a situation where doctors in high-level hospitals have more opportunities to diagnose and treat various diseases, allowing them to master their understanding of said diseases. Currently, China is trying to change the gap existing in the medical education. According to the national statistical data, the number of five-year medical students as increased from 320,000 to 3,050,000, and the number of three-year medical students in the same period as also increased from 530,000 to 1,210,000, from 1999 to 2018. According to the forecast of distribution of physicians' education degrees from 2015 to 2035, the ratio of physicians with education background of undergraduate and above will grow from 47% in 2015, to 54% in 2035 [10]. The already practicing doctors mainly improve their treatment level through CME. Therefore, another concern for our research is how to launch CME to provide the most efficient services to the doctor group.

The professional direction expected by doctors from hospitals at each level for strengthening of training, favorable training contents, and the degree of mastery of 19 diseases by doctors from hospitals at each level supplement each other. Doctors from hospitals at each level had relatively weak mastery of related gynecological endocrine diseases. In regard to professional direction expected for strengthening of training, doctors from hospitals at each level selected gynecological endocrine diseases as their first choice. Moreover, more than half of doctors from secondary and tertiary hospitals were familiar with, and even comprehensively mastered common gynecological and obstetric diseases. Since surgeries are the daily work of doctors from secondary and tertiary hospitals, needs for surgical skills ranked the second place. Doctors from primary and other hospitals seldom have the opportunity to engage in surgeries in their daily work due to the restriction of hospital levels, and therefore they have greater needs for the training of diagnosis and treatment of common gynecological diseases.

All doctors from hospitals at each level mainly chose online training forms and expected method to acquire professional resources and support. Meeting report and periodic WeChat push were the two training forms least chosen. With the development of network technology and the pandemic of coronavirus disease 2019 (COVID-19), online learning and medical education have been gradually integrated, and remote learning has become the norm [11]. According to some research findings, online learning has a certain impact on the learning effect due to its flexibility and convenience [12]. Furthermore, the quality of online learning is also a research focus. A meta-analysis indicated that the improvement of internet-based learning forms was seemingly related to learning achievements in terms of interaction, exercise, feedback, and repetition [13]. Other studies indicated that certain factors might influence the effect of online learning, such as interaction and communication between lecturers and trainees, centering on learners or not, and teaching based on learners' purposes and expectations [14,15]. However, an investigation targeted at senior doctors in Australia, with more than half of them being general practitioners, indicated that CME in traditional forms was much more popular than online learning [16]. The possible reason for this difference was analyzed as related to whether the contents of online learning complied with the educator's actual work needs and preferences.

The low response rate to the online questionnaire makes it possible that our findings are not representative of a larger group of physicians, potentially skewing our results in favor of physicians who have more time, or who are more willing to take the survey. The online questionnaire model may favor those who prefer to interact online. On the other hand, deviation may occur due to participants choosing to take online courses.

## 5. Conclusions

Our investigation results indicated that the degree of doctors' mastery of diseases presented positive correlation with different hospital levels, and gynecological endocrine diseases were not effectively mastered by doctors from hospitals at the different levels. Doctors from hospitals at each level failed to effectively master gynecological endocrine diseases, and AUB, menopausal syndrome, and PCOS were confirmed as diseases for which the doctors had the greatest need of continuing education. China's three-level medical system results in differential distribution of medical resources, and CME might be one of the methods to narrow this gap. Network teaching is a popular teaching method, and further researches shall be conducted as how to improve teaching quality by optimizing teaching methods.

## Availability of Data and Materials

All data points generated or analyzed during this study are included in this article and there are no further underlying data necessary to reproduce the results.

## Author Contributions

AS conceived and designed the study. HW, HD, YZou, WW, QZ, YF, ZT, XZ and YZhao performed the research. HW, JC, ZZ and YW extracted the data. HW analyzed the data and wrote the manuscript. AS, JC and ZZ revised the manuscript and supervised the study. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

## Ethics Approval and Consent to Participate

All subjects gave their informed consent for inclusion before they participated in the study. This nationwide online survey was approved by the Ethics Review Committee of the Peking Union Medical College Hospital, Chinese Academy of Medical Sciences, on June 8, 2020 (No. S-K 1206).


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## Conflict of Interest

The authors declare no conflict of interest.

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