# Study on the demand for public health professional after the COVID-19 epidemic in Zhejiang Province, China: A survey based on human- machine collaboration

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**Abstract:** To understand the needs of public health institutions in Zhejiang Province, China for public health personnel, and provide basis for training public health personnel. Methods: 512 public health institutions in Zhejiang Province were randomly selected from different levels and regions, and the number of ublic health professional and the demand for professional ability were investigated by questionnaire. Results: The preventive medicine personnel in public health institutions in Zhejiang Province are insufficient; There is a certain disjunction or dislocation between the abilities and needs of public health professional; The way of continuing education for public health professional is single and the opportunities are few. Conclusion: Zhejiang Province should appropriately expand the enrollment of preventive medicine majors, especially high-level preventive medicine talents, deepen the education and teaching reform of preventive medicine majors, and strengthen the continuing education and training of public health professional to meet the needs of public health services after the COVID-19 epidemic.

**Keywords:** Health institutions, Public health professional, COVID-19, Investigation and research

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With the development of social economy, the progress of science and technology and the continuous improvement of people's living standards, people's demand for health services is increasing (XU J., et al., 2019). The change of disease spectrum and the aging of population have brought many corresponding social health needs. In order to coordinate the development of human health and society and meet the needs of the people for medical care knowledge, it is necessary to develop public health as soon as possible and train public health professional to meet the needs of social development (HUANG L., 2020). In order to understand the demand of public health institutions in various cities and counties (districts) of Zhejiang Province for preventive medicine talents, from February to June 2022, the centers for disease prevention and control (epidemic prevention stations), health supervision centers, hospitals (general hospitals, integrated Chinese and western/ integrated Chinese medicine hospitals, specialized hospitals, nursing homes, etc.) Other professional public health institutions (specialized disease prevention and treatment centers, maternal and child health centers, first aid centers, blood collection and supply institutions, family planning technical service institutions, etc.), community health service centers/ stations, street/township health centers, other medical grassroots health institutions (village clinics, outpatient clinics, clinics, clinics, infirmaries, nursing stations, etc.) The public health institutions in 8 categories of other health institutions have conducted investigation and analysis on the number of preventive medicine talents and the demand for professional ability, with a view to providing a basis for the training of public health professional.

## Object and Method

### Investigation object

Nearly 600 public health institutions were randomly selected from Jinhua, Quzhou, Lishui and other inland areas in Zhejiang Province, and from Hangzhou, Ningbo, Wenzhou, Shaoxing and other coastal areas. The subjects were the director of the Center for Disease Control and Prevention, the director of the Institute of Health Supervision, the director of the hospital, the director of the community health service center, the director of the township health center and the relevant management personnel of other public health institutions. A total of 580 questionnaires were distributed in this survey, and 512 valid questionnaires were recovered, with the recovery rate of 88.28%.

### Method

Using the questionnaire survey method, the research group designed the questionnaire by referring to the relevant literature, and sent the questionnaire to two public health management experts (the dean of the college of public health management and the dean of the provincial key tertiary hospital) for consultation (HUANG Z. & ZHOU H., 2020; SHI L., et al., 2020; WU F.,2020). According to the feedback, it adjusted and revised the questionnaire to form the Questionnaire on the Quantity and Professional Competence Needs of Public Health Professional in Zhejiang Province, see Appendix 1. The mobile version of the questionnaire is formed through the questionnaire star. Through the recommendation of the health management department, the promotion of the medical system, and the introduction of acquaintances, under the overall balanced distribution of the security layers and regions, the questionnaire survey is randomly conducted on the management personnel of public health institutions, and collected through the questionnaire star system. There are 31 questions in the questionnaire. The survey contents mainly include the current situation of public health professional in public health institutions and the needs of public health professional, specifically including the problems of public health professional, the educational

level of public health professional, and the continuing re-education of public health professional; The overall demand for public health professional, the number of public health professional and the educational level of public health professional in the next three years; The personal accomplishment (professional etiquette, professional ethics, work attitude) of public health professional of public health institutions Theoretical knowledge (medical basic knowledge, clinical basic knowledge, epidemiology, environmental hygiene, occupational health and occupational medicine, food hygiene and nutrition, child hygiene, health statistics, diagnosis of chronic diseases, three-level prevention of chronic diseases, diagnosis of infectious diseases, prevention of infectious diseases, knowledge of health supervision laws and regulations, basic public health service specifications) Professional skills (Basic knowledge and basic operation process of hygiene chemistry, basic knowledge and basic operation process of toxicology, basic steps of statistical work, common statistical methods, basic theories and basic knowledge of epidemiology, basic characteristics of infectious diseases, clinical characteristics and treatment principles; basic characteristics and prevention methods of chronic diseases and common diseases; concepts, basic steps, contents and strategies of health management; health education and production of publicity materials; Child health and school health monitoring and disease prevention; Health care technology for women and children; National basic public health knowledge and skills; Detection and analysis of food nutritional components and nutritional intervention; Investigation of food pollution and food poisoning; Food hygiene inspection and evaluation; Occupational health detection, supervision and evaluation; Detection and evaluation of water, soil, air and other environmental sanitation; On-site disinfection technology; Hygienic microorganism detection technology; Health physical and chemical analysis technology; Conduct sanitary inspection and supervision on the workplace; Emergency response technology for public health emergencies), comprehensive quality (language expression, interpersonal communication, cooperation and coordination, organization and management, health education and publicity, analysis and solution of daily problems, emergency response, scientific research and innovation, English application, informational ability, self-study ability), etc.

**Statistical Methods**

SPSSAU platform was used for statistical analysis, descriptive analysis was used to process the data, and reliability analysis was performed on all 31 items of the questionnaire. Cronbach's α The coefficient is 0.901, indicating that the reliability of the scale is very good. At the same time, the validity analysis showed that the KMO value was 0.918 and the P value was<0.001, indicating that the validity was good.

## Results

**Current situation of preventive medicine personnels in public health institutions**

Among the 512 public health institutions surveyed in this survey, there are 77 centers for disease prevention and control, 72 health supervision centers, 25 other professional public health institutions (specialized disease prevention and control centers, maternal and child health centers, emergency centers, blood collection and supply institutions, family planning technical service institutions, etc.), 90 community health service centers/stations, and 70 street/township health centers, There are 80 other medical grassroots health institutions (village clinics, outpatient departments, clinics, infirmaries, nursing stations, etc.), 95 hospitals (general hospitals, integrated Chinese and Western hospitals, specialized hospitals, nursing homes, etc.), and 15 other health institutions. As shown in Figure 1, among the public

health services provided by 512 public health service institutions, the top five are infectious disease reporting and monitoring (51.17%), resident health records (47.66%), infectious disease epidemic survey (40.04%), chronic disease management (29.29%) and vaccination (26.17%). It can be seen from Figure 2 that in the public health service team, the number of people from clinical medicine is the largest, accounting for 50.98%, but there are also many people from preventive medicine, accounting for 30.47%. For the current problems of public health professional in public health institutions, 53.91% of the managers of public health management institutions believe that the educational background is generally low, 50.59% of the professional level and professional skills are not high, and 41.6% believe that the age structure is unreasonable. At present, the main way for public health professional in public health institutions to study is counterpart support and clinical study such as fixed-point assistance from superior units, 42.58% and 32.23% respectively.

**Demand for the number and level of public health professional**

Of the 512 public health institutions, the overall demand for public health professional in the next three years will increase by 218, with a small change of 72, and a decrease of 165, with 57 unclear. The

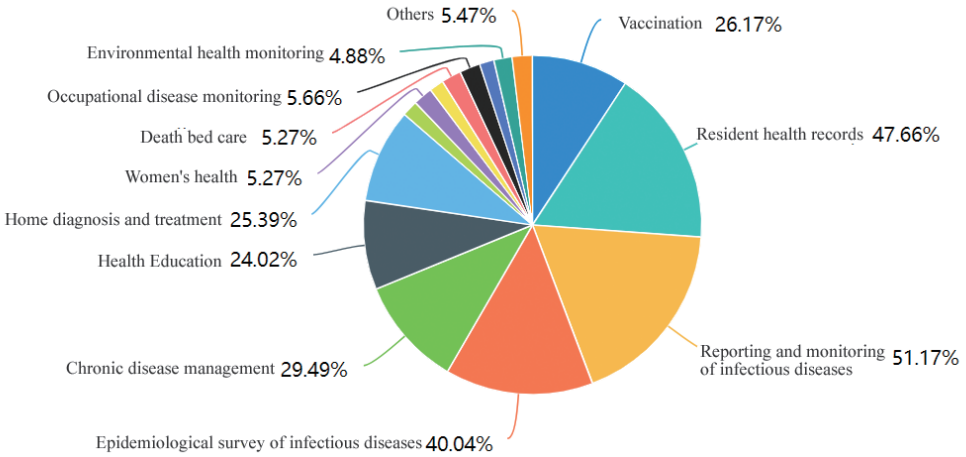


Figure 1 Main public health services provided by 512 public health service institutions

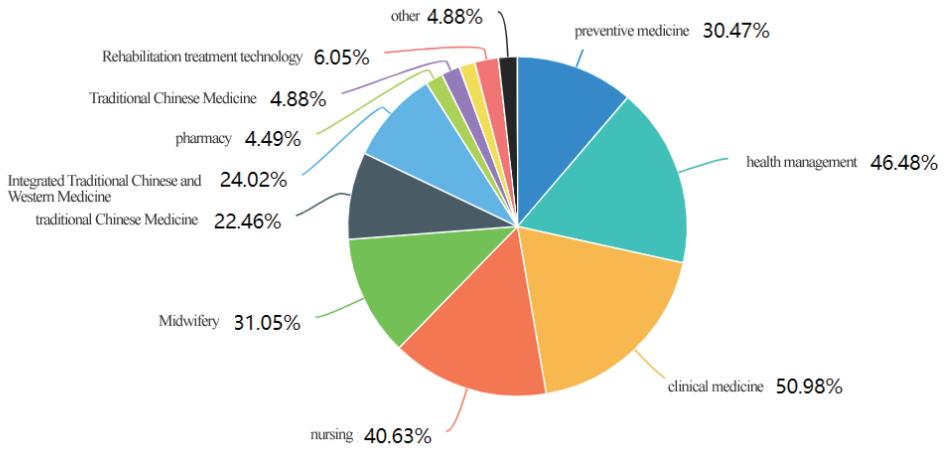


Figure 2 Proportion of preventive medicine majors in 512 public health institutions

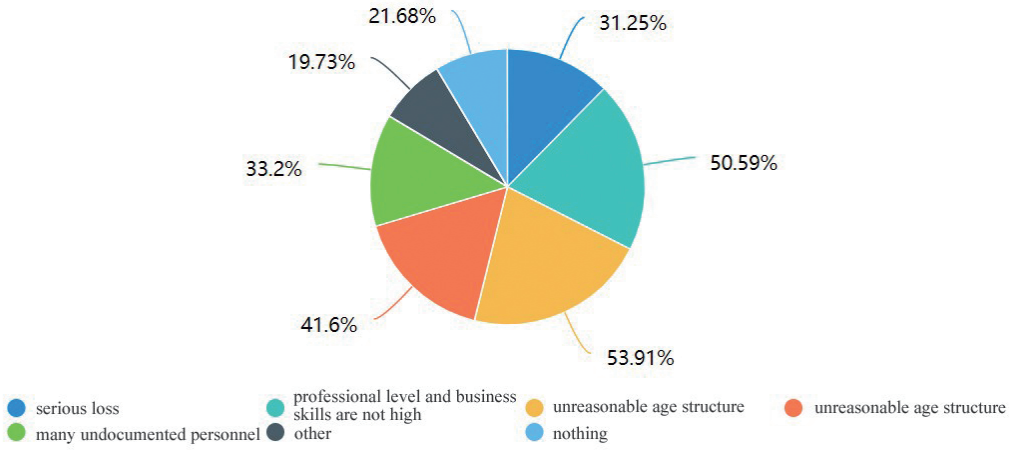


Figure 3　Problems of public health professional in 512 public health institutions

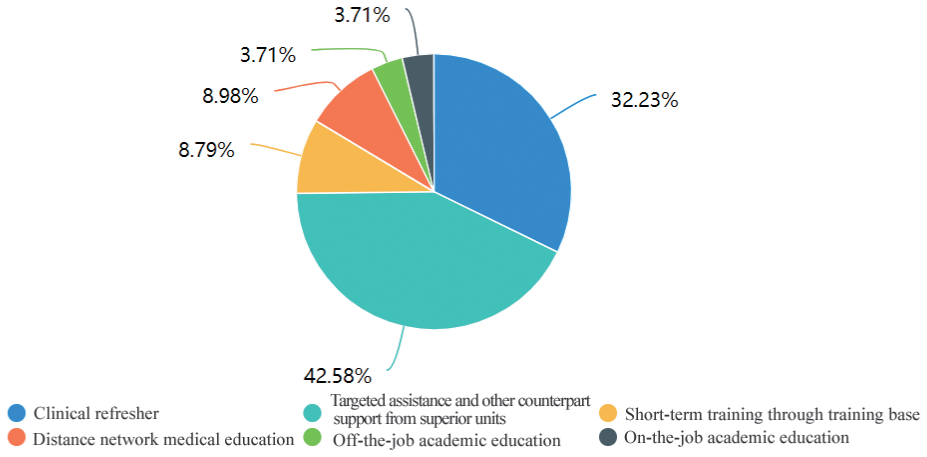


Figure 4　Main ways for public health professional to study in 512 public health institutions

main reasons for the increase in demand for public health professional are the expansion of the unit size (35.74%), the increasing business volume (26.95%), the need to improve the education and knowledge structure of the existing talent team (24.41%), and the serious brain drain (12.89%).

Table 1 shows the estimated demand of 512 public health institutions for public health professional in the next three years. It can be seen from Table 1 that hospitals, centers for disease prevention and control, and health supervision institutions are still the largest demand departments for public health professional. In general, in the next three years, the demand for public health professional will be the largest among 6-10 people, actually less than 5 people. In the next three years, 38.48% of public health institutions will require 6-10 preventive medical professional, and 27.15% of institutions will require less than 5. In the next three years, the most scarce academic qualifications of public health professional in public health institutions are shown in Table 2. It can be seen from Table 2 that there is a statistically significant difference in the types of educational qualifications of public health professional in public health institutions. The number of institutions most in need of master's degree graduates in the Centers for Disease Control and Prevention, the Health Supervision Institute, hospitals (general hospitals, integrated Chinese and

Western hospitals, specialized hospitals, nursing homes, etc.) is the largest, accounting for 36.36%, respectively 36.67%, 44.21%; The second is doctors, accounting for 28%, 20% and 25% respectively. Other professional public health institutions (specialized disease prevention and treatment centers, maternal and child health centers, first aid centers, blood collection and supply institutions, family planning technical service institutions, etc.), community health service centers/stations, street/township health centers, other medical grassroots health institutions (village clinics, outpatient clinics, clinics, clinics, infirmaries, nursing stations, etc.), and other health institutions have the most urgent demand for public health professional at the undergraduate level, accounting for 56% respectively 68.89%, 85.71%, 78.75%, 53.33%; Due to geographical disadvantages, some remote mountainous areas still have the demand for preventive medicine talents with professional or lower education, accounting for 6.45%.

**Table 1 Estimated demand for public health professional from 512 public health institutions in the next three years**

| Group | Total | <=5 | | 6-10 | | 11-15 | | 16-20 | | >=20 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | Proportion (%) | Number | Proportion (%) | Number | Proportion (%) | Number | Proportion (%) | Number | Proportion (%) |
| Center for Disease Control and Prevention | 77 | 19 | 24.68 | 32 | 41.56 | 8 | 10.39 | 14 | 18.18 | 4 | 5.19 |
| Health Supervision Institute | 60 | 18 | 30 | 21 | 35 | 7 | 11.67 | 11 | 18.33 | 3 | 5 |
| Hospital* | 95 | 25 | 26.32 | 37 | 38.95 | 7 | 7.37 | 15 | 15.79 | 11 | 11.58 |
| Other professional public health institutions* | 25 | 9 | 36 | 8 | 32 | 3 | 12 | 3 | 12 | 2 | 8 |
| Community health service center/station | 90 | 21 | 23.33 | 38 | 42.22 | 15 | 16.67 | 14 | 15.56 | 2 | 2.22 |
| Street/township health center | 70 | 25 | 35.71 | 21 | 30 | 10 | 14.29 | 8 | 11.43 | 6 | 8.57 |
| Other medical and grass-roots health institutions* | 80 | 17 | 21.25 | 35 | 43.75 | 11 | 13.75 | 12 | 15 | 5 | 6.25 |
| Other health institutions | 15 | 5 | 33.33 | 5 | 33.33 | 3 | 20 | 2 | 13.33 | 0 | 0 |

Note: * Hospitals refer to comprehensive hospitals, integrated Chinese and Western hospitals, specialized hospitals, nursing homes, etc.), other professional public health institutions refer to specialized disease prevention and treatment centers, maternal and child health centers, emergency centers, blood collection and supply institutions, family planning technical service institutions, etc., and other medical grass-roots health institutions refer to village clinics, outpatient departments, clinics, clinics, clinics, clinics, clinics, clinics, nursing stations, etc.

**Table 2 Distribution of the most scarce academic qualifications of public health professional in 512 public health institutions in the next three years**

| Group | Total | Doctor | | Master | | Undergraduate | | Junior college and below | |
|---|---|---|---|---|---|---|---|---|---|
| | | Number | Proportion (%) | Number | Proportion (%) | Number | Proportion (%) | Number | Proportion (%) |
| Center for Disease Control and Prevention | 77 | 28 | 33.77 | 26 | 36.36 | 15 | 19.48 | 8 | 10.39 |
| Health Supervision Institute | 60 | 20 | 33.33 | 22 | 36.67 | 11 | 18.33 | 7 | 11.67 |

| Group | Total | Doctor | | Master | | Undergraduate | | Junior college and below | |
|---|---|---|---|---|---|---|---|---|---|
| | | Number | Proportion (%) | Number | Proportion (%) | Number | Proportion (%) | Number | Proportion (%) |
| **Hospital*** | 95 | 25 | 26.32 | 42 | 44.21 | 13 | 13.68 | 15 | 15.79 |
| **Other professional public health institutions*** | 25 | 4 | 16 | 3 | 12 | 14 | 56 | 4 | 16 |
| **Community health service center/station** | 90 | 1 | 1.11 | 7 | 7.78 | 62 | 68.89 | 20 | 22.22 |
| **Street/township health center** | 70 | 0 | 0.00 | 8 | 11.43 | 60 | 85.71 | 2 | 2.86 |
| **Other medical and grass-roots health institutions*** | 80 | 2 | 2.50 | 8 | 10.00 | 63 | 78.75 | 7 | 8.75 |
| **Other health institutions** | 15 | 1 | 6.67 | 3 | 20.00 | 8 | 53.33 | 3 | 20.00 |

Note: * Hospitals refer to comprehensive hospitals, integrated Chinese and Western hospitals, specialized hospitals, nursing homes, etc.), other professional public health institutions refer to specialized disease prevention and treatment centers, maternal and child health centers, emergency centers, blood collection and supply institutions, family planning technical service institutions, etc., and other medical grass-roots health institutions refer to village clinics, outpatient departments, clinics, clinics, clinics, clinics, clinics, clinics, nursing stations, etc.

**Demand for professional ability of public health professional**

As shown in Figure 5, Figure 6, Figure 7 and Table 3, the needs of 512 public health institutions for personal accomplishment, theoretical knowledge, professional skills and comprehensive quality of public health professional are revealed.

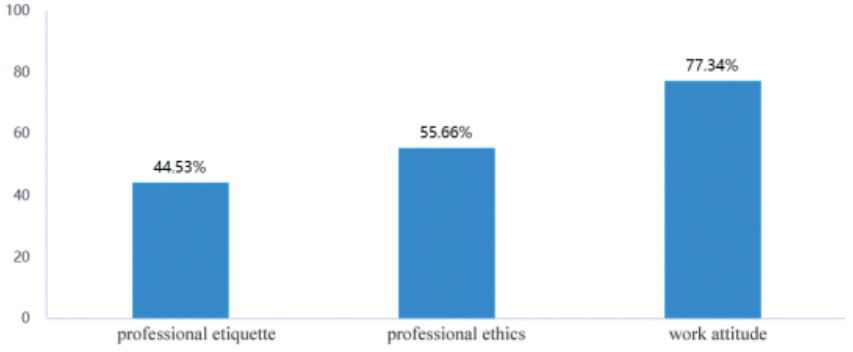


Figure 5 Demand of 512 public health institutions for personal cultivation of preventive medicine personnel

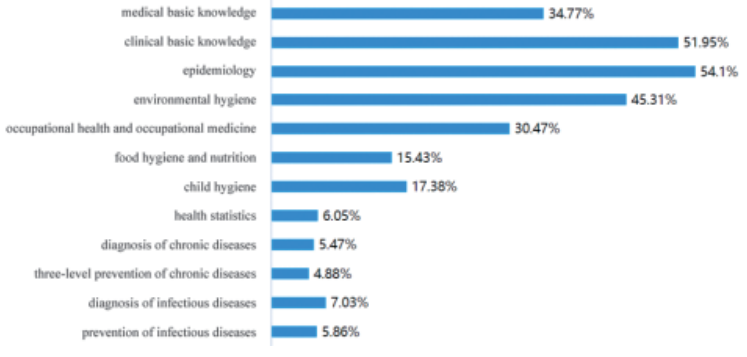


Figure 6 Demand of 512 public health institutions for theoretical knowledge of preventive medicine personnel

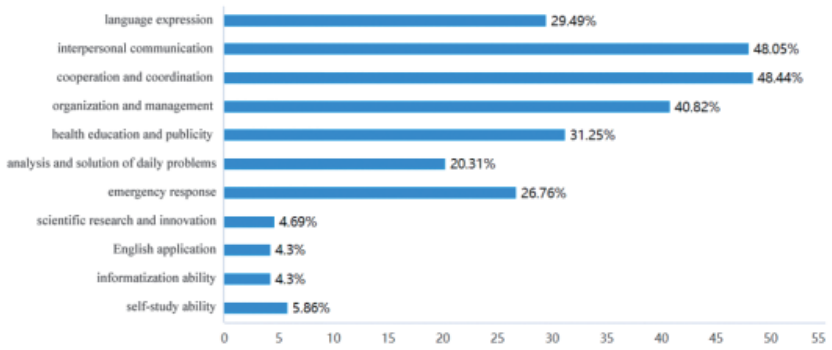


Figure 7 Demand of 512 public health institutions for comprehensive quality of public health professional

**Table 3 Demand for professional skills of public health professional from 512 public health institutions (%)**

| Topic\Options | Very important | important | generally | unimportant | very unimportant |
|---|---|---|---|---|---|
| Basic knowledge and basic operating procedures of sanitation chemistry | 125 (24.41%) | 113 (22.07%) | 148 (28.91%) | 88 (17.19%) | 38 (7.42%) |
| Basic knowledge and basic operating procedures of toxicology | 160 (31.25%) | 81 (15.82%) | 146 (28.52%) | 48 (9.38%) | 77 (15.04%) |
| Basic steps of statistical work, commonly used statistical methods | 84 (16.41%) | 169 (33.01%) | 194 (37.89%) | 29 (5.66%) | 36 (7.03%) |
| Basic theory and basic knowledge of epidemiology | 167 (32.62%) | 97 (18.95%) | 145 (28.32%) | 69 (13.48%) | 34 (6.64%) |
| Basic characteristics and clinical characteristics of infectious diseases Principles of treatment | 96 (18.75%) | 129 (25.2%) | 175 (34.18%) | 41 (8.01%) | 71 (13.87%) |
| Basic characteristics and prevention methods of chronic diseases and common diseases | 98 (19.14%) | 173 (33.79%) | 138 (26.95%) | 58 (11.33%) | 45 (8.79%) |
| The concept, basic steps, content and strategies of health management | 141 (27.54%) | 79 (15.43%) | 227 (44.34%) | 49 (9.57%) | 16 (3.13%) |
| Production of health education and publicity materials | 102 (19.92%) | 93 (18.16%) | 234 (45.7%) | 29 (5.66%) | 54 (10.55%) |
| Children's health and school health monitoring and disease prevention | 134 (26.17%) | 94 (18.36%) | 158 (30.86%) | 75 (14.65%) | 51 (9.96%) |
| Women's and Children's Health Technology | 95 (18.55%) | 126 (24.61%) | 180 (35.16%) | 77 (15.04%) | 34 (6.64%) |
| National basic public health knowledge and skills | 129 (25.2%) | 117 (22.85%) | 175 (34.18%) | 62 (12.11%) | 29 (5.66%) |
| Detection and Analysis of Food Nutrient Components and Nutritional Intervention | 136 (26.56%) | 105 (20.51%) | 183 (35.74%) | 33 (6.45%) | 55 (10.74%) |
| Investigation on Food Contamination and Food Poisoning | 94 (18.36%) | 120 (23.44%) | 186 (36.33%) | 53 (10.35%) | 59 (11.52%) |
| Food hygiene testing and evaluation | 92 (17.97%) | 168 (32.81%) | 164 (32.03%) | 37 (7.23%) | 51 (9.96%) |
| Occupational health inspection, supervision and evaluation | 149 (29.1%) | 94 (18.36%) | 173 (33.79%) | 42 (8.2%) | 54 (10.55%) |
| Water, soil, air and other environmental sanitation testing and evaluation | 123 (24.02%) | 114 (22.27%) | 199 (38.87%) | 32 (6.25%) | 44 (8.59%) |
| Field Disinfection Technology | 144 (28.13%) | 87 (16.99%) | 177 (34.57%) | 38 (7.42%) | 66 (12.89%) |
| Hygienic Microbiology Detection Technology | 83 (16.21%) | 150 (29.3%) | 187 (36.52%) | 62 (12.11%) | 30 (5.86%) |
| Sanitation Physicochemical Analysis Technology | 87 (16.99%) | 93 (18.16%) | 259 (50.59%) | 55 (10.74%) | 18 (3.52%) |
| Hygiene testing and supervision of workplaces | 119 (23.24%) | 125 (24.41%) | 161 (31.45%) | 24 (4.69%) | 83 (16.21%) |
| Emergency response technology for public health emergencies | 139 (27.15%) | 90 (17.58%) | 165 (32.23%) | 78 (15.23%) | 40 (7.81%) |
| Subtotal | 2497 (23.22%) | 2417 (22.48%) | 3774 (35.1%) | 1079 (10.04%) | 985 (9.16%) |

**Discussion and Conclusion**

Due to the lack of public health professional, It's suggested to expand the number of students enrolled in preventive medicine (CHEN, F., & Yu, X., 2021). The COVID-19 epidemic has brought enormous challenges and impacts to global public health institutions, and has also highlighted the importance of preventive medicine to a certain extent (JIN H., et al., 2016). In Zhejiang Province, China, the epidemic prevention and control has been well controlled and managed, but at the same time, the survey results of 512 public health institutions also revealed the shortage of preventive medicine talents and inadequate training. Especially in primary medical institutions, medical staff often focus on clinical treatment, lack of preventive medicine talents, and lack of support for public health education and prevention work. During the epidemic period, public health professional also need to carry out the relevant work of epidemic prevention and control, and the prevention and control of other infectious diseases also need to invest a lot of human, material and financial resources. Therefore, the scale of preventive medicine talent team needs to be expanded urgently, especially in primary medical institutions, priority should be given to training preventive medicine talents to better respond to future public health emergencies. Secondly, the structure of preventive medicine talent team is unreasonable. At present, there are some problems in the preventive medicine talent team, such as low professional level and professional skills, generally low educational background, and unreasonable age structure. These problems have affected the overall quality and professional ability of the preventive medicine talent team. In view of these problems, we should take targeted measures to improve the quality and ability of the preventive medicine talent team.

There are three universities in Zhejiang Province (Zhejiang University, Wenzhou Medical University and Zhejiang Traditional Chinese Medicine University) that have the ability and space to expand the enrollment of master's degree students in public health and preventive medicine. They should actively undertake the training task of expanding the enrollment of graduate students in the country, increase the enrollment of master's degree students in public health, and strive to appropriately increase the enrollment of undergraduate students in preventive medicine, The policy of targeted recruitment of rural students in Zhejiang Province is inclined to preventive medicine. Zhejiang University and Wenzhou Medical University should try to increase the enrollment of postdoctoral and doctoral students in public health, and cultivate high-end public health talents or chief experts.

There is a gap between the ability and needs of public health professional, and reform the training program of public health professional (WU X., et al.,2020; ZOU F.,2020; CHEN Y., et al., 2018; LIN L.,et al.,2006). Through the survey of the demand for various occupational abilities of public health professional, it can be found that, due to the continuous emergence of some new infectious diseases and public health emergencies in recent years, the disease prevention and control institutions are undertaking the arduous task of disease prevention, and the quality and management requirements of disease control personnel will also be more strict (YUAN L., et al.,2012; DUAN Z., 2020). With the development of the economy and the reform of the health system, the content and scope of health supervision are more extensive, and the requirements for the quality of law enforcement are higher and higher. Therefore, the quality of the health supervision team is the basis for ensuring supervision and law enforcement. In view of this situation, preventive medicine courses in colleges and universities should be highly valued, and curriculum reform should be strengthened to meet the needs of social development.

The community and health center also have higher and higher requirements for the clinical basic knowledge, epidemiology, diagnosis of chronic diseases, three-level prevention, diagnosis of infectious diseases and other theoretical knowledge of public health professional (CHEN, F., 2021).

At present, the training program of public health and preventive medicine focuses on the basic theory, basic knowledge and basic methods of preventive medicine (ZHANG F., et al., 2020). In the future reform of medical education, we should be guided by the needs of public health institutions for various talents, accurately grasp the orientation and training objectives of running a school, reform the theoretical knowledge system, comprehensive quality training, practical education methods, occupational spirit education and curriculum system, and increase the provision of emergency response technology Public crisis management, introduction to preventive medicine, emergency treatment of public health emergencies, health policy and management, social medicine and psychological medicine, health economy and other courses; Teachers of the School of Public Health and experts of public health institutions are encouraged to jointly compile public health and preventive medicine textbooks, so as to make the theoretical and practical aspects of the textbooks more integrated.

There are limited ways for public health professional to improve their skills, and further education and training for public health professional should be strengthened. Through the investigation on the current situation of various occupational abilities of public health professional, it can be concluded that public health professional in public health institutions have less opportunities for further training and a single way of continuing education, resulting in many public health institutions with low professional level and professional skills of public health professional and generally low educational level.

Public health institutions should carry out regular continuing education and training for technical personnel, through academic education, vocational education, continuing education after graduation and standardized training for public health doctors, to improve the quality of existing personnel and emergency response ability (YANG C., et al., 2019). It is necessary to strengthen the training and learning of laws and regulations related to public health emergencies, epidemiological characteristics of infectious diseases, epidemic treatment methods, treatment measures, disinfection and protection technology, wearing and taking off methods of isolation clothing, preparation methods and precautions of various disinfectants and other professional technologies. Establish and improve the health emergency training system to meet the needs of public health emergencies; Strengthen training and exercise to improve the ability of medical and health units and personnel at all levels to deal with public health emergencies. Adopt various forms of public health professional knowledge or short-term training to perform specific tasks, and popularize disease control knowledge among the Party schools, administrative colleges, civil servants and other teams, so as to improve the overall public health literacy, and then help to improve the professionalism and evidence-based decision-making ability of government departments.

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