Conducting General Practice Education Intervention Research: From Design to Post-Print Publication

Authors: Zou Chuan, Ou Jianming, Zeng Xin, Peng Tao, Zhou Yan, Xiao Chunyao, Tao Hongxia, Chen Qingqi, Lin Kai, Lin Kai

Date: 2022-08-17T00:00:00+00:00

Abstract

With the development of primary healthcare in China, nearly 400,000 general practitioners will be trained in the coming decade, among which the cultivation of competent general practitioners is of paramount importance. This requires general practice educators to explore numerous evidence-based concepts, methods, and contents for general practice education that are suitable for the Chinese context. Currently, the quality of domestic general practice education intervention research is poor, and most general practice education faculty and researchers still lack relevant training in education intervention research. This article aims to introduce the process of general practice education intervention research: from design to publication, dividing the research into four phases with a total of 13 steps. The four phases are research preparation (generating research inspiration, literature review, integrating theoretical/conceptual frameworks, refining research questions), research design (trial design, intervention measures, outcome evaluation), research implementation (establishing research teams, securing research resources, applying for research ethics, project implementation), and publication and evaluation phases (article writing, reflection and evaluation). The goal is to provide research methods and ideas for general practice education researchers and practitioners to conduct education intervention research, generate high-quality educational research "evidence", and further improve the quality of general practice education and training to cultivate competent general practitioners.

Full Text

Conducting General Practice Educational Intervention Research: From Design to Publication

Authors: Zou Chuan[1], Ou Jianming[1], Zeng Xin[1], Peng Tao[1], Zhou Yan[1], Xiao Chunyao[1], Tao Hongxia[2], Chen Qingqi[3], Lin Kai[4]*

Affiliations: 1. Department of General Practice, Chengdu Fifth People' s Hospital, Chengdu 611130, China 2. College of Medicine and Life Sciences, Chengdu University of Traditional Chinese Medicine, Chengdu 611137, China 3. United Family Healthcare Group, Shenzhen 518000, China 4. Department of General Practice, The First Affiliated Hospital of Shantou University Medical College, Shantou 515041, China

Corresponding Author: Lin Kai, Attending Physician, Lecturer; E-mail: Klin1@our.ecu.edu.au

Abstract: With the development of primary care in China, nearly 400,000 general practitioners will be trained in the coming decade, making it crucial to cultivate competent GPs. This requires general practice educators to explore numerous evidence-based educational concepts, methods, and content suitable for the Chinese context. Currently, the quality of educational intervention research in China is poor, and most general practice faculty and researchers lack relevant training in educational intervention studies. This article aims to introduce the process of conducting general practice educational intervention research from design to publication, dividing the research into four stages comprising 13 steps. The four stages are: research preparation (generating research inspiration, literature review, incorporating theoretical/conceptual frameworks, refining research questions), research design (trial design, intervention measures, outcome evaluation), research implementation (establishing a research team, securing research resources, applying for research ethics, project execution), and publication and evaluation (article writing, reflection and evaluation). We hope to provide research methods and ideas for general practice educators and practitioners to conduct educational intervention studies, generate high-quality educational research "evidence," and further improve the quality of general practice training to cultivate competent general practitioners.

Keywords: General Practice; Educational Research; Intervention Study

Introduction

To strengthen the primary healthcare service system and promote tiered diagnosis and treatment, cultivating competent general practitioners is essential. The 2018 State Council' s "Opinions on Reforming and Improving the Training and Incentive Mechanisms for General Practitioners" states that by 2030,

there should be five qualified GPs per 10,000 urban and rural residents, meaning China will train 400,000 GPs in the next decade [1]. However, China' s general practice started relatively late, and its training systems, concepts, and methods mostly draw on international experience. Combined with China' s unique healthcare service system and cultural traditions, the effectiveness and applicability of these approaches remain uncertain. Medical education has gradually evolved from theory-based teaching to evidence-based teaching, requiring educators to fully consider the evidence level of training methods and provide students with the best evidence-based medical education [2]. Educational intervention research in medical education can provide reliable evidence for teaching practices. Educational interventions primarily involve adopting new training programs, curriculum models, or teaching methods to purposefully and systematically implement educational practices, thereby reforming old educational systems or practices and improving teaching effectiveness [3]. With the rapid development of general practice education, it is necessary not only to learn from international GP training experience but also to conduct high-quality general practice educational intervention research domestically to generate more educational research "evidence" for evidence-based educational practice.

However, many researchers view medical education research as a "soft" science, resulting in insufficient rigor and scientific validity in study design. A systematic review of medical education research showed that included studies were generally of poor quality, lacking clear methodological descriptions, control groups, or institutional review board approval [4]. Another scoping review of general practice education research confirmed that most studies needed methodological optimization, with 23% of quantitative studies using pre-post tests, nearly half using questionnaires as the primary data collection method, and only 10% employing randomized controlled trials [5]. Inadequate research design reduces study validity and limits the generalizability of educational outcomes.

This article aims to introduce the four stages and 13 steps of general practice educational intervention research from design to publication through literature review and the authors' practical experience, providing research methods and ideas for general practice educators and practitioners to conduct educational intervention studies.

1.1 Step 1: Generating Research Inspiration

Generating research inspiration is the first step in constructing research questions. On one hand, general practice education researchers can obtain inspiration by reading extensive literature on general practice or education and participating in academic conferences [6]. On the other hand, the most important source of inspiration comes from the practical experiences of general practice educators [7,8]. General practice educators and practitioners continuously encounter various clinical problems and teaching dilemmas, and are exposed to new concepts and methods that help cultivate GP trainees, such as narrative medicine, shared decision-making, and simulation-based training, all of which

can provide valuable research directions.

1.2 Step 2: Literature Review

Once research inspiration or questions emerge, literature review helps researchers establish a comprehensive and clear picture of the current research landscape in their area of interest, identify research gaps, and avoid duplicating others' work. Simultaneously, researchers can learn from other scholars' experiences during the literature review process, such as trial design, intervention methods, assessment tools, and data analysis [9], to further develop their own research plans through learning and comparison.

1.3 Step 3: Incorporating Theory/Conceptual Framework

In educational intervention research, the theoretical/conceptual framework is akin to pharmacological mechanisms. Researchers must not only clarify whether the intervention produces effects but also use various theoretical/conceptual frameworks to guide intervention design and explain the reasons for effectiveness when publishing their research [10]. This represents the most significant difference between educational research and clinical research. Previous general practice education research and publications often lacked theoretical/conceptual frameworks [11]. Two reviews of literature published in major medical education journals in 2007 and 2019 indicated that nearly half of the papers lacked explicit theoretical or conceptual framework support [5,12], seriously affecting the rigor of research design in general practice education and constraining the generalizability and application of research findings.

Bordage et al. described theoretical/conceptual frameworks as "ways of thinking about problems or research, or methods of presenting complex relationships between things," primarily comprising educational theories (e.g., deliberate practice), models (e.g., Kolb' s learning model), or practice principles developed based on observation or empirical research [13]. Using theoretical/conceptual frameworks in research can help clarify the nature of problems, guide the development of potential solutions or interventions, and help peers or readers quickly understand the research foundation and assumptions, facilitating the generalization and application of research findings [14]. In educational research, theoretical/conceptual frameworks function like different "spotlights," reflecting and emphasizing certain aspects of research questions and presenting only partial objective reality [13]. For example, for a study aiming to "improve GP-patient communication skills," behaviorism emphasizes psychological strategies and practice evaluation, constructivism emphasizes steps for knowledge and skill acquisition, while social learning theory focuses on interactions between teachers and students or among students [15]. Therefore, well-designed educational intervention research often develops based on conceptual frameworks to enhance research rigor [6].

During design, researchers can use either a single conceptual framework or multi-

ple frameworks to achieve more ideal intervention effects. This article lists three commonly used conceptual frameworks in general practice education research for researchers' understanding and reference (see Table 1).

Table 1 Examples of Theory/Conceptual Frameworks in General Practice Educational Intervention Research

Theory/Conceptual Framework	Theoretical Content	Application in General Practice
Reflective Learning Theory	Reflective learning strengthens learning effects through reflection on the learning activity process. Reflection is the process of re-examining one's own thinking processes and results. Reflection in learning, like biological organisms digesting food and absorbing nutrients, is irreplaceable. Contemporary constructivism holds that learning requires construction in activities, requiring students to continuously reflect on, generalize, and abstract their activity processes.	Shaughnessy et al. introduced continuous reflective practice into a family medicine residency program. They organized residents to conduct reflections and documentation on clinical practice three times weekly, and conducted qualitative research through focus groups to enhance residents' self-development capabilities [16].

Theory/Conceptual Framework	Theoretical Content	Application in General Practice
Community of Practice	Knowledge, community, and practice are the three major elements of a community of practice. Characterized by members with similar identities or interests who learn, apply, and create knowledge together under common goals. In practical learning, the community shares common beliefs and understanding, conducts practical activities through communication and negotiation, ultimately forming exchanges and cooperation, sharing resources, helping each other, acquiring knowledge, and then having the ability to apply knowledge in practice.	Malaty et al. had family medicine residents form clinical practice teams to learn clinical practice management and use patient clinical data to improve diagnosis and treatment quality. Researchers regularly provided team management data and conducted quarterly teaching seminars where medical directors and resident faculty provided education on how to improve such indicators through institutional processes, ultimately evaluating various aspects of residents' knowledge and abilities [17].

Theory/Conceptual Framework	Theoretical Content	Application in General Practice
Adult Learning Theory	Adult learning theory examines learners' psychological characteristics and behavioral needs from an adult perspective. Adult learners are based on existing experience, have clear self-concepts, and therefore their learning is problem-centered, need-oriented, and driven by intrinsic motivation. China has strengthened research and application of transformative learning theory in medical education in recent years, aiming to help students transform themselves through learning. From the perspective of adult learning theory, greater emphasis is placed on cultivating students' autonomous learning and critical thinking abilities and habits.	Based on adult learning theory, the University of Alberta designed a two-year family medicine residency training program. The rotation curriculum covered 23 core topics in family medicine; the learning process also included a series of group activities such as problem-based learning modules, journal clubs, and exam preparation meetings. Finally, the entire teaching and training program was evaluated through multi-source methods [18].

Theoretical/conceptual frameworks in educational intervention research typically originate from education, psychology, or even sociology. The vast and often obscure theories or models can intimidate novice researchers. We recommend conducting systematic searches on relevant topics to understand and learn from conceptual frameworks used in previous research before selecting one. Of course, collaborating with experienced education researchers is a shortcut. Additionally, we recommend reading "Introduction to Medical Education Research" [19], which provides detailed discussions on various commonly used theoretical models in education research.

1.4 Step 4: Refining Research Questions

Transforming research inspiration into good educational intervention research questions is challenging. Researchers can use the PICOT format from evidence-based medicine to help general practice educators formulate clearer and more refined research questions. PICOT includes Population, Intervention, Comparison, Outcomes, and Timing [20]. For example, our research question is: "Compared with communication theory courses (C), can communication training salons based on the Calgary Guide (I) improve the outpatient consultation communication skills (O) of second-year general practice residents (P) after 3 months (T)?" The FINER criteria are commonly used to evaluate the quality of constructed research questions, including Feasible, Interesting, Novel, Ethical, and Relevant [21]. Relevance means the research question should be closely related to general practice teaching practice and aim to solve current difficulties and challenges in general practice education. Through these two methods, research inspiration can gradually be refined into specific, answerable, and practically innovative educational research questions.

2.1 Step 5: Research Trial Design

Once the research question is established, an appropriate study design must be selected to validate the effectiveness of the educational intervention method. Five common study designs are used in general practice educational intervention research: single-group post-test, single-group pre-post test, controlled pre-post test, randomized controlled post-test, and randomized controlled pre-post test. Educational research should use the same rigorous scientific standards as clinical research, while considering the advantages and disadvantages of specific designs in educational research. The actual design choice should be based on the research question, population, and resources. We will elaborate on the advantages and disadvantages of each design method with examples (see Table 2).

1. **Single-group post-test:** Data collection occurs at the end of the educational intervention. The main advantages are simplicity, cost-effectiveness, and ease of operation, allowing rapid acquisition of training feedback, making it common in medical research. With only one data collection point, participants invest relatively less time, and data analysis is straightfor-

ward [22]. However, the lack of baseline data comparison means results may be caused by factors other than the intervention.

2. **Single-group pre-post test:** Data collection occurs at two time points before and after the educational intervention, making it the most common design [4]. This design is more reliable than single-group post-test as it can more accurately detect changes before and after intervention. Its complexity and cost are moderate, and it can demonstrate changes without requiring a control group. However, despite collecting data at two time points, it cannot accurately attribute changes to the intervention or other confounding influences.

3. **Controlled pre-post test:** This quasi-experimental design can detect whether participant changes are due to the intervention or confounding factors, and controls for learning from the first assessment. Compared with the above two designs, controlled pre-post test provides more reliable results and is highly operational (e.g., using one class as control and another as experimental group), but still has limitations. It requires ensuring consistency in participant characteristics between groups; otherwise, differences in unmeasured factors may cause result variations. Additionally, including a control group increases data collection and analysis volume, raising costs. Attrition may occur since the control group does not receive intervention.

4. **Randomized controlled post-test:** Participants are randomly assigned to control and experimental groups, with data collected after intervention. Randomized controlled trials can more powerfully explain intervention-related changes. Randomization of course participants minimizes selection or recruitment bias. Compared with randomized controlled pre-post test, this design requires less investment while maintaining randomization. However, since it cannot show learners' pre-post changes, it requires precise sample sizes based on test hypotheses to eliminate baseline differences between groups. Educational intervention research typically has small sample sizes, making this design uncommon [23].

5. **Randomized controlled pre-post test:** Participants are randomly assigned to control and experimental groups, with data collected before and after intervention. This design is the gold standard for validating training effects with high external validity, controlling confounding variables through randomization and minimizing baseline differences. However, conducting randomized controlled trials in educational settings is difficult, requiring the most time, expense, and resources, making participant compliance hard to ensure, with high sample size requirements often necessitating multi-center collaboration.

Table 2 Advantages and Disadvantages of Five Design Methods in Educational Intervention Research and Their Examples in General Practice Research

Research Design	Advantages	Disadvantages	Example in General Practice
Single-group post-test	Simple, economical, easy to operate; rapid improvement suggestions.	Lack of baseline data; training effects may pre-exist; may be caused by natural maturation; may result from factors other than intervention.	**Research Question:** Can workshop teaching mode improve GPs' comprehensive abilities? [24] **Participants:** GP transfer training students; **Intervention:** Workshop teaching mode including general outpatient teaching, case discussions, and ward rounds; **Evaluation:** On-site questionnaire survey of teaching activity effectiveness.
Single-group pre-post test	Moderate complexity and cost; no control group needed; can show pre-post changes.	Training effects may result from factors other than intervention; may be caused by natural maturation; may stem from learning during pre-post assessments.	**Research Question:** Is community-based training evaluation base effective for GP training? [25] **Participants:** 30 GPs from community health centers; **Intervention:** Training at community-based evaluation base including theory, skills, physical examination, and doctor-patient communication; **Evaluation:** Pre-post assessment of various GP competency levels.

Research Design	Advantages	Disadvantages	Example in General Practice
Controlled pre-post test	Controls for measured factors other than intervention; controls learning from first assessment; more feasible than randomized studies.	Complex, requires substantial resources; difficult to achieve baseline consistency between groups.	**Research Question:** Can dementia education intervention improve GP residents' attitudes and confidence? [26] **Participants:** 332 GP residents; **Intervention:** 3-hour face-to-face workshop; **Evaluation:** Pre-post use of GP dementia confidence and attitude scale.
Randomized controlled post-test	Controls confounding variables; requires fewer resources while maintaining randomization.	Cannot show learners' pre-post changes; high sample size requirements; difficult to achieve baseline consistency.	**Research Question:** Can brief non-verbal communication training improve patient satisfaction? [27] **Participants:** 16 GPs randomly divided into intervention and control groups; **Intervention:** Brief non-verbal communication training with video review and reflection; **Evaluation:** Post-intervention patient completion of medical interview satisfaction scale.

Research Design	Advantages	Disadvantages	Example in General Practice
Randomized controlled pre-post test	High external validity; minimizes baseline differences; controls confounding variables.	Most complex, requires most resources; large sample sizes, often requires multi-center collaboration.	**Research Question:** Is learner-centered method more effective than traditional method for improving GP communication skills? [28] **Participants:** 100 Dutch GPs randomly divided into intervention and control groups; **Intervention:** Video observation and feedback on communication deficits; **Evaluation:** Pre-post video assessment of GP communication skills.

Note: E: Experimental group; C: Control group; R: Random; X: Intervention; O1: First measurement; O2: Second measurement.

2.2 Step 6: Developing Intervention Measures

Similar to clinical research, educational intervention research is complex, with results potentially influenced by many variables such as training content, teaching environment, teaching strategies, and training subjects. For example, different studies on doctor-patient communication training for hypertension management among medical personnel adopt different communication training content, teaching strategies, and durations, greatly affecting the heterogeneity of educational intervention effects on blood pressure management [29]. Therefore, developing educational intervention measures requires inclusion of numerous education-related factors such as teaching objectives, teacher qualifications, student numbers and knowledge base, teaching strategies, training schedule, course materials, training environment, training incentives, and teaching evaluation. Meinema JG et al. [30] developed a checklist for educational intervention measures based on the GREET guideline (Guideline for Reporting Evidence-Based Practice Educational Interventions and Teaching) developed by Phillips et al., comprising 3 parts and 17 criteria to comprehensively describe educational interventions in medical education. This can effectively assist researchers in developing more detailed educational intervention measures to enhance research transparency and replicability, and better explain research results.

2.3 Step 7: Intervention Outcome Evaluation

Educational intervention research requires selecting appropriate outcome indicators to evaluate and demonstrate training effectiveness. Among numerous educational evaluation models, Kirkpatrick' s four-level model of evaluation is most widely applied in educational research and has been adopted by the Best Evidence Medical Education (BEME) collaboration as the "evidence" grading standard for evaluating various educational models or methods [31,32]. Kirkpatrick' s model not only focuses on medical education interventions' impact on learner satisfaction, knowledge, and skill improvement but also evaluates training effects on learner work behavior and patient care outcomes. It includes four levels (see Table 3): Reaction (satisfaction), Learning (attitudes, knowledge, and skills), Behavior (work behavior change), and Results (patient impact) [33]. Yardley et al. found in their review of medical education intervention research literature that 24% of studies evaluated outcomes at Level 1, 64% at Level 2, and only 12% at Levels 3 and 4 [31]. However, during research design, the pursuit of higher-level outcome evaluation should be balanced with research purpose and resources. Generally, studies with lower-level outcome evaluation but highly innovative intervention methods are more likely to attract attention, while studies with lower innovation levels typically require higher-level outcome evaluation.

After determining the outcome evaluation level, appropriate evaluation methods and tools must be selected. For example, questionnaires are typically used to assess learner satisfaction, knowledge tests evaluate knowledge mastery, standardized patients assess skill improvement, and medical record quality control evaluates actual behavior change (see Table 3). Different outcome evaluation levels have different methods, and the same method has different tools. For instance, after training doctor-patient communication skills, evaluating behavior change in GPs' outpatient consultations can be assessed through self-report, direct researcher observation, video recording, or anonymous standardized patients, with direct observation using tools like self-made scoring sheets, the SEGUE scale, or the Calgary-Cambridge Guide [34]. Renowned medical education scholar Professor Cook recommends first determining the outcome evaluation level, then the evaluation method, and finally the evaluation tool [35]. Each evaluation method has its advantages and disadvantages, and tools have different reliability and validity [36]. Researchers should strive to select existing tools with high reliability and validity to avoid spending too much time developing new tools. If no existing tools are available, a compromise approach can combine existing tools with research needs to develop new assessment tools. Pilot testing is recommended to validate evaluation tools and identify problems in data collection [35].

Table 3 Kirkpatrick' s Four-Level Evaluation Model with Application Examples

Level	Evaluation Type	Specific Content	Common Evaluation Methods	Example (GP Colorectal Cancer Screening Training)
Level 1	Reaction	Learners' evaluation of training: engagement, satisfaction, acceptability, practicality	Questionnaire survey	GP satisfaction and practicality questionnaire for "How to Conduct Colorectal Cancer Screening in General Practice" course
Level 2	Learning	Learners' gains from training: knowledge, skills, attitudes, confidence, competence	Knowledge test; Standardized patient; Questionnaire scale	1. Knowledge test: Measure GP mastery of colorectal cancer knowledge; 2. Standardized patient: Assess GP communication and decision-making skills for community colorectal cancer screening; 3. Questionnaire scale: Evaluate GP willingness and attitudes toward community colorectal cancer screening
Level 3	Behavior	Learners' behavior changes in practice after training	Video or direct observation; Anonymous standardized patient; Medical record review	1. Direct observation: Researchers observe via video whether GPs conduct colorectal cancer screening in actual consultations; 2. Medical record review: Whether eligible patients receive screening
Level 4	Results	Institutional changes or patient health outcomes brought by training	Institutional statistical reports	1. Number of colorectal cancer screenings conducted by institution one month post-training; 2. Number of colorectal cancer patients diagnosed within one year post-training; 3. Number of colorectal cancer patient deaths in the community post-training

3.1 Step 8: Building a Research Team

A good research team is crucial for successful project implementation. The principal investigator should ensure the team has appropriate personnel with not only relevant professional backgrounds and experience but also passion and commitment for the research. Junior members with less experience but willingness to contribute may be as valuable as senior members with extensive experience but limited dedication. Therefore, a general practice research team should mainly include two types of members: first, project implementers who conduct educational assessment, intervention, and data collection, which can include colleagues at the same level or junior physicians, graduate students, residents, and interns; second, project expert advisors, such as senior education researchers, statistics experts, and experienced teachers. These advisors may not be clinicians familiar with specific clinical environments, but their rich knowledge and experience in educational theory and research methods can provide excellent suggestions for high-quality educational projects [22]. If such personnel are not available in your institution or hospital, try contacting external collaborators from other institutions who are interested in your research and have relevant experience [37].

As the principal investigator, you need to, on one hand, through open discussion, make members aware of their roles and expectations in the educational research implementation process; on the other hand, consider how to benefit team members from the research, such as co-authoring publications, learning new research skills, making new friends, obtaining degrees, enhancing professional resumes, receiving compensation, and getting your mentorship recommendations. Each member' s expectations differ and require careful balancing by the researcher to effectively unite team members and ensure sustained contributions. An effective strategy is to reach consensus on authorship order and contributions early in the research project, even signing collaboration agreements to avoid later conflicts among team members [38].

3.2 Step 9: Securing Research Resources

The research team needs to carefully consider and secure various resources required during educational research project implementation. First, try to convince your institution or relevant leaders to recognize and support your educational intervention research project, helping stakeholders recognize the potential value of the teaching research for the institution and trainees, thereby providing convenience for student organization, venues, and equipment during educational intervention. Second, most busy general practice clinical faculty have their own clinical work or teaching tasks, making it difficult to find sufficient time for educational research. The suggestion to overcome this difficulty is to conduct educational research around existing general practice courses or training programs, which reduces resource investment. Finally, it is necessary to apply for funding for your educational intervention project. Many schools or medical institutions provide internal funding support for teaching innovation and reform

projects, which researchers can fully utilize to conduct pilot studies of educational intervention research. Initial research results can provide strong support for applying for external funding. Currently, many municipal or provincial health commissions or general practice professional associations in China can provide funding support for general practice educational intervention projects, and there are also specialized funds for general practice education research, such as the General Practice Education and Teaching Research jointly launched by the National Medical Degree Education Steering Committee and the Chinese Medical Doctor Association [39]. If readers are unfamiliar with how to write educational research grant proposals, they can refer to corresponding proposal writing guidelines [40,41].

3.3 Step 10: Obtaining Ethics Approval

Although researchers generally agree that ethics approval is needed in clinical research, there is great variation in medical education research. On one hand, researchers may believe that educational research does not directly involve patients and tend to think educational interventions benefit students, thus easily overlooking potential risks. On the other hand, the dual purpose of educational research (education and research) can mask potential ethical issues [42]. Hally et al.' s survey showed that only 5% of original studies published in four major medical education journals underwent institutional ethics committee review [43]. Moreover, students remain a "vulnerable population" in educational research. Since researchers also serve as teachers, students may worry that their research cooperation will affect teachers' evaluation of them or their grades, forcing them to participate; research may also occupy time students could use for clinical practice, studying other subjects, or leisure; poor performance during research may even affect students' confidence outside the research context; simultaneously, research carries the risk of exposing student privacy [42]. Therefore, like clinical research, medical education intervention research still needs to ensure authenticity and validity while guaranteeing students' autonomous choice, risk minimization, and social justice, requiring institutional ethics committee approval before implementation. Although most medical education research can be exempted from ethics approval, this decision is made by the ethics committee, not the researcher. Currently, medical education journals are gradually becoming stricter, requiring institutional ethics committee approval before publication [44].

Researchers can take a series of measures during study design to minimize ethical risks and smoothly obtain ethics committee approval. First, the research protocol should clearly describe the informed consent process, detailing that students can freely choose to participate without worrying about any consequences from refusal, and can withdraw after consent [45]. Second, use anonymous methods or codes during survey assessments to reduce the risk of student identification, and researchers must properly store research data to avoid leaking student privacy [45]. Meanwhile, for fairness and justice considerations, ethics

committees tend to favor crossover design research plans where both experimental and control groups receive educational interventions [46]. Scholars Egan-Lee and Boileau E respectively summarized 12 tips for obtaining ethics approval for medical education research [45] and 12 avoidable pitfalls [47] for novice medical education researchers. Finally, researchers need to understand the role of ethics committees in research and maintain communication with ethics committee experts through a collaborative attitude to jointly ensure educational research can be conducted safely and ethically.

3.4 Step 11: Project Implementation

Successful teaching research projects require not only careful and rigorous design but also practical and strict execution. When research projects truly enter the implementation phase, project leaders must shift roles from researcher to project "manager."In addition to building research teams and securing resources, as project managers, they need to create a detailed timeline during implementation, clarifying start and end times for all tasks including participant recruitment, course training, data collection nodes, data entry and analysis, and publication timing, while clarifying each team member' s responsibilities in each 环节. We recommend using Gantt Charts to help research leaders track implementation progress. However, project leaders should have reasonable expectations about implementation smoothness, as various difficulties and obstacles will inevitably arise, such as some students not cooperating with surveys, pandemic impacts on training progress, contamination between experimental and control groups, and inability to conduct outcome evaluation as scheduled. At this point, establishing a regular meeting system among team members (e.g., weekly) to regularly report and communicate research progress and encountered difficulties, through brainstorming and open discussion, can collectively discuss and solve problems in project implementation. We recommend beginners familiarize themselves with basic knowledge and skills in project management [48] to better advance research.

4.1 Step 12: Article Writing and Publication

Successful publication of educational intervention research reports not only benefits researchers' academic development and expands their academic influence but also facilitates the transformation and promotion of educational intervention measures, providing references for other researchers. However, the reporting quality of medical education intervention research is generally poor, often missing many basic elements of scientific reporting [5]. Meinema JG et al.' s 2019 systematic review found that among 105 included medical education intervention studies, 52.4% did not state the study' s cognitive framework, 43.8% did not describe learning objectives, 53.3% lacked student satisfaction reports, with an average reporting quality score of only 15.9 (out of 32), and 76% of articles scored only 11-20 [30]. Therefore, understanding reporting guidelines for educational research is crucial for successful publication to ensure research follows rele-

vant internationally recognized standards. Currently, reporting guidelines have been developed for educational intervention research (see Table 4), such as the BMJ guidelines [49], Cook' s key reporting elements [5], and GREET (Guideline for Reporting Evidence-Based Practice Educational Interventions and Teaching) [30,50]. These reporting guidelines provide detailed instructions on how to write educational intervention articles, saving time for general practice education researchers, reducing blind spots in writing, and improving reporting quality. We recommend referring to these guidelines during the research design phase.

Additionally, selecting appropriate journals is an important strategy for successful publication. For general practice educational intervention research, consider both general practice journals and education journals in Chinese and English. Using CNKI database as the data source, we searched for published Chinese general practice education research with search terms: "(Title=general practice) OR (Title=community doctor) OR (Title=general practice standardization) OR (Title=family doctor) OR (Title=rural doctor)" AND "(Title=education) OR (Title=training) OR (Title=curriculum) OR (Title=teaching)" , with search time from 2010 to present. English literature was searched in PubMed with search strategy: ((((education[Title])) OR (curriculum[Title])) OR (teaching[Title])) OR (training[Title])) OR (course[Title]) AND ((((((family physician[Title])) OR (general practitioner[Title])) OR (family practice[Title])) OR (general practice[Title])) OR (primary care physician[Title])) OR (GP residents[Title]). We listed the top 5 Chinese and English journals for general practice education research publication (see Table 5) for readers' reference.

Table 4 Summary of Reporting Guidelines for Medical Education Intervention Studies

Publication Year	Authors	Study Type	Evaluation Content Description
BMJ guidelines [49]	Luisa Dillner et al.	Educational intervention	Guidelines divided into 4 parts (overview, theoretical considerations, training introduction and design, discussion) and 18 items
Key reporting elements [5]	Cook DA et al.	Educational intervention	Quality reporting characteristics based on guidelines include: literature review, conceptual framework, research intent, study design, intervention and control groups, and ethical considerations

Publication Year	Authors	Study Type	Evaluation Content Description
GREET [50]	Phillips et al.	Educational intervention	Identified 39 items to describe evidence-based practice educational interventions, providing detailed information for describing intervention measures only, to be combined with existing reporting guidelines for study design
ReMERM [51]	Cohen ER et al.	Mastery learning	Guidelines include 22 categories and 38 essential items divided into six sections: title and abstract, introduction, methods, results, discussion, and other information
GREET [30]	Meinema JG et al.	Educational intervention	Identified additional items not covered by GREET, adding criteria to the checklist: learning needs, intervention development process, context and environment, participants, and evaluation and satisfaction

GREET: Guideline for Reporting Evidence-Based Practice Educational Interventions and Teaching

Table 5 Common Chinese and English Journals for General Practice Education Research Publication

Chinese Journals	Proportion	English Journals	Proportion
Chinese General Practice	8.11%	Education for Primary Care	3.95%
General Practice Education	3.95%	BMC Medical Education	3.17%
Chinese Journal of General Practice	3.17%	The British Journal of General Practice	2.77%
General Practice Education Research	2.77%	Australian Family Physician	2.56%
General Practice Education Forum	2.56%	The Medical Journal of Australia	

4.2 Step 13: Reflection and Evaluation

Despite careful design, actual research always has various flaws due to objective conditions and resource limitations. Issues such as "poor sample representativeness, incomplete description, improper data processing" directly reduce research quality, causing result bias and lack of scientific value [52]. Therefore, reflection after research completion is particularly important for future teaching research. We recommend applying scientific rules for quality appraisal (Critical Appraisal) across five domains: study object representativeness, intervention description, bias control, outcome evaluation, and analysis reporting methods [53].

Among published quality appraisal tools, several are applicable to medical education research, with different emphases based on different evaluation content and standards (see Table 6). These appraisal tools provide a planning and evaluation framework for educational research projects, offering high-quality reference standards for researchers in project design, implementation, data collection and analysis, and result reporting. They also help academic journal reviewers, peer reviewers, and readers conduct homogeneous review of educational intervention research reports [54].

Table 6 Quality Evaluation Tools for Medical Educational Intervention Research

Quality Appraisal Tool	Authors & Publication Year	Suitable Study Types	Evaluation Content
MERSQI [55]	Reed DA et al.	Experimental, quasi-experimental, observational	Study design, sample, data type, evaluation tool validity, data analysis, outcome evaluation
BEME [56]	Littlewood S et al.	Teaching in clinical or community settings	Evaluates study results and conclusions based on Kirkpatrick' s evaluation model, ultimately classifying into six levels of evidence

Quality Appraisal Tool	Authors & Publication Year	Suitable Study Types	Evaluation Content
NOS-E [57]	Cook DA et al.	Non-randomized controlled studies, cohort studies, internet-based interventions	Evaluates sample representativeness, comparability, study design, and outcome evaluation methods based on Newcastle-Ottawa Scale
AEM [58]	Farrell SE et al.	Hypothesis testing of educational interventions in quantitative research	Introduction, measurement, data collection, data analysis, discussion, limitations, innovation, generalizability, writing clarity

MERSQI: Medical Education Research Study Quality Instrument; BEME: Best Evidence in Medical Education; NOS-E: Newcastle-Ottawa Scale-Education; AEM: Education Research Scoring Metrics Instrument

Discussion

Due to China' s unique healthcare service system and social environment, general practice educators must recognize that GP training will face many new problems and challenges that require rigorous and effective methods to explore and change. We attempt to provide general practice educators with preliminary ideas and steps for conducting intervention research to guide future general practice teaching practice, improve research rigor, and publish innovative teaching practices in journals for more general practice educators to learn from and reference.

Before conducting educational intervention research, general practice educators need to learn to design medical education curricula standardly, including needs assessment, teaching content, curriculum objectives, educational strategies, curriculum implementation, and curriculum evaluation. This is the prerequisite for teaching research. Readers can refer to SCHNEIDERHAN et al.' s work and the book "Medical Education Curriculum Development: Six-Step Approach" [59]. On this basis, integrate the above research steps to transform teaching projects

into teaching research [60]. For beginners, we recommend collaborating with experienced general practice educators and researchers within and outside your institution to accumulate research experience and ensure research innovation and rigor. If research resources are limited, teaching research can be conducted based on existing general practice training programs to improve feasibility.

Due to space limitations, this article cannot deeply explore every research step nor cover all steps and methods in educational intervention research, such as sample size calculation, data collection, and data analysis [9]. Readers can read the references cited in each step and also recommend books "Introduction to Medical Education Research" [19] and "Educational Research: Quantitative, Qualitative, and Mixed Methods" for further study. China University MOOC offers open courses on educational research, such as "Educational Research Methods" by Southwest University and Zhejiang University [61]. While methods, books, and courses help build foundational knowledge of educational intervention research, the best strategy for mastering this research method is continuous practice and summarization. Meanwhile, readers should remember that educational intervention research has its limitations and cannot answer all educational research questions. For example, descriptive questions require surveys, while exploratory questions need qualitative research, requiring different research methods for different questions [62]. Moreover, even well-designed educational intervention research can improve internal validity, but due to the close relationship between educational intervention effects and local context (learners, teachers, culture, etc.), the generalizability of research results is greatly limited, making the incorporation of theoretical/conceptual frameworks particularly important.

Conclusion

As general practice educators, we have the responsibility to satisfy GP trainees and improve their theoretical knowledge and skill levels to cultivate competent GPs. On the other hand, we also hope training measures can produce actual effects and improve patient health, which is the original intention of conducting general practice training. Through the methods and steps presented in this article, such as constructing research questions, designing trial methods and outcome evaluation, and utilizing reporting guidelines and quality appraisal tools for educational research, we hope general practice educators can conduct intervention research scientifically, standardly, and effectively, playing an important bridging role between general practice education theory and clinical practice.

Author Contributions: Zou Chuan, Lin Kai, and Zeng Xin were responsible for conceptualization and design. Zou Chuan and Lin Kai conducted feasibility analysis and manuscript revision. Ou Jianming, Peng Tao, Zhou Yan, Xiao Chunyao, and Tao Hongxia were responsible for literature/data collection and manuscript drafting. Zeng Xin handled English revision. Chen Qingqi (academic GP) provided review and editing. Lin Kai and Zou Chuan were responsible for quality control and final approval, with overall responsibility and

supervision.

Conflict of Interest: No conflict of interest exists in this article.

Acknowledgments: We thank the Southern Medical University-FAIMER Regional Institution for guidance and training on educational research conducted by team members.

References: [1] Zou C, Liao X Y, Spicer J, et al. Ten years' GP training in China: progress and challenges [J]. Br J Gen Pract, 2020, 70(699): 511-512. [2] Harden R M, Grant J, Buckley G, et al. Best Evidence Medical Education [J]. Adv Health Sci Educ Theory Pract, 2000, 5(1): 71-90. [3] Cruz-Cunha M M, Miranda I M, Gonçalves P. What is Educational Intervention [J]. 2013. [4] Cook D A, Beckman T J, Bordage G. Quality of reporting of experimental studies in medical education: a systematic review [J]. Med Educ, 2007, 41(8): 737-745. [5] Cook D A, Beckman T J, Bordage G. Quality of reporting of experimental studies in medical education: a systematic review [J]. Medical Education, 2007, 41(8): 737-745. [6] Yarris L M, Deiorio N M. Education research: a primer for educators in emergency medicine [J]. Acad Emerg Med, 2011, 18 Suppl 2: S27-35. [7] Boet S, Sharma S, Goldman J, et al. Review article: medical education research: an overview of methods [J]. Can J Anaesth, 2012, 59(2): 159-170. [8] Cleland J, Durning S J. Researching Medical Education [M]. 2015. [9] Tavakol M, Sandars J. Quantitative and qualitative methods in medical education research: AMEE Guide No 90: Part I [J]. Med Teach, 2014, 36(9): 746-756. [10] Mann K V. The role of educational theory in continuing medical education: has it helped us? [J]. J Contin Educ Health Prof, 2004, 24 Suppl 1: S22-30. [11] Brown J, Bearman M, Kirby C, et al. Theory, a lost character? As presented in general practice education research papers [J]. Med Educ, 2019, 53(5): 443-457. [12] Meinema J G, Buwalda N, Van Etten-Jamaludin F S, et al. Intervention Descriptions in Medical Education: What Can Be Improved? A Systematic Review and Checklist [J]. Acad Med, 2019, 94(12): 1938-1947. [13] Bordage G. Conceptual frameworks to illuminate and magnify [J]. Med Educ, 2009, 43(4): 312-319. [14] Abramson E L, Paul C R, Petershack J, et al. Conducting Quantitative Medical Education Research: From Design to Dissemination [J]. Acad Pediatr, 2018, 18(3): 237-244. [15] Slotnick H B, Shershneva M B. Use of theory to interpret elements of change [J]. J Contin Educ Health Prof, 2010, 22(4): 197-206. [16] Shaughnessy A F, Duggan A P. Family medicine residents' reactions to introducing a reflective exercise into training [J]. Educ Health (Abingdon), 2013, 26(3): 141-146. [17] Malaty J, Williams M, Carek P J. Impact of Providing Data on Family Medicine Practice Management Education [J]. Family Medicine, 2020, 52(6): 432-434. [18] Klein D, Schipper S. Family medicine curriculum: improving the quality of academic sessions [J]. Can Fam Physician, 2008, 54(2): 214-218. [19] Wang W M. Introduction to Medical Education Research [M]. Beijing: Peking University Medical Press, 2020. [20] Riva J J, Malik K M, Burnie S J, et al. What is your research question? An introduction to the PICOT format for clinicians [J]. J Can Chiropr Assoc, 2012, 56(3): 167-171. [21] Hulley S B, Cummings S R, Browner W S. Conceiving the research

question and developing the study plan [M]. Designing Clinical Research 4th ed. Philadelphia: Lippincott Williams and Wilkins, 2013: 14-22. [22] Boet S, Sharma S, Goldman J, et al. Review article: medical education research: an overview of methods [J]. Can J Anaesth, 2012, 59(2): 159-170. [23] Mcgaghie W C, Issenberg S B, Cohen E R, et al. Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-analytic comparative review of the evidence [J]. Acad Med, 2011, 86(6): 706-711. [24] Wei N N, Liang B, Li Y W, et al. Practice and exploration of workshop teaching mode in general practitioner transfer training [J]. Chinese Journal of General Practice, 2021, 19(10): 1657-1660. [25] Zuo W J, Duan W X, Gu Y Y, et al. Study on the effect of general practitioner training based on community training evaluation base [J]. Chinese and Foreign Medical Research, 2016, 14(17): 148-149. [26] Mason R, Doherty K, Eccleston C, et al. Effect of a dementia education intervention on the confidence and attitudes of general practitioners in Australia: a pretest post-test study [J]. BMJ Open, 2020, 10(1): e033218. [27] Little P, White P, Kelly J, et al. Randomised controlled trial of a brief intervention targeting predominantly non-verbal communication in general practice consultations [J]. Br J Gen Pract, 2015, 65(635): e351-356. [28] Hobma S, Ram P, Muijtjens A, et al. Effective improvement of doctor-patient communication: a randomised controlled trial [J]. Br J Gen Pract, 2006, 56(529): 580-586. [29] Yao M, Zhou X Y, Xu Z J, et al. The impact of training healthcare professionals' communication skills on the clinical care of diabetes and hypertension: a systematic review and meta-analysis [J]. BMC Fam Pract, 2021, 22(1): 152. [30] Meinema J G, Buwalda N, Etten-Jamaludin F V, et al. Intervention Descriptions in Medical Education: What Can Be Improved? A Systematic Review and Checklist [J]. Acad Med, 2019, 94(12): 1938-1947. [31] Yardley S, Dornan T. Kirkpatrick' s levels and education 'evidence' [J]. Med Educ, 2012, 46(1): 97-106. [32] Reeves S, Fletcher S, Barr H, et al. A BEME systematic review of the effects of interprofessional education: BEME Guide No. 39 [J]. Med Teach, 2016, 38(7): 656-668. [33] Kirkpatrick D L. Evaluating training programs: The four levels [M]. Berrett-Koehler Publishers, 2006. [34] Deng L L, Liao X Y, Wu J, et al. Enlightenment of foreign doctor-patient communication models for GP communication skills training in China [J]. Chinese General Practice, 2021, 24(13): 1593-1598. [35] Cook D A. Twelve tips for evaluating educational programs [J]. Med Teach, 2010, 32(4): 296-301. [36] Anderson T R, Rogan J M. Bridging the educational research-teaching practice gap: Tools for evaluating the quality of assessment instruments [J]. Biochem Mol Biol Educ, 2010, 38(1): 51-57. [37] Scott K, Caldwell P, Schuwirth L. Ten steps to conducting health professional education research [J]. Clin Teach, 2015, 12(4): 272-276. [38] Sommers M S. Negotiating journal authorship: strategies and hazards [J]. Clin Nurs Res, 2011, 20(2): 115-119. [39] National Medical Degree Committee. Notice on the Announcement of 2021 National General Practice Education and Teaching Research Project Approval Results [EB/OL]. (2022-01-08)[2022-03-20]. http://www.medgrad.cn/site/content/2824.html. [40] Blanco M A, Lee M Y. Twelve tips for writing educational research grant proposals [J]. Med Teach, 2012, 34(6): 450-455. [41] Blanco M A, Gruppen L D, Artino A

R, et al. How to write an educational research grant: AMEE Guide No. 101 [J]. Med Teach, 2016, 38(2): 113-122. [42] Keune J D, Brunsvold M E, Hohmann E, et al. The ethics of conducting graduate medical education research on residents [J]. Acad Med, 2013, 88(4): 449-453. [43] Hally E, Walsh K. Research ethics and medical education [J]. Med Teach, 2016, 38(1): 105-106. [44] Eva K W. Research ethics requirements for Medical Education [J]. Med Educ, 2010, 44(3): 194-195. [45] Egan-Lee E, Freitag S, Leblanc V, et al. Twelve tips for ethical approval for research in health professions education [J]. Med Teach, 2011, 33(4): 268-272. [46] Kraus C K, Guth T, Richardson D, et al. Ethical considerations in education research in emergency medicine [J]. Acad Emerg Med, 2012, 19(12): 1328-1332. [47] Boileau E, Patenaude J, St-Onge C. Twelve tips to avoid ethical pitfalls when recruiting students as subjects in medical education research [J]. Med Teach, 2018, 40(1): 20-25. [48] Project Management Institute. A Guide to the Project Management Body of Knowledge (PMBOK Guide) 6th Edition [M]. Beijing: Electronic Industry Press, 2018. [49] Guidelines for evaluating papers on educational interventions [J]. BMJ, 1999, 318(7193): 1265-1267. [50] Phillips A C, Lewis L K, Mcevoy M P, et al. A Delphi survey to determine how educational interventions for evidence-based practice should be reported: stage 2 of the development of a reporting guideline [J]. BMC Med Educ, 2014, 14: 159. [51] Cohen E R, Mcgaghie W C, Wayne D B, et al. Recommendations for Reporting Mastery Education Research in Medicine (ReMERM) [J]. Acad Med, 2015, 90(11): 1509-1514. [52] Jennifer P, Barton B. Medical statistics: A guide to data analysis and critical appraisal [M]. Oxford: Blackwell Publishing; BMJ Books, 2005. [53] Price E G, Beach M C, Gary T L, et al. A systematic review of the methodological rigor of studies evaluating cultural competence training of health professionals [J]. Acad Med, 2005, 80(6): 578-586. [54] Cook D A, Reed D A. Appraising the quality of medical education research methods: the Medical Education Research Study Quality Instrument and the Newcastle-Ottawa Scale-Education [J]. Acad Med, 2015, 90(8): 1067-1076. [55] Reed D A, Cook D A, Beckman T J, et al. Association Between Funding and Quality of Published Medical Education Research [J]. JAMA, 2007, 298(9): 1002-1009. [56] Littlewood S, Ypinazar V, Margolis S, et al. Early practical experience and the social responsiveness of clinical education: Systematic review [J]. BMJ, 2005, 331(7513): 387-391. [57] Cook D A, Levinson A J, Garside S, et al. Internet-Based Learning in the Health Professions: A Meta-Analysis [J]. JAMA, 2008, 300(10): 1181-1196. [58] Farrell S E, Kuhn G J, Coates W C, et al. Critical appraisal of emergency medicine education research: the best publications of 2013 [J]. Acad Emerg Med, 2014, 21(11): 1274-1283. [59] Thomas P A, Zhou Y J. Medical Education Curriculum Development: Six-Step Approach 3rd Edition [M]. Beijing: Science Press, 2019. [60] Zou C, Liao X. Transforming a medical curriculum development into an education research [J]. Fam Med Community Health, 2019, 7(3): e000105. [61] Chen S J, Zhou Q, Wang Z Q. Educational Research Methods [EB/OL]. https://www.icourse163.org/course/ZJU-1206404806?from=searchPage. (2022-03-08)[2022-07-01]. [62] Ringsted C, Hodges B, Scherpbier A. 'The research compass' : an introduction to research in medical education: AMEE Guide no.

56 [J]. Med Teach, 2011, 33(9): 695-709.

Note: Figure translations are in progress. See original paper for figures.