Clinical training in China needs to be improved: A cross-sectional study of MD graduates

XIAONING ZHANG

Xuzhou Medical University

Chong Li

Xuzhou Medical University

Cailing Yue

Xuzhou Medical University

Xue Jiang

Xuzhou Medical University

Junli Cao

Xuzhou Medical University

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Abstract

Background: China is experiencing medical education reform to construct national quality standards, modernise and standardise health professionals, and advance health delivery system requirements. Graduate medical education (GME) is being piloted as a merger of Doctor of Medicine (MD) and PhD programs to improve academic research and clinical training. However, the academic degree-centred system has led to a preoccupation with academic research rather than clinical training. Quality information regarding the clinical training of MD graduates from Chinese medical schools is lacking. This general investigation aims to provide an overview from the perspective of recent MD graduates in China.
  Methods: Self-reports on MD clinical training were obtained from 432 MD graduates in 2017 via an online survey. The reports included information on overall satisfaction, educational supervision, supervised learning events, curriculum coverage, local teaching, teamwork, educational governance, workload, supportiveness of the environment, feedback, clinical experience, patient safety, handovers, and reporting systems. Descriptive analysis was used to summarise the outcome.   Results: Of the 432 MD graduates surveyed, only 37.4% reported satisfaction with the overall clinical training quality; 54.6% rated the informal and bedside quality as "good"; 64.4% reported that they knew who provided clinical supervision; only 35.5% highly rated the quality of clinical supervision; 51.8% reported that they judged senior physicians as "not competent"; 48.1% believed that their concerns about education and training would be addressed; 41.9% agreed that the staff treated each other respectfully; 97.4% admitted that they worked beyond the mandatory hours and claimed they were regularly short of sleep; 84.2% raised concerns about patient safety; 45.3% reported that they received regular informal feedback. Conclusions: This study suggests that the quality of clinical training for MD graduates needs to be improved; however, even though most participants seemed satisfied with their clinical training. The overall satisfaction with the teaching quality was acceptable, whereas the quality of many clinical training aspects was scored poorly. Each aspect may encourage a deeper investigation into the understanding of causes and possible remediation. Some suggestions include improving safe and effective care, providing positive clinical supervision, offering appropriate practice opportunities, providing health care services, and maintaining optimal patient safety.

Background

Health care professionals continue to deliver optimal clinical practice to improve patient outcomes. Inadequate clinical practice is related to the current doubled reforms of higher education and health care systems in China. Seven government ministries in China have jointly launched standardised residency training (SRT) as a national strategy [1]. In recognising the gap in medical education between China and developed countries, China is undergoing medical education reform to construct national quality standards, modernise and standardise health professionals, advance health delivery system requirements, and meet the health demands of the Chinese public. Physician-scientists play important roles in medical education, research, and clinical practice [2]; this title describes a physician who devotes

much more time to clinical practice than to academic research, and who is committed to the quest for new knowledge and approaches to diagnose, treat, and prevent disease [3].

China is producing world-class physician-scientists who are competitive with international standards. Graduate medical education (GME) is being piloted as a merger of MD and PhD programs at some super-universities to improve academic research and clinical training. This training program provides integrated academic and clinical training of Doctor of Medicine (MD) graduates. Understanding medical degrees may be difficult, and China has built a unique degree and credentialing system as compared with other countries, especially during the rapidly changing start-up phase from 2013 to 2020 when China adopted an ambitious plan to improve the quality of its physicians. By the end of 2014, the SRT under the National Health and Family Planning Commission (NHFPC, formerly the Ministry of Health) and the Ministry of Education (MoE) jointly reformed the medical degree program [1]. The normal model mandates five years of undergraduate study (Bachelor of Medicine), followed by three years of SRT (Master of Medicine, MM), and X years of standardised subspecialty training (SST) (Doctor of Medicine, MD), which are collectively referred to as "5+3+X" [undergraduate (5 years) + SRT (3 years) + SST (X years)] (Figure 1). The X-year MD program is controversial in China. In the US, the average training length of MD-PhD graduates increased from 6.5 years in 1980 to 8.0 years today [3]. MD-PhD programs at most US and a few Canadian medical schools incorporate two years of medical school, four years of the PhD degree, and another two years of medical school to complete the MD degree [3].

The main purpose of MD-PhD programs in medical education in developed countries is to train qualified practitioners, rather than to train those who focus only on academic research. Therefore, an ideal GME system is more ambitious in China, as it combines clinical training and academic research. In 1956, Case Western Reserve University in the US launched its integrated MD-PhD program that highlights flexible and self-directed learning [4]. The difference between models in China and the US is the involvement of SRT and SST with the medical degree. By distinguishing professional degrees from researchers' academic degrees, MM graduates must undergo SRT training, while MD graduates must undergo SST training (MD degree with SST). GME reform requires the completion of a combination of SRT training and MM; MM graduates obtain both an MM degree and certificate of SRT (MM degree with SRT) [1]. The MD-PhD (referred to as an MD program in this study) is the highest level of medical education, and is a critical pathway to the cultivation of next-generation physician-scientists in China [5]. MD graduates are criticised for concentrating primarily on academic research, and their clinical practice training is inadequate [6]. This academic degree-centred system has led to a preoccupation with research, rather than clinical training, in China.

The Medical Scientist Training Programs (MSTPs) train physician-scientists who play crucial roles in medical research and education [7], and have enhanced science in medical education in the US by integrating MD-PhD training in the context of dual-degree programs [4]. MD graduates will be future physician-scientists in China and worldwide. These graduates make important contributions to basic and medical research, and contribute to most research and publications. Although clinical training is a core competency required to be a physician-scientist, the goal of the MD in China is to cultivate scientific research and academic competency [8]. Concerns have been raised regarding the current clinical competency of MD graduates who have deficits in clinical practice as compared with peer physicians [9], although changes have been made to develop new training similar to that of original well-educated, developed countries.

To date, comprehensive quality data regarding the clinical training of MD graduates are unavailable in China. To sustainably cultivate physician-scientists, their clinical training needs to be studied. This study investigates the clinical training of MD graduates, examines crucial evidence to improve MD cultivation quality, and explores cultivation trends in GME to contribute to policy considerations to underpin the GME. This study may help identify optimal clinical training and the areas that fail to meet acceptable standards. This study provides insight into the different areas of clinical training as experienced in different contexts (e.g., physician-scientists in the US). The obtained data provide the opportunity to address the issues raised in evaluating the MD program.

Methods

Participants

This study was a cross-sectional study in which a self-report questionnaire was used to evaluate the clinical training of MD graduates. The inclusion criteria included participants studying in different disciplines and at different training stages, and those who were interested in this study. Purposive sampling was conducted [10], and, based on a pilot study, the calculated sample size was 341. An attempt was made to achieve as much diversity as possible in the research size and medical schools, and questionnaires requesting participation were sent to the administrators at a national medical education conference. MD graduates were defined as those studying at the time that this research was conducted; 432 MD graduates from informal student organisations in 10 universities agreed to participate from 1 January to 1 March 2017 via an online survey. As compensation, participants received an incentive worth ￥10.00 on the website.

Data collection

The questionnaire was modified from the General Medical Council (GMC) National Trainee Survey [11], which monitors the quality of clinical training and education of doctors in the UK [12]. This training survey is a core part of the effort to monitor and report the quality of postgraduate medical education and doctors in clinical training every year. The participants in this study were MD graduates, most of them had Chinese medical licences, and the questionnaire was deemed optimal for this group based on a literature review. The questionnaire included questions on basic information and the indicators of "overall satisfaction," "adequate experience," "workload," "clinical supervision," and "educational supervision". The questionnaire comprehensively evaluates the quality of clinical practice. Two bilingual researchers translated the initial questionnaire from English to Chinese using the back-translation technique based on a literature review [13]. Discrepancies between the original English and back-translated Chinese versions were discussed among the bilingual researchers until they reached a consensus regarding the linguistic and cultural equivalences.

The questionnaire was pretested on ten participants in advance to ensure that it was easily understood before undertaking the pilot study. A pilot study for the questionnaire was conducted to improve its clarity, consistency, and validity; it included the participation of fifteen participants who were representative of the target population, and the questionnaire was not changed after the pilot study. The questionnaire was reviewed and validated by nine experts, and the inclusion criteria included experts working in different Chinese GME disciplines and MD supervisors who were interested in the study and willing to participate. The H-coefficient and Cronbach's alpha were used to assess internal reliability (Cronbach's alpha = 0.78) according to the pilot study.

The eleven components of the final questionnaire focused primarily on clinical training, and included demographic data (gender, age, working time, professional title, living situation), overall satisfaction, educational supervision, supervised learning events, curriculum coverage, local teaching, teamwork, educational governance, workload, supportiveness of the environment, feedback, clinical experience, patient safety, handover, and reporting systems. Response formats included multiple choices with three to six options, yes/no responses, Likert-type scales, and open-ended questions.

To improve responses and obtain the target number of participants, participants completed the questionnaire via computers or smart devices. If participants attempted to move on to the next question without answering the current question, a warning appeared and they were directed back to the unanswered question. The IP addresses identified and eliminated duplicate participant responses. Responses were examined for indications of systematic response bias (e.g., clicking the same response option to move rapidly through the questionnaire).

Potential participants were provided with an electronic summary of this study that detailed the research aim, procedure, expected outcomes, risks, benefits, and their rights to not participate. Participants were recruited online; the first page of the online questionnaire provided an outline and guide to the study, and all data were anonymised with regards to data protection and the storage of personal data [14]. This study received ethical approval, and informed consent was provided after the study guide. All participants signed their names on the online informed consent form.

Statistical analysis

The data were analysed using Microsoft Excel 2016 (Microsoft Corporation, Redmond, Washington, USA) for Windows. Descriptive analysis (means, standard deviations, and percentages) was used to quantify the responses and summarise the outcome variables.

Results

The participants' mean age was 28 ± 3.6 years, and 54.4% were married, 64.0% were men, 24.9% stated that they have never had a job, 69.5% obtained professional MM degrees, and 88.9% obtained SRT certificates. Of the participants, 45.4% reported that they received informal feedback from senior physicians at least once a month, while 22.6% responded that they never receive informal feedback. Moreover, 51.8% reported that they had received feedback about their progress from their educational supervisors, 37.7% did not consider their feedback to be useful, and 32.6% reported that they had received useful formal assessments of performance in the workplace. Additionally, 61.2% agreed on educational objectives with their educational supervisors, and 64.4% admitted they had a training agreement with their educational supervisors that set their respective responsibilities. Furthermore, 84.2% had raised concerns about patient safety, and 74.4% reported that their concerns had been resolved or were being addressed.

Figure 2 (Table 1) shows that 37.4% of the participants were satisfied with the overall quality of clinical training, 61.2% believed an MD career would ensure that they acquired the competencies they needed, and 64.4% agreed an MD career would be useful for their future career.

Figure 3 (Table 1) shows that 57.9% of the participants agreed or strongly agreed that "my organisation encourages teamwork culture between multidiscipline health care professionals"; 67.7% reported the same about the teamwork culture between clinical departments; 54.7% were confident that they would receive help if they turned to other departments; 41.8% agreed or strongly agreed with the statement, "I

am confident that I know how to raise a concern about my education and training". When they raised concerns about the education and training, 48.1% believed the concerns would be addressed; 54.9% agreed or strongly agreed with the statement "I know how or could find out how to escalate such a concern if I felt it wasn't being addressed"; 70.8% agreed or strongly agreed that the training environment was fully supportive; 29.1% agreed or strongly agreed that staff was always treated fairly; 41.9% agreed or strongly agreed that staff treated each other with respect; 41.9% obtained support to build confidence in the training environment. When the participants disagreed with senior physicians, 38.6% reported that their views would be treated openly, and 54.7% reported that they knew who to approach if they had personal or training concerns.

As shown in Figure 4 (Table 1), 80.7% of the participants agreed that supervised learning events (SLEs) made them reflect on clinical practice; 77.5% agreed that SLEs had helped them to identify and develop clinical practice gaps; 80.7% were confident that SLEs enabled them to improve clinical practice; 61.2% reported that it was easy to obtain SLEs from proper physicians; 64.4% reported that they could contact onsite senior physicians at all times; 67.7% agreed that senior physicians could advise them on any clinical situation. Regarding curriculum coverage, 51.39% of the participants were confident that the curriculum would meet their objectives related to professional experience (leadership, teaching, research, and quality improvement); 48.14% agreed that an MD career would meet their objectives for clinical practical experience for procedures and treatments, with 54.65% reporting the same regarding clinical experience.

As Figure 5 (Table 1) shows, 74.19% of the participants agreed or strongly agreed that handover arrangements always ensured the continuity of patients' care between shifts; 74.2% agreed or strongly agreed that handover arrangements always ensured the continuity of patients' care between departments; 64.4% agreed or strongly agreed that appropriate multidisciplinary members were included in handover. Additionally, 67.5% were aware of how to report patient safety incidents and near-misses; 51.4% reported a culture of proactively reporting concerns; 67.4% reported a culture of learning lessons from concerns raised; 64.2% were confident that concerns were effectively dealt with when they were raised; 64.2% believed that the subsequent actions were fed back appropriately.

Figure 6 (Table 2) shows that 64.4% of the participants rated the local or departmental teaching quality as "good" or "excellent"; 54.7% rated the clinical teaching quality including informal and bedside teaching, as well as formal and organised sessions as "good" or "excellent"; 35.6% rated the clinical supervision quality as "good" or "excellent"; 64.4% reported that they knew who provided clinical supervision when they were working; 32.1% rated the clinical experience quality as "good" or "excellent"; 45.1% rated the practical experience as "good" or "excellent".

As Figure 7 (Table 3) shows, 51.9% of the participants reported being supervised by incompetent senior physicians, with 39.0% reporting that this phenomenon happened at least monthly; 26.0% responded that they felt forced to cope with clinical problems beyond their competence or experience weekly or daily; 77.2% reported being expected to obtain consent for procedures for which they did not understand the risks of the proposed intervention. All participants admitted that they worked out of hours, including night shifts and weekends. All claimed to be short on sleep while at work in their current working pattern; 35.6% reported feeling short of sleep on a daily basis, while 38.6% reported that this occurred weekly.

Discussion

To the best of the authors' knowledge, this is the first analysis to explore the quality of the clinical training of Chinese MD graduates from a range of specialties and at different stages, and to include foundation, core, and specialty clinical training. This study indicates that the participating MD graduates were a young group with primary titles, and most had experienced short-term clinical training before entering the MD program. The findings suggest that the quality of overall satisfaction, the training environment, feedback, clinical experiences, clinical teaching, and supervision should be improved. During challenging times, it would be deeply concerning and understandable to evaluate the quality of clinical training that MD graduates receive, as well as what would be necessary to sustain this training pathway.

Clinical training challenges

GME reform is backed by substantial public financing because of the uniqueness of the Chinese medical education context. Change is extremely challenging to implement, and imbalances exist between public expectation, rapid economic and social development, and the lagging medical education. China has recently strengthened the coordination between the NHFPC and the MoE, but achieving coordination with finance, human resources, and civil affairs is difficult. The State Commission Office for Public Sector Reform (SCOPSR) and the government ministries in China have many diverse and complicated facets, such as the household registration system, the general workforce, employment, and income management. To improve the sustainable quality of clinical training and the roles of professional development, the administrative power of educational institutions at all levels should be clarified and strengthened. Some piloted reforms are being launched in some super-universities, such as those in Beijing and Shanghai, but some medical education resources, such as hospital training quality and qualified clinical preceptors and graduates, are not replicable at other universities. Clinical training focuses on patient care and cooperation with patients, family members, physicians, and other health professionals, and different care settings affect overall satisfaction. Policymakers should issue policies and regulations, as professional bodies have not been active in ensuring clinical training quality across different universities.

MD graduates have remained silos of professional practice with little horizontal professional mobility or quality assurance. Technological innovation should be promoted across health care systems, and the quality of clinical training is substantially below the standard. Most MD graduates are broadly accepting of the clinical training they received; however, they received inadequate training time and support. MD graduates desire high-quality and effective clinical training, which does not align perfectly with academic competency. A pragmatic alternative is to combine the degree and clinical training, although clinical competency is inherently associated with academic research. This study identified some challenges in clinical training that need to be addressed. The clinical competency of Chinese physicians, even those with higher academic degrees, is often judged due to the demands for academic degrees and a lack of well-established clinical training and teaching. MD graduates face higher demands of academic research than clinical training; normally, one detrimental graduation condition is to publish English papers in journals with high impact factors. Every MD graduate must complete a great deal of research, thus losing clinical training time. MD graduates are challenged by interruptions in their clinical training [2], and do not receive the optimal combination of clinical training and academic research in China [15]. In this study, MD graduates stated that they need more support to balance clinical training and academic research, which is consistent with the situation in the US. The boundary is unclear, and MD-PhD programs in the US encourage the integration of clinical and academic training. Additionally, academic research training has been neglected in the US [6]; another study reported that graduates from 24 MD-PhD programs spent 75% to 80% of their time conducting academic research [3].

Most MD graduates that participated in this study had previous job experience, which is inconsistent with MD-PhD students in the US [3]; however, professionalism is insufficient and requires improvement [17,18]. The inadequate instructional abilities and professionalism of preceptors were commented on frequently by MD graduates, which is consistent with a study conducted in the US [2]. The present study revealed that the clinical training of MD graduates, especially supervision and feedback, requires urgent improvement. Poor levels of clinical supervision create an unsafe and unsupportive clinical environment, and improper clinical supervision may impact patient safety and health outcomes. Although MD graduates expressed satisfaction with preceptor quality, it seemed that the levels of preceptors were proper. This study indicates the importance of highlighting clinical supervision and raises concerns about frequent and effective feedback. Clinical training environments present challenges including patient care and multidisciplinary pressures on clinical training and supervision [19]. Pressure exists in health care service across China and preceptors are experiencing similar pressures, thus raising concerns about the balance between clinical training and routine clinical work [20]. Our responsibility is to protect, enhance, and recognise the importance of preceptors, and to provide consistent ongoing support. MD graduates and preceptors are working together to improve health care service, and it is clear that medical education is a priority. Health care service provision and medical education are inextricably linked, and a lack of training opportunities and a busy working environment influence patient safety and care. Another

important area to explore is the health and wellbeing of MD graduates, and the growing concerns about the impact of the working environment on individuals.

Physicians with higher-level degrees are more likely to find higher-paying jobs in higher-level hospitals and larger cities, where they could also obtain high-quality and organised clinical training associated with medical career progression and increased future income. Therefore, very few MD physicians serve in rural areas [3], which is consistent with the results of this study. A considerable proportion of Shanghai master trainees dropped out of the SRT to enter an MD program; a doctorate is more attractive than an SRT certificate [1]. Without a valid 3-year MM with SRT, graduates cannot enter an X-year program or MD program. MD graduates normally complete an examination organised by universities and have a curriculum vitae and expert recommendation letters. After passing the examination, candidates are interviewed by an expert panel, including supervisors. The admission for MD graduates transfers to the application to enter an MD program without an entrance examination, in contrast to the previous strict national entrance examination. These silo positions are extremely competitive; to ensure fairness, the US Medical College Admission Test (MCAT) is valid for admission [16].

Recommendations for the improvement of training in clinical practice

Sorting through these challenges that are unique to China will take time. How can cultivation quality in the combination of an MD degree and SST be ensured? Complicated clinical environments challenge contemporary clinical training, emergency patient care, advanced technology, and multidisciplinary cooperation for mentoring [19]. The accreditation of SRT and SST training institutions is essential and China is constructing and following the medical education systems of developed countries. The Chinese Medical Doctor Association (CMDA) has been designated to manage accreditation; within a very short period, it has accredited approximately 500 training bases spread geographically [1]. This crucial work may need to be strengthened with regard to professional expertise, acceptance of its authority, and financial resources.

Criticisms that have arisen concern the length of clinical training and low compensation. MD-PhD programs in the US and institutional, federal, and societal programs provide full tuition and a stipend to support their graduates' training [3]. MD graduates in the US obtain funding to support laboratory-based research [3], which is inconsistent with the situation in China. Most graduates conduct clinical research and obtain research funding from their supervisors, which might limit their research interests and delay the time at which they conduct independent research. The standards of SRT and SST cannot satisfy the clinical competencies of MD graduates. High-quality professional expertise is only present in a few top hospitals; therefore, a new certification mechanism needs to be established [1]. Moreover, with the

support of the China Medical Board (CMB), seven leading teaching hospitals of 24 demonstration bases have recently developed the China Consortium of Elite. Medical education reform is led by the government, but may depend upon the capacity of Chinese professional associations in the future.

The questionnaire comments provided recommendations for improving the MD program. Most MD graduates appreciated the MD program and stated that its strengths were that combining the SST with the degree saves time, and that they acquired a range of clinical cases and experiences. However, the quality of the clinical training remained the most important point; issues were raised regarding whether MD graduates achieved clinical training standards, and whether the MD program was safe and supportive for MD graduates, preceptors, and patient care. The educational culture should be caring, compassionate, and provide optimal patient care, value, and support. Educators, researchers, and administrators should pay close attention to those who disagree with the responsibilities of MD graduates, and preceptors should be selected, inducted, trained, and appraised to reflect clinical training. They should receive support, resources, and time to meet cultivation responsibilities. MD graduates stated that their preceptors lacked the time to supervise, and policies should support them in optimally completing their clinical training plans. This study integrates some suggestions, including improving safe and effective care, providing positive clinical supervision, offering appropriate practice opportunities, providing health care services, and maintaining optimal patient safety in challenging times.

Implications for future MD program development

Knowing the clinical training status characteristics could help predict and prevent problems at an earlier stage. Policymakers should cooperate with stakeholders before the quality worsens and causes harm to patient care and undermines clinical training. More effective recommendations in this critical area should be actively considered. All training hospitals should depend on local conditions and have the approval and the capacity to support the clinical training of MD graduates, which would help them develop adequate competencies and maintain optimal clinical training. Policymakers should reflect current clinical training to provide and refine sustainable guidance to assist MD preceptors, work with preceptors to make improvements where necessary, and consider more flexible clinical training programs. The training standards should outline how MD graduates can be treated more professionally at all training stages and individuals clinical training components [6].

MD graduates receive lengthy training and inadequate funding support China. In contrast, in the US, medical students receive public and private funding for year-long research opportunities [21]. To design subspecialties and their respective lengths based on existing SRT specialties, the monitoring, evaluation, and integration of SST with an MD degree must be researched systematically and sustainably. Our

mission is to provide a supportive and sustainable training environment. Impactful recommendations include (a) providing targeted funds or rewards for academic and clinical training, and (b) establishing a supervising team to guide clinical training. A clinical scientist committee should be established to help overcome challenges at various training stages [22], especially funding, individual training, supervision, and feedback [23].

Overall, MD graduates in China do not receive the optimal combination of clinical training and academic research. Supervision of, and feedback on, clinical training for MD graduates need to be improved. Only a few top hospitals present high-quality professional expertise, and a new certification mechanism needs to be established. Policymakers should pay close attention to those who disagree with the cultivation responsibilities of MD graduates. Preceptors should be selected, inducted, trained, and appraised to reflect clinical training. Some suggestions include improving safe and effective care, providing positive clinical supervision, offering appropriate practice opportunities, providing health care services, and maintaining optimal patient safety in challenging times. Current clinical training should provide refined and sustainable guidance to make improvements where necessary.

Limitations

This cross-sectional study was based on purposive sampling and self-reporting. Although this study was limited by a small sample size, and therefore cannot be generalised to all Chinese MD graduates, the strengths of this study included its investigation of clinical training independently from academic research. In subsequent research, optimal integrated clinical training and academic aspects should be developed. All comments were collected from open-ended questions, and interviews were not conducted; however, this would be useful in future studies. A national cohort study is needed, and it is suggested that in-depth and national clinical training cohort studies be conducted yearly.

Conclusions

With the combination of an MD degree and SST certificate in this round of GME reform, Chinese MD graduates do not receive the optimal combination of clinical training and academic research. This study presented a complex overview of the clinical training of MD graduates, identified the poor training standards of MD graduates, highlighted that the expertise of preceptors must be elevated, and revealed that clinical training needs to be improved. Most surveyed MD graduates reported satisfaction with the clinical training they received, but the quality of the overall satisfaction, training environment, feedback, clinical teaching, and supervision should be improved. Each of these aspects may enable a deeper understanding of causes and possible remediation. A supportive training environment should be created and strategies should be developed to balance academic research and clinical training for MD graduates to ensure that both MD graduates and preceptors receive the best possible support.

Declarations

Abbreviations

GMC: General Medical Council; GME: Graduate Medical Education; CMB: China Medical Board; CMDA: Chinese Medical Doctor Association; MCAT: Medical College Admission Test;

MD: Doctor of Medicine; MM: Master of Medicine; MoE: Ministry of Education; MSTP: Medical Scientist Training Program; NHFPC: National Health and Family Planning Commission, formerly the Ministry of Health; SCOPSR: State Commission Office for Public Sector Reform; SLEs: supervised learning events; SRT: standardised residency training; SST: standardised subspecialty training.

Ethical approval and consent to participate

Human participation was approved by the institutional review board of Xuzhou Medical University (Number: 201568). Participants provided signed consent online.

Consent for publication

Not applicable.

Availability of data and material

The datasets that support the findings of this study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

XNZ contributed to study conceptualisation, data collection, analysis, and interpretation, and the original draft, review, and editing of the manuscript. CL contributed to data collection and analysis. CLY contributed to data collection. XJ contributed to data analysis. JLC contributed to conceptualisation review and the editing of the manuscript. All authors have read and approved the manuscript.

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References

1. Zhu JM, Li WK, Chen L. Doctors in China: improving quality through modernisation of residency education. *Lancet* 2016;388(10054):1922-29. doi: 10.1016/S0140-6736(16)00582-1

2. Bills JL, Davidson M, Dermody TS. Effectiveness of a clinical intervention for MD/PhD students re-entering medical school. *Teach Learn Med* 2013;25(1):77-83. doi: 10.1080/10401334.2012.741539

3. Brass LF, Akabas MH, Burnley LD, et al. Are MD-PhD programs meeting their goals? An analysis of career choices made by graduates of 24 MD-PhD programs. *Acad Med* 2010;85(4):692-701. doi: 10.1097/ACM.0b013e3181d3ca17

4. Harding CV, Akabas MH, Andersen OS. History and Outcomes of 50 Years of Physician-Scientist Training in Medical Scientist Training Programs. *Acad Med* 2017;92(10):1390-98. doi: 10.1097/ACM.0000000000001779

5. Paik JC, Howard G, Lorenz RG. Postgraduate choices of graduates from medical scientist training programs, 2004-2008. *JAMA* 2009;302(12):1271-3. doi: 10.1001/jama.2009.1355

6. Milewicz DM, Lorenz RG, Dermody TS, et al. Rescuing the physician-scientist workforce: the time for action is now. *J Clin Invest* 2015;125(10):3742-7. doi: 10.1172/JCI84170

7. Al Khaja KA, James H, Sequeira RP. Effectiveness of an educational intervention on prescription writing skill of preclerkship medical students in a problem-based learning curriculum. *J Clin Pharmacol* 2013;53(5):483-90. doi: 10.1002/jcph.68

8. Wiley CA. Medical Scientist Training Programs: a modest proposal to eliminate federal funding in favor of individual fellowships. *Acad Med* 2010;85(10):1558. doi: 10.1097/ACM.0b013e3181f119ad

9. Goldberg C, Insel PA. Preparing MD-PhD students for clinical rotations: navigating the interface between PhD and MD training. *Acad Med* 2013;88(6):745-7. doi: 10.1097/ACM.0b013e31828ffeeb

10. Safa M, Arash G, Taghi K. The relationship of antisocial personality disorder and history of conduct disorder with crime incidence in schizophrenia. *Journal of Research in Medical Sciences* 2012;17(6):566-71.

11. Council GM. National training surveys 2017 [Available from: https://www.gmc-uk.org/education/how-we-quality-assure/national-training-surveys accessed 12-18 2018.

12. Council GM. National Training Survey Documents 2015 [Available from: www.gmc-uk.org/education/nts_documents.asp accessed 23 April 2019.

13. Warner M. Whither Chinese HRM?: Paradigms, Models and Theories2018.

14. Merlo LJ, Curran JS, Watson R. Gender differences in substance use and psychiatric distress among medical students: A comprehensive statewide evaluation. *Substance Abuse* 2017;38(2):00-00.

15. Goldstein MJ, Kohrt HE. What happened to the concept of the physician-scientist? *Acad Med* 2012;87(2):132-3. doi: 10.1097/ACM.0b013e31823f0eeb

16. Bills JL, VanHouten J, Grundy MM, et al. Validity of the Medical College Admission Test for predicting MD-PhD student outcomes. *Adv Health Sci Educ Theory Pract* 2016;21(1):33-49. doi: 10.1007/s10459-015-9609-x

17. Blumenthal D, Hsiao W. Lessons from the East–China's rapidly evolving health care system. *N Engl J Med* 2015;372(14):1281-5. doi: 10.1056/NEJMp1410425 [published Online First: 2015/04/02]

18. Whitehead C. Let Me Heal The Opportunity to Preserve Excellence in American Medicine. *Science* 2015;347(6219):240-40. doi: 10.1126/science.aaa0165

19. Godefrooij MB, Diemers AD, Scherpbier AJ. Students' perceptions about the transition to the clinical phase of a medical curriculum with preclinical patient contacts; a focus group study. *BMC Med Educ* 2010;10:28. doi: 10.1186/1472-6920-10-28

20. Moss F, McManus IC. The anxieties of new clinical students. *Med Educ* 1992;26(1):17-20.

21. Ognibene FP, Gallin JI, Baum BJ, et al. Outcomes From the NIH Clinical Research Training Program: A Mentored Research Experience to Enhance Career Development of Clinician-Scientists. *Acad Med* 2016;91(12):1684-90. doi: 10.1097/ACM.0000000000001245

22. Ogdie A, Shah AA, Makris UE, et al. Barriers to and Facilitators of a Career as a Physician-Scientist Among Rheumatologists in the US. *Arthritis Care Res (Hoboken)* 2015;67(9):1191-201. doi: 10.1002/acr.22569

23. Tong CW, Ahmad T, Brittain EL, et al. Challenges facing early career academic cardiologists. *J Am Coll Cardiol* 2014;63(21):2199-208. doi: 10.1016/j.jacc.2014.03.011

Tables

Table 1 Overall satisfaction, adequate experience, teamwork, educational governance, supportive environment, curriculum coverage, supervised learning events, handover and reporting systems (*n*=430)

Overall satisfaction and adequate experience	Strongly agree, *n* (%)	Agree, *n* (%)	Neutral, *n* (%)	Disagree, *n* (%)	Strongly disagree, *n* (%)	
I am satisfied with the quality of training in clinical practice.	84 (19.53)	77 (17.91)	54 (12.56)	167 (38.84)	48 (11.16)	
I am confident that MD career will help me acquire the competencies I need at my current stage of training.	26 (6.04)	237 (55.12)	112 (26.05)	55 (12.79)	0 (0.00)	
This post will be useful for my future career.	54 (12.56)	223 (51.86)	126 (29.30)	27 (6.28)	0 (0.00)	

Teamwork, educational governance and supportive environment	Strongly agree, *n* (%)	Agree, *n* (%)	Neutral, *n* (%)	Disagree, *n* (%)	Strongly disagree, *n* (%)	NA, *n* (%)
My organization encourages teamwork culture between multidiscipline healthcare professionals.	54 (12.56)	195 (45.35)	181 (42.09)	0 (0.00)	0 (0.00)	0 (0.00)
My organization encourages teamwork culture between clinical departments.	67 (15.58)	224 (52.09)	125 (29.30)	14 (3.26)	0 (0.00)	0 (0.00)
If I asked for help from outside my department, I'm confident I would receive it.	68 (15.81)	167 (38.84)	125 (29.07)	56 (13.02)	14 (3.26)	0 (0.00)
I am confident that I know how, or could find out how, to raise a concern about my education and training.	54 (12.56)	126 (29.30)	166 (38.60)	56 (13.02)	14 (3.26)	14 (3.26)
If I were to raise a concern about my education and training, I'm confident it would be addressed.	54 (12.56)	153 (35.58)	181 (42.09)	28 (6.51)	14 (3.26)	11 (2.56)
I am confident that I know how, or could find out how, to escalate such a concern if I felt it wasn't being addressed.	55 (12.79)	181 (42.09)	139 (32.33)	41 (9.53)	0 (0.00)	14 (2.69)
The training environment is fully supportive.	109 (25.35)	196 (45.43)	83 (19.30)	14 (3.26)	28 (6.51)	0 (0.00)
Staff is always treated fairly.	14 (3.26)	111 (25.81)	180 (41.86)	98 (22.79)	27 (6.28)	0 (0.00)
Staff always treats each other with respect.	28 (6.51)	152 (35.35)	153 (35.58)	97 (22.56)	0 (0.00)	0 (0.00)
The training environment is one that fully supports the confidence building of physicians in training.	28 (6.51)	152 (35.35)	181 (42.09)	41 (9.53)	14 (3.26)	14 (3.26)
If I were to disagree with senior physicians, they would be open to my opinion.	13 (3.02)	153 (35.58)	181 (42.09)	55 (12.79)	14 (3.26)	14 (3.26)
If I had any concerns (personal or educational) I would know who to approach to talk to in confidence.	41 (9.53)	194 (45.12)	153 (35.58)	42 (9.77)	0 (0.00)	0 (0.00)

Curriculum coverage and supervised learning events						
I'm confident that this post will give the opportunities to meet cultivation objectives in: PROFESSIONAL EXPERIENCE (leadership, teaching, research, and quality improvement etc.)	41 (9.53)	180 (41.86)	181 (42.09)	28 (6.52)	0 (0.00)	0 (0.00)
I'm confident that this post will give the opportunities to meet cultivation objectives in: PRACTICAL EXPERIENCE (procedures and treatments of chest drains, passing NG tubes, minor surgeries under local anesthetic, biopsies, fitting coils, injections, psychological therapies etc.)	40 (9.30)	167 (38.84)	181 (42.09)	42 (9.77)	0 (0.00)	0 (0.00)
I'm confident that this post will give the opportunities to meet cultivation objectives in: CLINICAL EXPERIENCE (examination skills, taking a history, deciding investigations and management, seeing a variety of patients in different settings etc.)	68 (15.81)	167 (38.84)	195 (45.35)	0 (0.00)	0 (0.00)	0 (0.00)
Supervised learning events (SLEs) have led to me reflecting on my clinical practice.	83 (19.30)	264 (61.40)	83 (19.30)	0 (0.00)	0 (0.00)	0 (0.00)
SLEs have helped me to identify areas in which I need to develop.	69 (16.05)	264 (61.40)	97 (22.56)	0 (0.00)	0 (0.00)	0 (0.00)
SLEs have enabled me to improve my practice.	69 (16.05)	278 (64.65)	69 (16.05)	14 (3.26)	0 (0.00)	0 (0.00)
How easy or difficult was it to get a suitable physician to complete an SLE with you?	27 (6.28)	236 (54.88)	139 (32.33)	28 (6.51)	0 (0.00)	0 (0.00)
I have access to a senior physician who is onsite at all times.	27 (6.28)	250 (58.14)	153 (35.58)	0 (0.00)	0 (0.00)	0 (0.00)
The senior physician onsite could advise on any clinical situation.	41 (9.53)	250 (58.14)	111 (25.81)	28 (6.51)	0 (0.00)	0 (0.00)

Handover and reporting systems						
Handover arrangements always ensure continuity of care for patients between shifts.	109 (25.35)	210 (48.84)	83 (19.30)	28 (6.52)	0 (0.00)	0 (0.00)

Handover arrangements always ensure continuity of care for patients between departments.	151 35.12	168 39.07	97 22.56	14 3.26	0 0.00	0 0.00
Appropriate members of the multidisciplinary team are included in handover.	110 25.58	167 38.84	111 25.81	28 6.51	14 3.26	0 0.00
I have been made aware of how to report patient safety incidents and near misses.	69 16.05	221 51.40	84 19.53	14 3.26	0 0.00	42 9.77
There is a culture of proactively reporting concerns.	69 16.05	152 35.35	167 38.84	0 0.00	0 0.00	42 9.77
There is a culture of learning lessons from concerns raised.	124 28.84	166 38.60	98 22.79	14 3.26	0 0.00	28 6.51
I am confident that concerns are effectively dealt with.	110 25.58	166 38.60	112 26.05	14 3.26	0 0.00	28 6.51
When concerns are raised, the subsequent actions are fed back appropriately.	96 22.33	180 41.86	98 22.79	28 6.51	0 0.00	28 6.51

Table 2 Clinical experience, clinical supervision, local teaching and overall satisfaction (n=430)

	Excellent, n (%)	Good, n (%)	Fair, n (%)	Poor, n (%)	Very poor, n (%)
How would you rate the quality of the local/departmental teaching?	40 9.30	237 55.12	97 22.56	56 13.02	0 0.00
How would you rate the quality of teaching (informal and bedside teaching as well as formal and organized sessions)?	27 6.28	208 48.37	181 42.09	14 3.26	0 0.00
How would you rate the quality of clinical supervision?	14 3.26	138 32.09	223 51.86	55 12.79	0 0.00
How would you rate the quality of clinical experience?	54 12.56	84 19.53	237 55.12	55 12.79	0 0.00
How would you rate the practical experience you were receiving?	54 12.56	140 32.56	209 48.60	27 6.28	0 0.00

Table 3 Feedback frequency, clinical supervision and workload (n=430)

Feedback frequency	Daily, n (%)	Weekly, n (%)	Monthly, n (%)	Less than once a month, n (%)	Never, n (%)	
How often (if at all) do you receive informal feedback from senior physicians about your performance?	28 6.51	125 29.07	42 9.77	138 32.09	97 22.56	
clinical supervision and workload	Daily n (%)	Weekly n (%)	Monthly n (%)	Less than once a month n (%)	never n (%)	NA n (%)
How often (if ever) are you supervised by someone who you feel isn't competent to do so?	14 3.26	98 22.79	56 13.02	55 12.79	95 22.09	112 26.05
How often (if ever) do you feel forced to cope with clinical problems beyond your competence or experience?	14 3.26	98 22.79	42 9.77	164 38.14	42 9.77	70 16.28
How often (if ever) are you expected to obtain consent for procedures where you feel you do not understand the proposed intervention and its risks?	28 6.51	70 16.28	42 9.77	192 44.65	28 6.51	70 16.28
Have you worked out of hours (this includes night shifts and weekends)?	97 22.56	166 38.60	153 35.58	14 3.26	11 2.56	0 0.00
How often (if at all) do your working pattern leave you feeling short of sleep when at work?	153 35.58	166 38.60	111 25.81	0 0.00	0 0.00	0 0.00

NA = not applicable

Figures
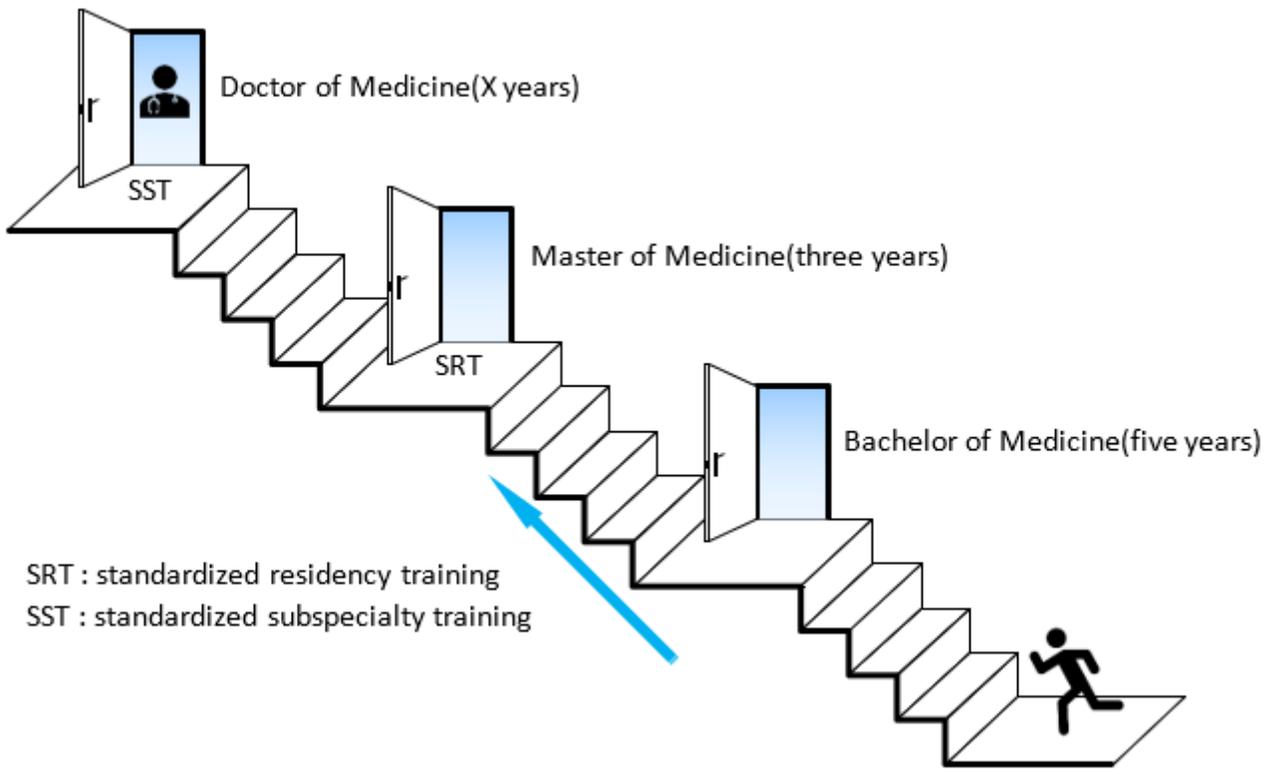
Figure 1

Chinese "5+3+X" model
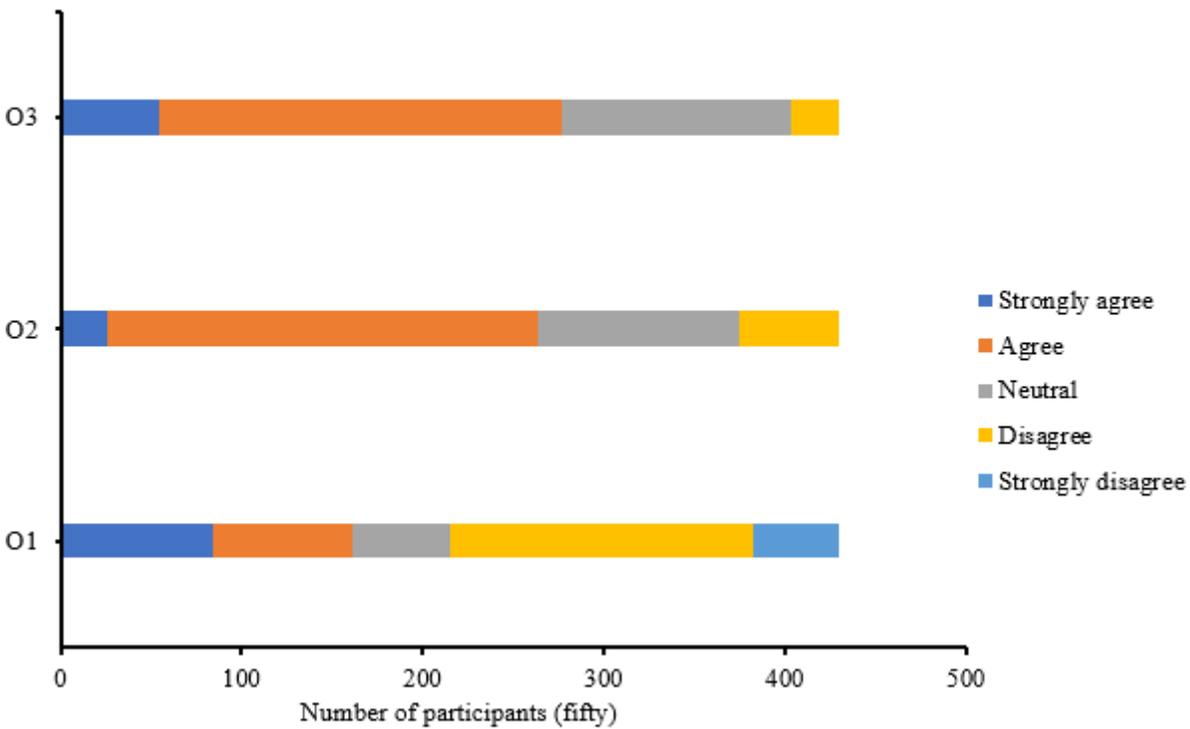
Figure 2

Overall satisfaction and adequate experience. O1: I am satisfied with the quality of training in clinical practice. O2: I am confident that MD career will help me acquire the competencies I need at my current stage of training. O3: This post will be useful for my future career.
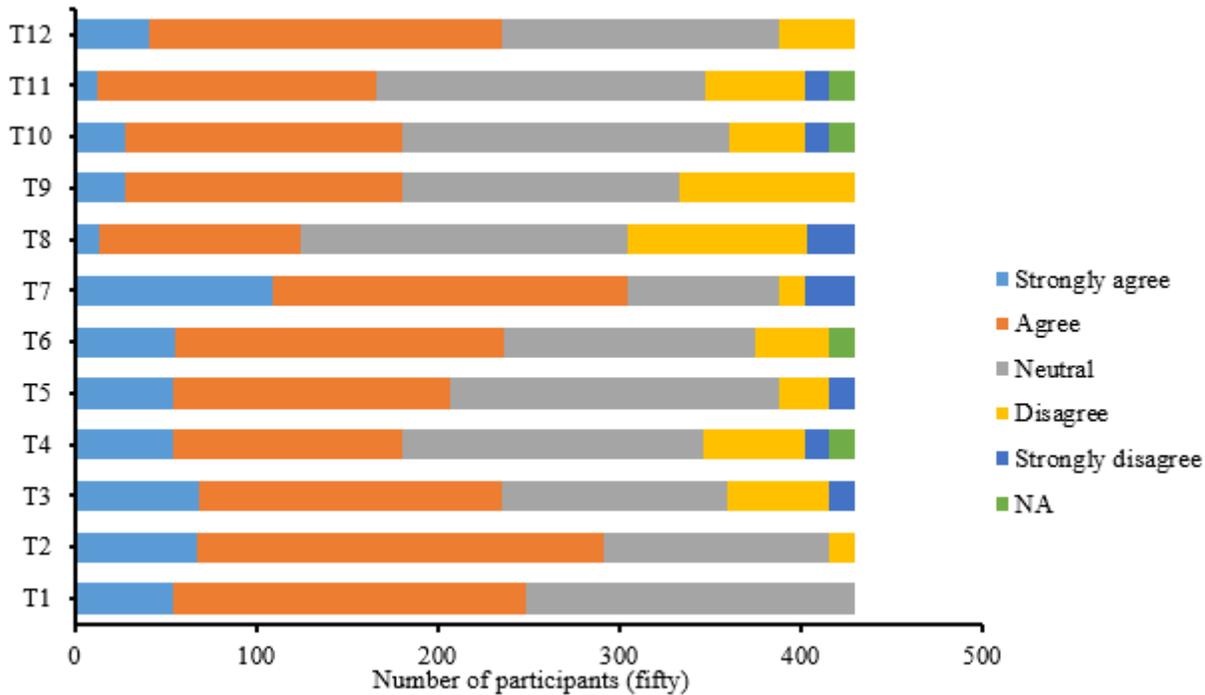
Figure 3

Teamwork, educational governance and supportive environment. T1: My organization encourages teamwork culture between multidiscipline healthcare professionals. T2: My organization encourages teamwork culture between clinical departments. T3: If I asked for help from outside my department, I'm confident I would receive it. T4: I am confident that I know how, or could find out how, to raise a concern about my education and training. T5: If I were to raise a concern about my education and training, I'm confident it would be addressed. T6: I am confident that I know how, or could find out how, to escalate such a concern if I felt it wasn't being addressed. T7: The training environment is fully supportive. T8: Staff is always treated fairly. T9: Staff always treats each other with respect. T10: The training environment is one that fully supports the confidence building of physicians in training. T11: If I were to disagree with senior physicians, they would be open to my opinion. T12: If I had any concerns (personal or educational) I would know who to approach to talk to in confidence.
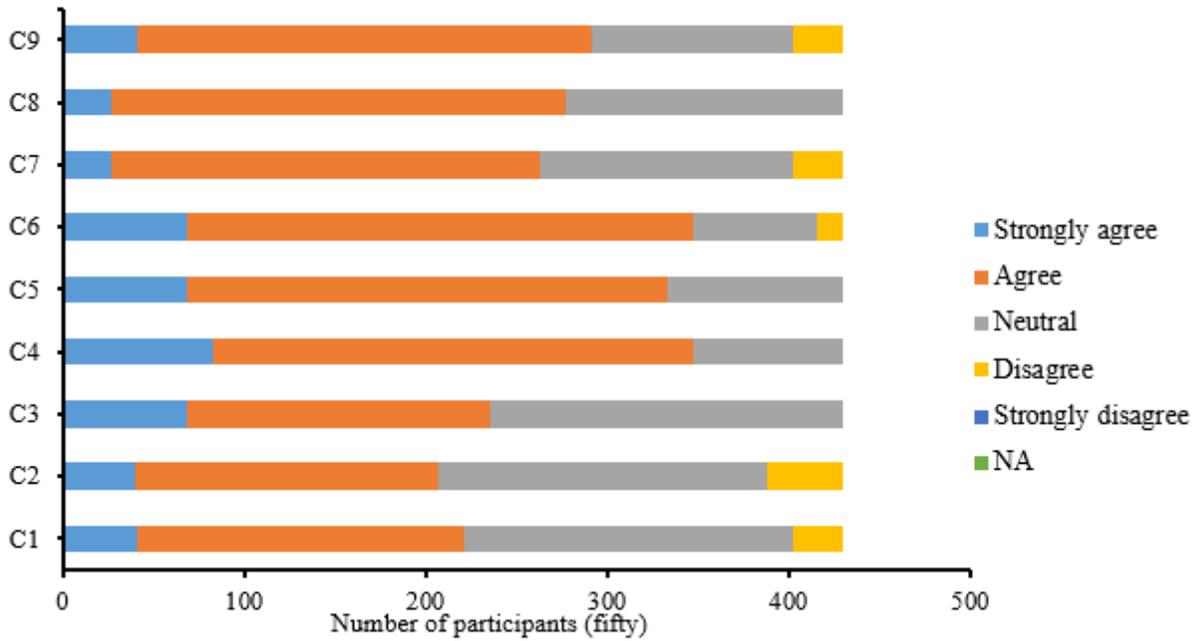
Figure 4

Curriculum coverage and supervised learning events. C1: I'm confident that this post will give the opportunities to meet cultivation objectives in: PROFESSIONAL EXPERIENCE (leadership, teaching, research, and quality improvement etc.). C2: I'm confident that this post will give the opportunities to meet cultivation objectives in: PRACTICAL EXPERIENCE (procedures and treatments of chest drains, passing NG tubes, minor surgeries under local anesthetic, biopsies, fitting coils, injections, psychological therapies etc.). C3: I'm confident that this post will give the opportunities to meet cultivation objectives in: CLINICAL EXPERIENCE (examination skills, taking a history, deciding investigations and management, seeing a variety of patients in different settings etc.). C4: Supervised learning events (SLEs) have led to me reflecting on my clinical practice. C5: SLEs have helped me to identify areas in which I need to develop. C6: SLEs have enabled me to improve my practice. C7: How easy or difficult was it to get a suitable physician to complete an SLE with you? C8: I have access to a senior physician who is onsite at all times. C9: The senior physician onsite could advise on any clinical situation.
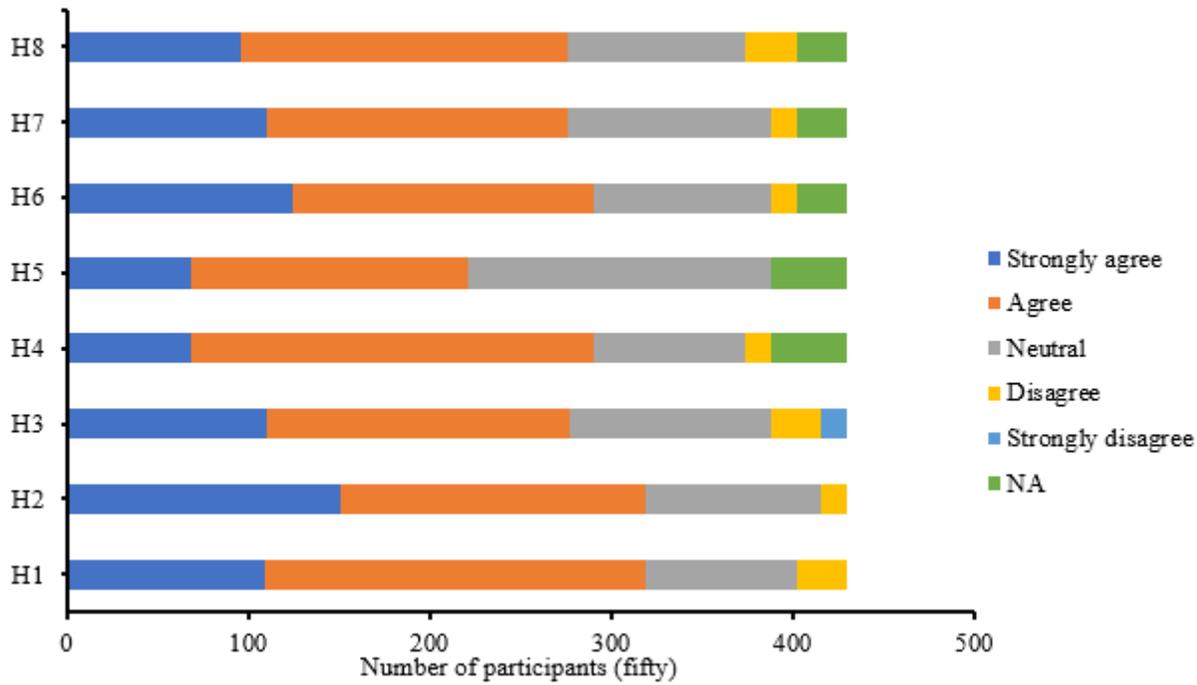
Figure 5

Handover and reporting systems. H1: Handover arrangements always ensure continuity of care for patients between shifts. H2: Handover arrangements always ensure continuity of care for patients between departments. H3: Appropriate members of the multidisciplinary team are included in handover. H4: I have been made aware of how to report patient safety incidents and near misses. H5: There is a culture of proactively reporting concerns. H6: There is a culture of learning lessons from concerns raised. H7: I am confident that concerns are effectively dealt with. H8: When concerns are raised, the subsequent actions are fed back appropriately.
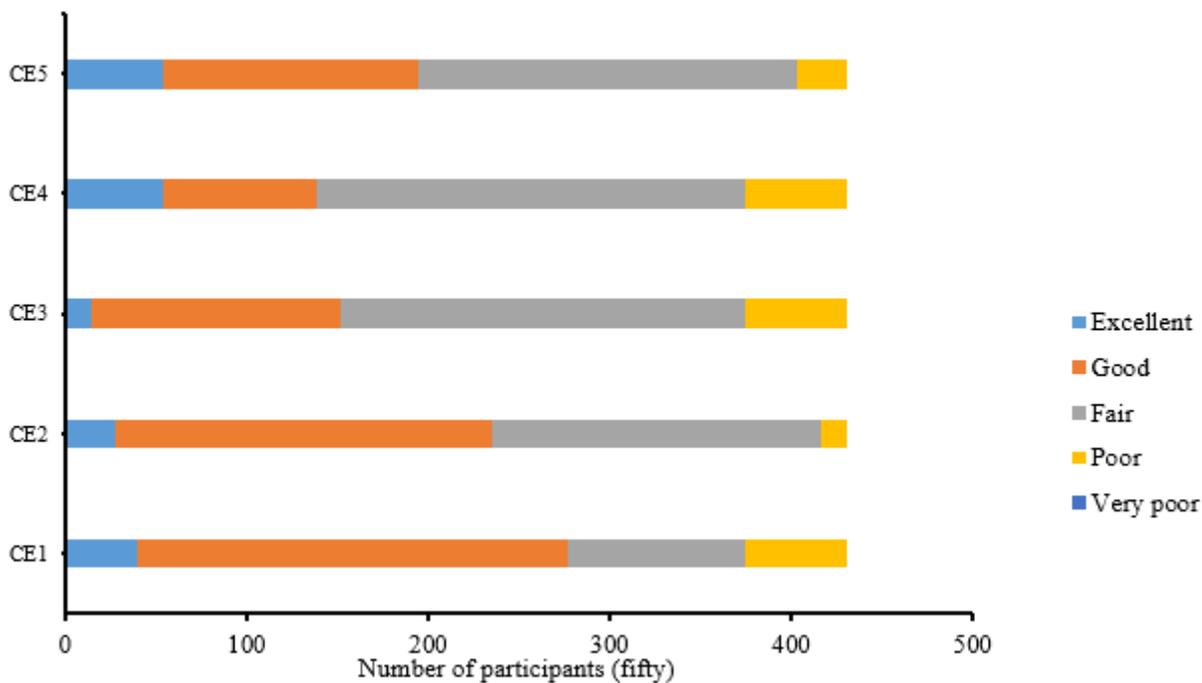
Figure 6

Clinical experience, clinical supervision, local teaching and overall satisfaction. CE1: How would you rate the quality of the local/departmental teaching? CE2: How would you rate the quality of teaching (informal and bedside teaching as well as formal and organized sessions)? CE3: How would you rate the quality of clinical supervision? CE4: How would you rate the quality of clinical experience? CE5: How would you rate the practical experience you were receiving?
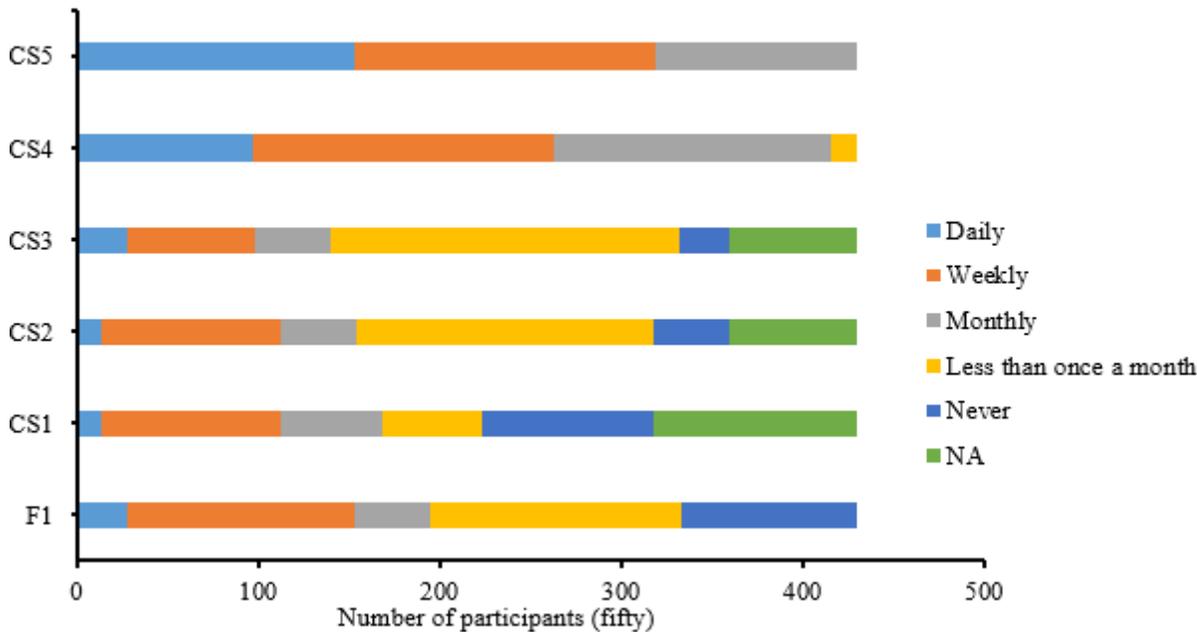
Figure 7

Feedback, clinical supervision and workload. F1: How often (if at all) do you receive informal feedback from senior physicians about your performance? CS1: How often (if ever) are you supervised by someone who you feel isn't competent to do so? CS2: How often (if ever) do you feel forced to cope with clinical problems beyond your competence or experience? CS3: How often (if ever) are you expected to obtain consent for procedures where you feel you do not understand the proposed intervention and its risks? CS4: Have you worked out of hours (this includes night shifts and weekends)? CS5: How often (if at all) do your working pattern leave you feeling short of sleep when at work?