

**Implementation of a mental healthcare service delivery model
for children with Attention-Deficit/Hyperactivity Disorder (ADHD)
in China**

**by
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Abstract

Background: Attention-deficit/hyperactivity disorder (ADHD) is the most prevalent neurodevelopmental disorder among school-age children. In China, current healthcare configuration shows a notable mismatch between the continuous service needs for ADHD diagnosis and intervention and available resources. Drawing on Manitoba (Canada)'s mature ADHD service framework, this study implemented a culturally adapted project in Shantou, Guangdong, to develop a context-appropriate integrated mental health service model for school-age children with ADHD.

Methods: Using mixed qualitative and quantitative methods, an inter-professional team in Shantou University Mental Health Center (STUMHC) was assembled, which collectively 1) built a regional referral network, 2) delivered culturally tailored public-education campaigns, and 3) designed and provided comprehensive, evidence-based outpatient assessment and treatment services. The efficacy of this model was evaluated from the domains of ADHD clinic visiting numbers, treatment outcome, participants' satisfaction, and economic/personnel cost. By comparing pilot data with international practices experiences, the study proposed policy refinements aimed at scaling the model provincially and nationally, thereby narrowing the existing service gap for Chinese children with ADHD.

Results: Following implementation of the integrated model, STUMHC ADHD outpatient visits rose from 196 (2018) to 1,197 (2024); 6 - 12-year-old first visits increased from 45 to 126.7%, and 10% of new cases (2022 to 2024) were from primary care with comorbidities. An analysis of 26 children who completed a 6-month intervention revealed statistically significant improvements in scores on the CBRS, ADHDDS-P, and FES-CV, indicating reduced core symptoms and enhanced social and family functioning. Cost analysis indicated that the estimated annual per capita treatment cost for school-age children with ADHD under this model was approximately 6,388.81

CNY in 2024, with only 0.13 child and adolescent psychiatrists per 100,000 children aged 0–14 years.

Conclusions: The model is effective. Given the relatively high treatment burden and low workforce density, future strategies should emphasize adjustments to national medical insurance policies, supplementary commercial insurance mechanisms, expanded professional training, and intersectoral governmental collaboration to alleviate resource shortages and reduce family economic pressure. Such measures are critical for the sustainable nationwide expansion of the integrated ADHD service model.

Keywords: Attention-deficit/hyperactivity disorder, China, Implementation science, Manitoba service model, multidisciplinary collaborative approach

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Dedication

This thesis is dedicated to my beloved parents, Mr. Rao and Mrs. Li, whose unwavering love and support made this journey possible, and to the loving memory of my co-supervisor, Dr. Huang, whose guidance and encouragement continue to inspire me.

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1. Introduction and Background

1.1 Research Background

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder that is characterized by over-activity, impulse, and attention difficulty. With an onset before 12 years old, these core symptoms compromise patients' performance in school and work settings, social interactions, and family relationships¹⁻³. Children and adolescents with untreated ADHD are at a higher risk of accidental injury, low school grade-point averages, dropping out of school, and antisocial behaviors⁴. Likewise, adults with ADHD are at a greater risk for psychopathology as well as for receiving lower work-performance ratings and being involved in at-fault car accidents⁵.

ADHD affects 5% to 10% of children worldwide⁶. About 30% – 50% of ADHD patients will live with symptoms through adulthood^{7,8}. Because of different research methods and clinical diagnostic systems, prevalence in different countries could be varied. With the introduction of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition-TR (DSM-5-TR), an increase in ADHD prevalence was found, especially in adolescents and adults⁹. It likely resulted from increased awareness, improved access to treatment and changes in clinical practices^{1,2,10}. This result calls for standardized diagnostic methodology, effective clinical practice model and public health awareness. With such a high prevalence and potentially long-lasting functional impairments, ADHD has become a significant public health concern worldwide.

Interventions such as medical treatment, behavioral therapy, lifestyle changing, parent training, family/school-based interventions, and psychotherapy have been shown to be effective in improving the performance of ADHD children and adolescents^{6,11,12}. However, access to healthcare for ADHD patients varies greatly from region to region. In China, treatment rates of ADHD are reportedly from 1% to 10%¹²⁻¹⁴. ADHD patients in developed countries are well-covered with advisable treatments. For instance, in the U.S., about 74% - 98% of the

ADHD patients received treatments ^{9,15,16}. In the province of Manitoba, Canada, the majority of the ADHD children received clinical interventions, with 58.6% of which received pharmacological treatment ^{17,18}. Compared to their North American counterparts, the treatment rates for ADHD in China are of serious concern. As a matter of fact, interventions that were recommended for ADHD in the U.S. and Canada including medication and behavioral therapy, were also effective in China ^{11,15,19}. These results suggest that it is not the efficacy of evidence-based interventions but a lack of mental healthcare services that results in a low coverage for ADHD patients. Chinese people, including the majority of Chinese parents, have limited knowledge but a strong stigma about ADHD. The fact that parents usually consider ADHD symptoms as “natural traits” of a growing child means that their children with ADHD have little opportunity to seek medical attention. Even when parents recognize the problem, cultural stigma of mental disorders would stop them from seeking mental health service but turn to educational institutes for help. Moreover, parents’ concern about the adverse effects of medication could discourage them from putting their children under pharmacological treatments for ADHD.

1.2 Literature Review

In previous research, interventions such as pharmacological treatment, behavioral therapy, parent training, health education, family/school-based interventions, and psychotherapy have been shown to be effective in improving the performance of ADHD children and adolescents ^{11,12,20, 21}. However, the efficacy of each intervention could be varied. According to clinical practice guidelines from multiple countries, multi-modal and individualized treatment is recommended ^{11,12,20,21}.

The efficacy of pharmacological treatment for ADHD symptoms has been strongly proved. Since 1937, studies have confirmed that psychostimulants can effectively control the core symptoms of ADHD, especially attention-deficit and hyperactivity ²²⁻²⁶. Nowadays, the most widely used psychostimulants for ADHD

treatment include methylphenidate and amphetamine ^{11,12,21}. At present, osmotic release technology allows long-acting psychostimulants to ensure the drug release gradually as well as to maintain stable efficacy ²⁷. Long-acting psychostimulants, such as long-acting methylphenidate, assure the effectiveness on the basis of improving the safety of clinical application, such as decreasing the possibility of addiction, and lead to better treatment compliance ^{28,29}. This group of medications has become the first-line recommended medication for both childhood and adult ADHD patients no younger than 6-year-old in clinical practices ^{11,12,21}. Another major group of medications used in the treatment of ADHD is non-psychostimulants, including selective norepinephrine reuptake inhibitors such as atomoxetine, central norepinephrine modulators such as clonidine and guanfacines, antidepressants such as tricyclic antidepressants, bupropion, selective serotonin reuptake inhibitors, and serotonin and norepinephrine reuptake inhibitors ³⁰. With much lower risk of addiction, atomoxetine has become the first non-psychostimulants approved for the treatment of ADHD for both children and adults ^{11,12}. Although there is no risk of addiction, monitoring the liver function of patients should be necessary since in some cases, liver injury may happen ^{31,32}. When ADHD comes with one or more coexisting conditions, the pharmacological treatment needs to be arranged on the basis of the clinical comorbidity situation, for instance, the usage of mood stabilizers should be considered when bipolar disorder co-occurs with ADHD ^{11,14,21,33,34}.

Currently, with the understanding that the treatment goal for ADHD has been moved from controlling core symptoms to the improvement of overall life quality while improving core symptoms as much as possible, psycho-social interventions are playing an increasingly important role in the treatment of ADHD ^{11,12,33,35}. Evidence-based research shows that behavioral therapy can improve the core symptoms of ADHD, while significantly improving the long-term social function of children with ADHD. Therefore, behavioral therapy is often recommended as a first-line treatment option in clinical practice guidelines, especially for preschoolers with whom medications for ADHD should be carefully used ^{11,12,36-38}.

Recommended behavioral therapies included standardized parent training such as “eight steps” by Russell A. Barkley ³⁹⁻⁴¹, school-based classroom behavioral interventions focusing on both classroom management and academic interventions, “organizational skills training (OST)” and social skills training ⁴²⁻⁴⁵. Although not as evidently effective as medication and behavioral therapy, psychotherapy is also considered an important option for the treatment of ADHD, especially in the treatment of adolescents, adult patients, and patients with comorbidity. The main therapeutic methods include cognitive behavior therapy (CBT), mindfulness meditation training, and family and marriage therapy ^{11,12,21,33,46,47}. Working with ADHD individuals or in groups, CBT can significantly reduce levels of depression and anxiety, by focusing on patients' compensatory skill learning and cognitive intervention for dealing with negative cognitive patterns and related negative emotions ^{37,46-53}. Mindfulness meditation training is believed to be able to improve the attention and emotion control ability of ADHD patients because of its need to maintain concentration during practice. Studies found that through mindfulness meditation training, the anxiety and depression symptoms of adolescent and adult ADHD patients were significantly reduced, and the self-evaluation of attention deficit and hyperactivity symptoms was significantly improved ⁵⁴⁻⁵⁹. For those who have family relationship problems, family therapy project including emergency management skills, problem-solving strategies and communication skills would be suggested ⁶⁰⁻⁶³. Finally, since health education and health promotion are not only effective prevention and control measures of chronic diseases, but also effective supporting measures and appropriate technologies for chronic disease management ⁶⁴, they are considered as significant interventions in the management of ADHD. Parents' health education plan including contents about disease knowledge, medication characteristics and efficacy, parenting skills, and local resource information is considered to be effective in improving the medication compliance of ADHD children ⁶⁵⁻⁶⁸. Additionally, health education that provides information about knowledge of ADHD and special classroom supports ADHD children may need should be quite useful for school teachers. It can enable

teachers to better identify ADHD children early so that the children can get under the treatment early, and to better implement school behavior interventions for these children to achieve better outcomes ^{37, 68, 69}.

Furthermore, occupational therapy and rehabilitation treatments, such as cognitive function (attention) training via computers and multimedia ⁷⁰⁻⁷³, as well as biofeedback therapy ⁷⁴⁻⁷⁶, are also considered effective for improving ADHD symptoms.

For decades, numerous studies have confirmed that adopting individualized comprehensive interventions in ADHD intervention strategies, which involve providing personalized interventions by integrating the aforementioned treatment methods, yield significantly better therapeutic outcomes than using procedural, single-modality treatments. Back in 1999, a 14-month randomized, multi-center clinical trial revealed the advantage of multimodal treatment strategies for patients with ADHD. The advantage was more significant with the patients' non-ADHD symptoms such as confrontation and aggression ⁷⁷. This improvement of patients' non-ADHD symptoms will help to better restore social function and quality of life, and it is easier to achieve the goal of our clinical treatment. In 2004, another 24-month outcome evaluation also suggested the advantage of multi-modal treatment ⁷⁸. As a chronic neurodevelopmental disorder, the symptoms of ADHD will be long-lasting but may change over time. Thus, a "life course perspective" is necessary when assessing and treating ADHD ^{4,6,11}. Treatment goals in different stages of patient's life can be different, so different treatment forms and methods are required. For the treatment of ADHD, the Canadian clinical practice guidelines emphasize that the treatment should be multi-modal and individualized ¹¹. According to the clinical practice guidelines from the American Academy of Pediatrics, the treatment plan should be made based on the severity of patient's ADHD symptoms. Patients with mild ADHD may need no treatment or only small number of interventions, while the severe ADHD patients may need multi-modal treatments including pharmacological means. In 2020, the Subcommittee on Children and Adolescents with Attention-Deficit/Hyperactive Disorder, American

Academy of Pediatrics suggested that treatment plan for complex ADHD need to includes 2 main categories -- psychosocial and pharmacological, while each category comprises at least 1 specific intervention, and the interventions are usually varied ⁷⁹. All of these proposed that ADHD calls for multi-modal treatment toward a better outcome.

Multi-modal treatment in clinical practice refers to that clinicians choose multiple interventions based on comprehensive clinical evaluation of the patient, which may include pharmacological treatment, behavioral therapy, psychotherapy, health education and other treatments. All of the interventions need to fit the patient's condition and specific needs, so as to reduce the patient's symptoms and improve his/her social function to the greatest extent. It is worth noting that interventions involved the multi-modal treatment must be scientific, effective and evidence-based. The key is to choose these treatment methods reasonably according to the characteristics of the patient's symptoms ^{11,12,21,79}. Meanwhile, individual/family treatment preferences need to be considered when making treatment plan. This patient-centered approach should be conducted in order to enhance the treatment compliance.

Based on the severity of the ADHD symptoms and the specific goals through the life span, medication can be chosen for elder patients who have more severe symptoms as first-line intervention, while behavioral therapy and other psychosocial interventions can be chosen first for younger, moderate patients ^{11,12,21,36,37,79} (Figure 1).

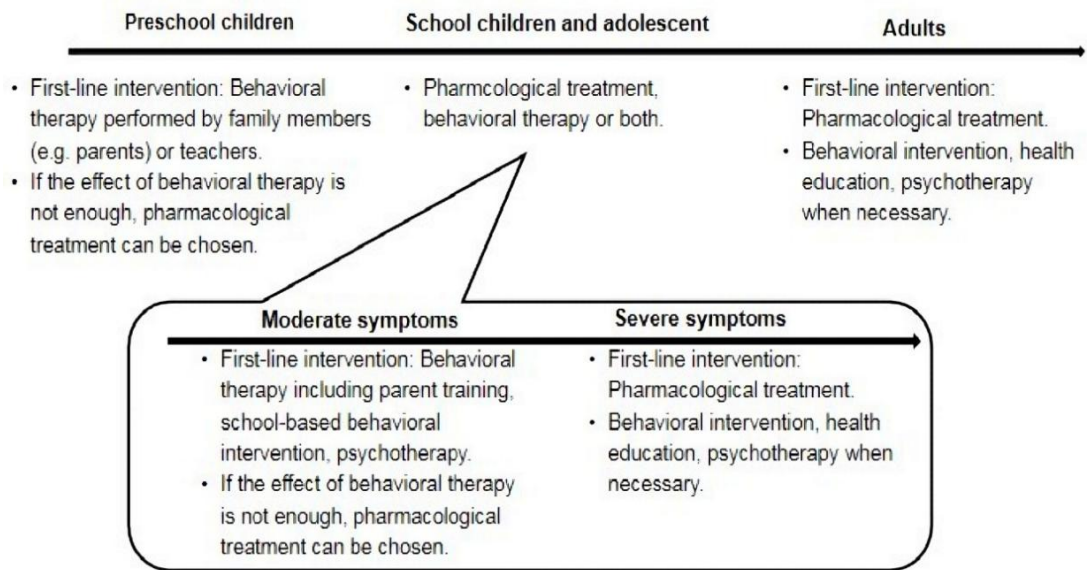


Figure 1. ADHD Multimodal Treatment Strategies Based on Severity and Age Differences.

This figure summarized the recommended treatments from clinical practice guidelines of Canada, U.S. and China, based on the severity levels of the ADHD symptoms in different stage of one's life span. Both age and clinical measurement should be considered when a multi-model treatment plan is employed.

When working with ADHD patients have one or more comorbidities, a comprehensive and accurate clinical evaluation needs to be conduct first, to understand which disease has a greater impact on the patient's dysfunction, what problems need to be solved and what kind of supports the patient may need. On the basic of this information, a multi-model treatment plan can be established. For instance, ADHD patients with ASD needs specific behavior training for ASD core symptoms and pharmacological treatment for ADHD, while ADHD patients with specific learning disorder need both behavioral training and medication for ADHD plus specific learning strategy. Both of these plans should be provided by a multidisciplinary team including clinicians, social workers, teachers and special education experts ^{11,73,80,81}. One of the wildly-used working strategies is the client-friendly model described previously by Hazelwood and his colleagues ⁸². In this model, the clinical case manager will be the single point of entry into the

system. At this initial point, there will be a comprehensive gathering of information and assessment to determine the flow of intervention. An individualized multi-modal package is then formulated, and a team is built around the needs of the case. In the process of treatment, confounding factors that emerge in the case will be addressed through the feedback loops.

According to the characteristics of patients' symptoms and functional defects, most effective intervention methods for specific symptoms and functional defects can be chosen to formulate specific multi-modal treatment strategies ^{11,12,79,81} (Fig. 2)

Targeted Symptom	Specific intervention
• ADHD core symptoms	• Pharmacological treatment (First-line medicine) • Behavioral therapy • health education • Second-line medicine if needed
• Oppositional defiance, conduct disorder	• Sepecific behavioral therapy and training both at home and at school • Parent training and health education • Psychotherapy • Pharmacological treatment for ODD/CD
• Depression, anxiety and other emotional problem	• CBT • Pharmacological treatment for emotional problem
• Impairment of family function	• Family therapy
• Other comorbid (e.g. learning disorder)	• Specific intervention for certain comorbid (e.g. specific education support)

Figure 2. ADHD Multimodal Treatment Strategies Based on Specific Symptoms.

This figure emphasized the specific evidence-based interventions that are effective for certain targeted symptoms from clinical practice guidelines of Canada, U.S. and China. Clinicians should facilitate individualized treatment plan based on the patient's clinical symptoms with comprehensive evaluation, in order to reach the best treatment outcome.

Although multi-modal intervention is recommended as the best treatment strategy for ADHD in the clinical practice guidelines of many countries, the actual implementation and accessibility of this approach varies significantly among

different countries. In North American countries that have well-developed public health system and multidisciplinary teams, such as Canada, multi-modal treatment for ADHD is easy to access. In Manitoba province, Canada, multi-modal treatment service follows a family focused model within a multidisciplinary team is provided to local ADHD patients from 6 to 17 years old ⁸³. The service includes diagnostic services, subsequent treatment and support. With this effective service, the majority of the ADHD children in Manitoba received clinical interventions, while 58.6% of which received pharmacological treatment ⁸⁴.

Meanwhile, in China, treatment rates of ADHD patients were varied from region to region, from 1% to 10%, and the treatment compliance in general is poor ¹². The majority of ADHD patients in China receive pharmacological treatment other than multi-modal interventions though the national clinical practice guideline recommends multi-modal treatment strategy ^{12,14}. This may relate to the lack of public awareness of ADHD, the imperfect construction of social medical welfare framework and the lack of mental health service professionals for children and adolescents. Thanks for the current national health care reform work and the “2015-2020 National Mental Health Work Plan” that pays more attention to child and adolescent mental health care ⁸⁵, pharmacological and psycho-social combined multi-modal treatment for ADHD become more and more accessible in some regions of China, especially in first-line cities such as Beijing, Shanghai, Shenzhen and Nanjing ^{12,30,86-88}. However, researches support the efficacy or about the experience in implementation are rare. More evidence is needed to demonstrate the achievement of the progress of multi-modal treatment for ADHD in these areas. Moreover, these changes have been primarily concentrated in first-line cities, while there was a significant disparity in the comprehensive ADHD mental healthcare services between regions. Many second-line and third-line cities lack of the capability and resources to provide such services. Thus, how to effectively implement comprehensive ADHD mental healthcare service models in areas outside of first-line cities—namely, the majority of regions in China—remains an urgent issue that requires resolution ^{12,30,86}. How, then, can China resolve this

dilemma and ensure that children with ADHD receive timely, comprehensive, and effective interventions? This is precisely the question the present study seeks to address.

1.3 Research Questions, Rationale and Outline of Specific Objectives

As mentioned above, comprehensive multidisciplinary service based on individual needs would be most effective for ADHD children. And there were successful service models, such as which applied in Manitoba, that were capable of delivering high-quality, adequate interventions for the majority of patients. These findings indicate that the mental-health service gap for ADHD can be closed. To estimate the magnitude of treatment gaps in mental health care, 2 indicators were commonly used: contact coverage to measure service use, and effective coverage to further measure the extent to which the service has effectively improved the health of people who accessed it. Based on these rationales, the researcher conducted a implementation research that was going to develop a mental health care service delivery model for ADHD children in China to file the service gap, and test its effectiveness.

To accomplish this outcome, efforts must be made along 2 key dimensions: 1) To increase contact coverage for children with ADHD through a series of “contact coverage initiatives”, including establishment of specific multidisciplinary service team, to provide family-centered clinical services, education, research, and advocacy for ADHD, and 2) To improve the effective coverage of ADHD by training healthcare professionals and implementing the comprehensive, multidisciplinary mental health service to each ADHD child.

To reach the goals listed above, this research aims to develop and implement an accessible, holistic and multidisciplinary mental health care service delivery model for children with ADHD in Longhu district, Shantou, China, to improve the local mental health service for this group, thereby exploring pathways to enhance the level of mental-health services for children with ADHD across China. There are 2 specific objectives for the research implementation: 1) professional training for specialists and health education for the public will increase contact coverage

for children with ADHD in Longhu district; and 2) an individualized client-friendly care model will improve the effective coverage of ADHD in Longhu district.

The next chapter provides a detailed description of the methodology employed to achieve these 2 objectives.

2. Research Methods

2.1 Introduction of Methodology

To achieve the 2 specific objectives mentioned above, a sequence of activities was carried out, employing both qualitative and quantitative research methods throughout the study. This mix-method research would implement a service model that is modified from the ADHD service model of Manitoba, and evaluate its efficacy as well as its feasibility and scalability. To increase contact coverage, a series of “contact coverage initiatives”, including training for specialists and education for the public, will be conducted to increase contact coverage for children with ADHD. To improve the effective coverage of ADHD patients in Shantou, an individualized, multi-modal mental healthcare model for each ADHD child will be introduced and implemented. The efficacy of this model will be evaluated from the domains of ADHD clinic visiting numbers, treatment outcome, participants’ satisfaction, and economic/personnel cost. Because the study was conducted in Shantou and the primary implementation team was the Child and Adolescent Psychiatry Team at the Shantou University Mental Health Center, the research protocol and related informed-consent documents were approved by the Ethics Committee of the Shantou University Mental Health Center.

It took three steps for the researcher to reach the specific objectives, the methods of which will be elaborated in sequence followed.

2.1.1 Methodology for New Service Model Design

First, the general outline of the new mental health service model should be designed. Although Canada possesses a well-established intervention model, cultural differences, resource availability, and varying patient needs preclude direct replication; the model must therefore be adapted to local contexts.

Consequently, the initial step of the study was service-model design. A accompaniment of the Manitoba (Canada) and Guangdong (China) contexts, supplemented by semi-structured interviews designed by the research team, was conducted in July to August, 2018, to collect qualitative data on health-service needs among families of 6 to 12 years old children with ADHD. To elicit these needs, the research team conducted semi-structured interviews with parents of school-aged children diagnosed with ADHD. Parents of children between 6 to 12 years old with ADHD were randomly selected for a semi-structured interview lasting approximately 45-60 minutes in the STUMHC outpatient clinic with inform consent. The purpose of the interview was to understand the needs and expectations of ADHD families regarding mental health service. The interview included a list of 9 open-ended basic questions covered 4 dimensions related to “disease health knowledge”, “resource acquisition”, “medical service experience”, and “shortcomings and suggestions” (detailed questions can be found in Appendix Table 1). Further questions were asked based on the parents’ answers to gain a deeper understanding of specific topics.

To avoid examiner bias, the interviews were done by 2 psychiatrists who had been went through a consistency training to insure the consistency of the outcome. Each trained psychiatrist interviews a couple for 45 minutes individually. In order to ensure the repeatability and recording ability of the research process, and to guarantee the reliability and authenticity of the research results, researchers obtained the consent of the interviewees before each interview, recorded all interviews, and transcribed word for word afterwards. After each interview, researchers sit together, went over the transcriptions to ensure the accuracy of transcription, the accuracy and completeness of key information, and to compare whether there was new key information that did not appear in previous interviews. The process would end when there was now new key information found from the interview. These data were integrated to inform the foundational design of the new mental health care service model.

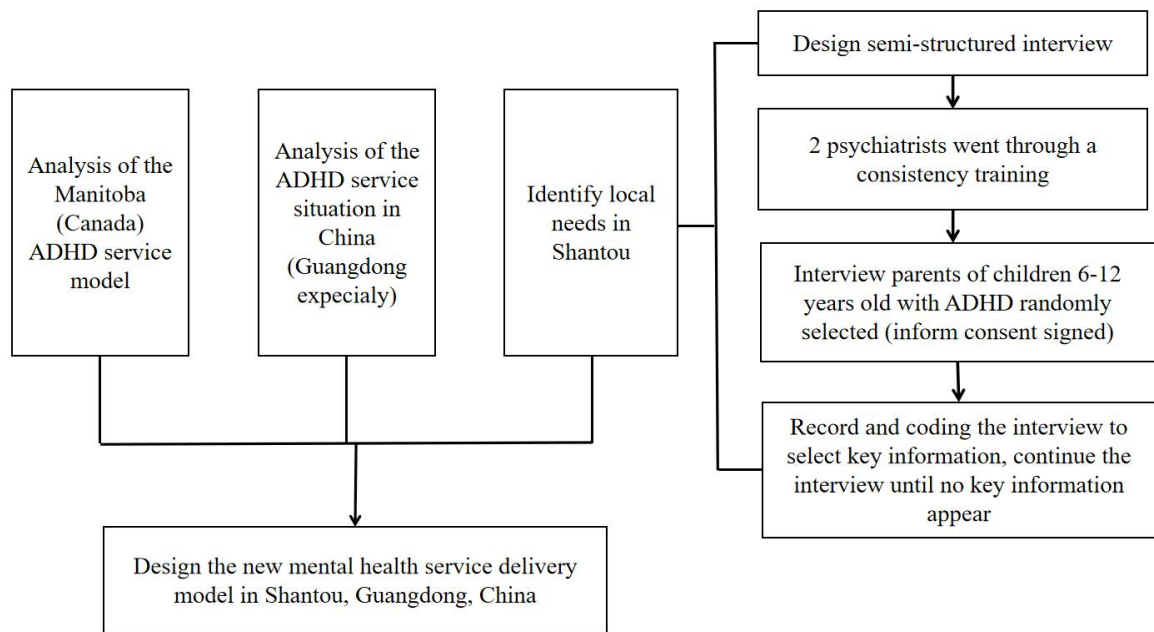


Figure 3. Flowchart of the New Service Model Design Process.

The diagram depicts the iterative steps used to localize the Manitoba (Canada) ADHD service framework for Shantou, Guangdong. A comparative analysis of the existing Manitoba model and the current ADHD service landscape in China with the resulting qualitative data from semi-structured interviews with school-age ADHD children’s parents from Shantou locally were integrated to inform the design of the culturally adapted mental health service delivery model.

2.1.2 Methodology for Team Building

The second step was to implement the new model, including the process of team building and contact coverage enhancement, and the service enhancement. A process of team building must come ahead since it served as a prerequisite for carrying the new model out. This was not only for enhancing the specific professional service level, but also for initiating the local contact coverage of ADHD patients. Team building in this research incorporated 2 dimensions: 1) the specific core team in the Shantou University Mental Health Center (SUMHC) where the only child and adolescent psychiatric team of the city is working , and 2) the community team including general pediatricians and family doctors in

community healthcare clinics, and community professionals including psychotherapists, counselors and social workers in community mental health clinics and/or service system. Training packages were designed to meet the specific needs of each group according to the design of the new model. By doing these, a referral network will be established to allow easy access of the ADHD patients in communities where local specialists were trained. The numbers of clinic visits, re-visits and first visits of ADHD patients at STUMHC and the patient-source composition from 2018 to 2024 were compared to verify the effectiveness of team building and contact coverage enhancement, both in the urban area and rural area of Shantou.

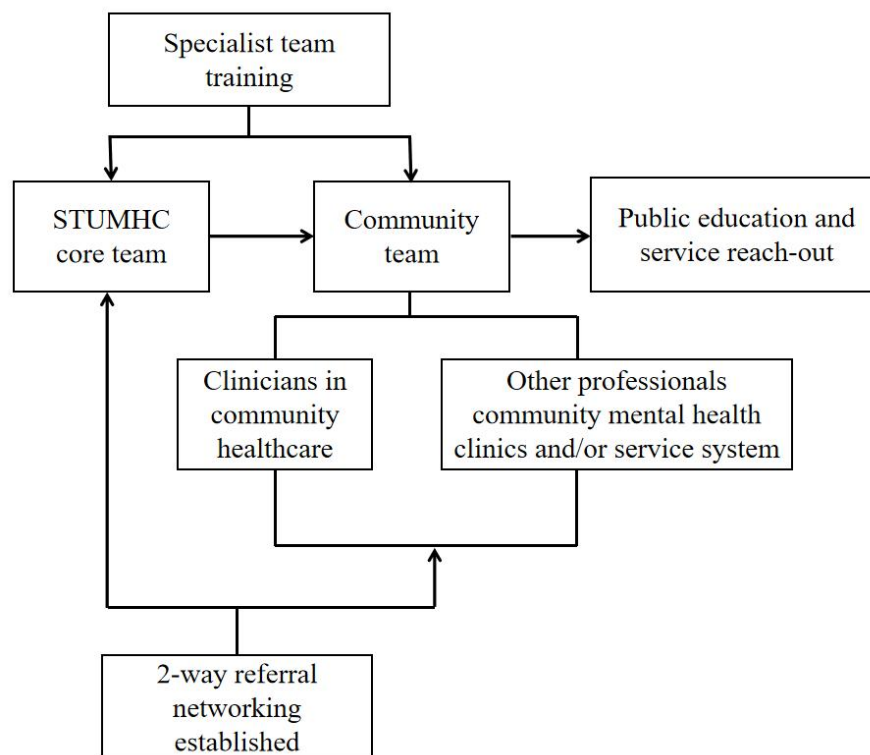


Figure 4. Flowchart of the Specialist Team Training Process.

The diagram illustrates the two-tier, bidirectional model developed for this implementation study. The STUMHC core team (child-and-adolescent psychiatrists, psychotherapists, psychological assessors) provides specialist assessment and integrated treatment, while the community team (trained clinicians, psychotherapists, social workers) delivers screening, brief interventions, and family support in

primary-care clinics, schools, and community mental-health centers. A formal two-way referral network (dashed arrows) links the tiers, enabling step-up referrals for complex cases and step-down referrals for continued community management. Public-education activities (media, workshops, dialect radio programmers) extend service reach across all Shantou districts.

2.1.3 Methodology for Service Enhancement and outcome evaluation

Following the completion of team building and the establishment of a two-way referral network—on the basis of increased contact coverage, a process of service enhancement was conducted to carry out the localization of the ADHD healthcare service model. To reflect a patient-centered approach, the team utilized the Quality Function Deployment (QFD) tool ^{89, 90} based on the needs of the service target group. Drawing on the multidisciplinary team comprehensive service model from Manitoba, integrating the actual conditions of Shantou and the outcomes of the parents interviews mentioned before, a brainstorming session was conducted to construct the "Shantou City School-Age ADHD Children's Mental Healthcare Service Quality Improvement House" by the STUMHC core team members, and a bottleneck analysis was performed to identify the key interventions that would drive the greatest improvement in service quality and coverage. Beginning in 2019, with the results of the bottleneck analysis, the STUMHC core team launched a clinical-intervention improvement initiative at the center using the Plan-Do-Check-Act (PDCA) quality-improvement framework ^{91, 92}: plans were formulated and rigorously executed, annual satisfaction surveys and progress audits (such as calculation of the types of services provided) were conducted to verify goal attainment, and the efficacy of interventions were evaluated to confirm the treatment efficacy of the new mental-health services.

The sample for evaluating treatment efficacy of school-age children with ADHD who first visited the outpatient clinic at the STUMHC during the period when the new service model was relatively mature, from 2023 to 2024. Inclusion criteria included: 1) ADHD patients aged 6-12 years old and their primary

caregivers; 2) Diagnosis of ADHD confirmed by a child psychiatrist or well-trained pediatricians; 3) Exclusion of any other significant physical disorders; 4) Parents do not have any cognitive or mental disorders; 5) Completion of the consent form by guardians and participant caregivers.

To access the efficacy of the clinical service, the clinical treatment outcome of the study group was evaluated. ADHD Diagnostic Scale-Parent Version (ADHDDS-P) (Chinese vision), Conners’ Behavior Rating Scales (CBRS) (Chinese version), and Integrated Visual and Auditory Continuous Performance Test (IVA-CPT) were used before and 6-month after the treatment started to evaluate the changing level of ADHD symptoms ⁹³, while the Family Environment Scale Chinese Versions (FES-CV) was used before and 6-month after the treatment started for evaluating the family environment changes with interventions ⁹⁴. Detailed information regarding the administration and scoring criteria for each assessment instrument is provided in Appendix.

After the new model was gradually refined and implemented from 2019 to 2024, along with the evaluation of the efficacy, feasibility and scalability of the service model were also evaluated as well. The feasibility and scalability of this service model were evaluated through economic cost and personal cost. For evaluating the economic cost, the average cost per visit for ADHD patients of both across all-age groups and school-age group were calculated and estimate the annual cost per person based on the frequency of 1 follow-up clinic visit per month. The per capita annual cost of the Shantou intervention model was compared with the city’s per capita disposable income and with local expenditures on health care and cultural/educational services to determine affordability for resident households; it was also bench-marked against corresponding income and expenditure indicators in high-, middle-, and low-economic-level cities throughout Guangdong Province to assess the model’s economic scalability. Personnel cost of the service model was calculated by

$$\frac{\text{Child and Adolescent Mental Health Care Specialists}}{\text{local Child and Adolescent Population}} \quad (\text{per } 100,000 \text{ } 0\text{-}14 \text{ years old})$$

population). The calculated economic and personnel costs, together with the intervention-outcome evaluation results, will—alongside the challenges encountered and advantages identified during model implementation—inform the discussion on refining China’s mental health service delivery model for children with ADHD.

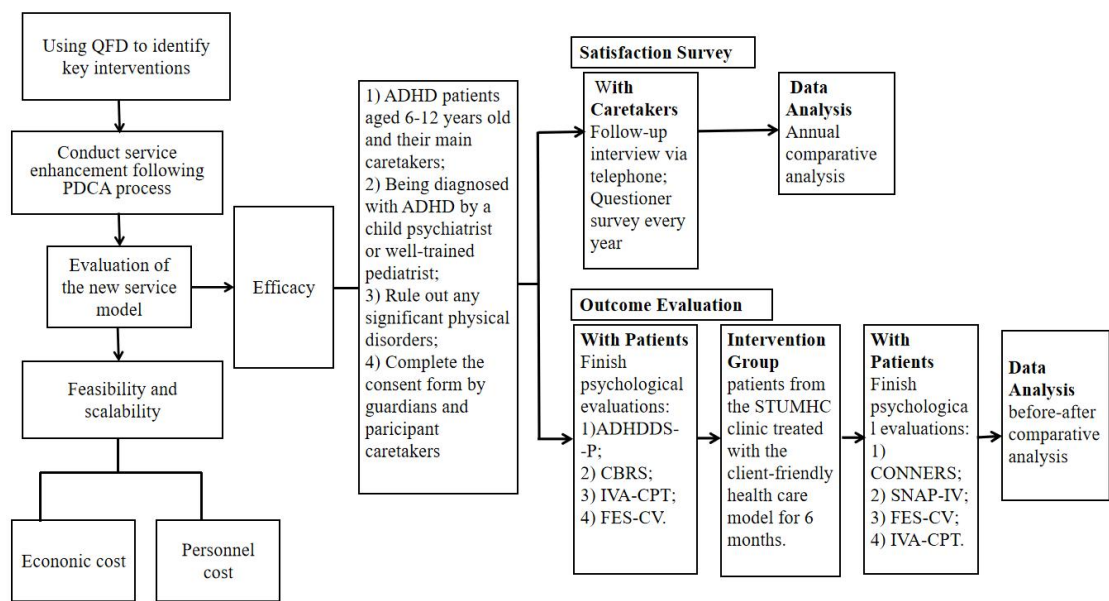


Figure 5. Flowchart of the Service Enhancement and Evaluation Process.

The flowchart depicts the mixed-methods evaluation cycle used to implement and assess the new service model. Key interventions were first identified with Quality Function Deployment (QFD) and then conducted following PDCA process from 2019 to 2024. Annual telephone follow-ups and satisfaction surveys were conducted with 6- to 12-year-old ADHD patients and their main caregivers. Psycho-evaluation including ADHDDS-P, CBRS, SNAP-IV, IVA-CPT, and FES-CV were used before and 6-month after treatment for outcome evaluation. Comparative analysis of personnel and economic costs informed feasibility and scalability conclusions.

2.2 Dissertation Outline

This paper would first delineate the theoretical foundations and conceptual framework of the integrated intervention model, then details its implementation procedures and observed outcomes, and finally analyzes encountered challenges and potential solutions. Through this implementation research, we aim to enhance

the quality of mental health services for school-aged children with ADHD in the local region while providing empirical evidence for regional mental health policy development.

3. Design the Service Model

3.1 Foundation and Role Model: The ADHD Service Model in Manitoba, Canada

Manitoba's approach to ADHD is organized within a publicly funded, tiered, and multisector system that spans the life course. The model integrates provincial health data, school-based supports, and community services under the overarching governance of Manitoba Health and the Regional Health Authorities (RHAs).

The public health system in Manitoba works through a "Data-Driven, Tiered Care" way. An operational definition and surveillance method is used to provide evidence-base of the policy making. The Manitoba Centre for Health Policy (MCHP) employs an administrative case-ascertainment algorithm (≥ 1 hospital or physician visit with ICD-9-CM 314 or ICD-10-CA F90, or ≥ 2 ADHD-specific prescriptions after exclusion of competing diagnoses) that has been validated across multiple population cohorts in year of 2004, 2010, 2012, and 2015⁹⁵⁻¹⁰⁰. These data guide resource allocation and policy evaluation to ensure that resources such as government health insurance are accessible to the target population with the greatest need.

ADHD service in Manitoba is delivered following a three-tier service pathway, including primary care, regional Child and Youth Mental Health Service (CYMHS) and tertiary care. In primary care, family physicians conduct initial screening, provisional diagnosis, and medication initiation. CYMHS deliver behavioral parent training, cognitive-behavioral therapy, and complex comorbidity assessment. For tertiary care, the Health Sciences Centre in Winnipeg hosts a multidisciplinary ADHD clinic for refractory cases and adult referrals^{18,84}.

Beyond the provision of specialized diagnostic and treatment services, the Province of Manitoba offers comprehensive support to individuals with ADHD and their families across economic, educational, and life-span domains. There is

pharmacological policy that all first-line stimulant and non-stimulant medications listed in the Provincial Drug Formulary (e.g., methylphenidate, atomoxetine) are fully covered by Manitoba Health when prescribed by a licensed physician. Annual prescription profiles were linked to the MCHP repository to monitor regional prevalence and adherence, revealing markedly lower rates in the Northern and rural RHAs ^{96,100}. For educational supports, individualized Education Plans (IEPs) and 504 Plans are mandated under The Public Schools Act for students with a formal ADHD diagnosis. Accommodations include extended test time, preferential seating, and access to educational assistants ¹⁰¹. Non-profit and fee-for-service agencies complement public care, such as adult ADHD program emphasizing occupational-therapy-based executive-function training ¹⁰².

In summary, Manitoba integrates government stewardship, population-based surveillance, school-health collaboration, and community supplementation to deliver comprehensive ADHD services, while continuing efforts to enhance geographic equity and system responsiveness. However, in China, the landscape of ADHD diagnosis and treatment is markedly different. This situation will be elaborated in the following section.

3.2 Current Situation in China: Population, Economy, and Policies

School-age children with ADHD in China constitute a prominent public health issue characterized by high symptom prevalence, low treatment-seeking rates, and even lower rates of guideline-concordant care. Recent epidemiological evidence indicates a pooled ADHD prevalence of 6.4% among children and adolescents aged 6-16 years, corresponding to approximately 23 million affected individuals nationwide. Incidence peaks at 5-9 years of age, whereas both prevalence and disability-adjusted life years (DALYs) reach their maximum between 10 and 14 years ^{12,13,30,103,104}. Nevertheless, owing to limited mental-health literacy, disparities in parental education, and uneven regional resource distribution, fewer than 10% of affected children access clinical services, and only one-third of those who receive a diagnosis subsequently initiate evidence-based treatment ^{12,30}.

From a clinical and social characteristics aspect, we can see that symptom spillover is common in ADHD children in China: 62% of school-age children with ADHD present with comorbid social anxiety disorder. Female, co-occurring autism spectrum disorder (ASD), lower parental educational attainment, and greater severity of inattention or hyperactivity/impulsivity constitute significant risk factors ^{12,30,103}. Longitudinally, 66%–85% of affected children continue to meet diagnostic criteria into adolescence or adulthood, resulting in academic underachievement, reduced occupational attainment, and heightened family stress ^{12,13,105}. Researches on ADHD treatment adherence in China suggested that barriers to Chinese parents seeking clinical care for children with ADHD include low parental awareness of the disorder, heightened concerns regarding medication side effects, and insufficient knowledge of available resource ¹⁰⁶⁻¹⁰⁸. Utilization rates are markedly lower in northwestern and southwestern China than in eastern regions; girls are disproportionately under-identified because of symptom masking ^{12,30}.

Looking at the policy evolution and system status, over the past 2 decades, Chinese mental-health policy has shifted from an absence of ADHD-specific guidance to a life-course approach. The first national guideline published in 2007 and its 2015 revision aligned diagnostic criteria with international standards and, for the first time, included recommendations for adult ADHD management ^{12,109}. The “*Healthy China 2030 Action Plan*”, which was officially promulgated in 2016 by the Central Committee of the Communist Party of China and the State Council, elevated the development of child and adolescent mental health services to a national strategic level ¹¹⁰. The construction of a team of mental health professionals for children and adolescents is crucial for ensuring the mental health of young people. In the U.S., the ratio of child and adolescent psychiatrists to the child and adolescent population (0-14 years old) was about 1.14 per 10,000. However, as of 2018, there were only about 40,000 licensed mental health professionals practicing in China, including fewer than 500 full-time child and adolescent psychiatrists. This was grossly insufficient for the approximately 220

million children aged 0 to 14 years nationwide. Since 2021, the National Health Commission has piloted hospital-school-family collaborative models under the “*Mental Health Promotion Action*” of the “*Healthy China 2030 Action Plan*”¹¹⁰, encouraging teachers to employ standardized screening tools (e.g., the Swanson, Nolan, and Pelham Rating Scale-Fourth Edition [SNAP-IV]) and integrating ADHD surveillance into student health records. Generally, there were 3 core contradictions presenting the policy–reality tensions in this situation.

1) High prevalence versus limited-service accessibility: 23 million children contrast sharply with the paucity of specialist clinics, especially in rural areas.

2) Updated guidelines versus lagging parental cognition: Although current guidelines emphasize combined pharmacological and behavioral interventions, nearly 30% of parents continue to misinterpret ADHD as mere “naughtiness” or “poor habits”, yielding medication adherence below 80%.

3) Regional disparities versus equity goals: Guidelines advocate primary-level first contact and two-way referral, yet psychiatric beds and specialists are unevenly distributed; bed availability per 100,000 population in western China is one-third that in eastern regions, undermining policy implementation.

Applying the national prevalence estimate to Guangdong’s school-age population of about 15 million (2018)¹¹¹ yields approximately 960,000 affected children. Prior to 2012, no dedicated ADHD services existed; diagnoses were fragmented across pediatric primary-care, general psychiatry, or developmental-behavioral pediatrics departments within tertiary hospitals in Guangzhou and Shenzhen. By the year of 2012, the Affiliated Brain Hospital of Guangzhou (Guangzhou Huiai Hospital) established the first specialized ADHD Center in South China, introducing standardized assessment rooms equipped with the Conners’ Rating Scales and the Integrated Visual and Auditory Continuous Performance Test (IVA-CPT)¹¹². Concurrently, education bureaus in Guangzhou piloted psychological screening that includes ADHD screening in primary schools; screen-positive students were referred to alliance hospitals for confirmatory

assessment, forming an early hospital-school collaboration prototype ¹¹³.

Government departments in Guangdong have also recognized the importance of effective prevention and treatment for ADHD. The Guangdong Provincial Health Commission issued “*Implementation Plan for the Mental Health Service Year Campaign in Guangdong Province (2025–2027)*”, designating ADHD as a primary-care index condition. Responsibilities were explicitly delineated: township health centers/community health service centers conduct initial screening, parent education, and follow-up; county-level hospitals assume diagnostic confirmation and basic medication management; tertiary hospitals address refractory or comorbid cases ¹¹⁴. However, the strategy developed was challenging to implement as planned within Guangdong province: The distribution of ADHD diagnostic and treatment resources within Guangdong province was characteristically higher in the east and lower in the west, higher in cities and lower in rural areas, with a significant disparity between regions, and the economic gradient played a decisive role in the density of resources. By the year 2018, as previously mentioned, the core Zhujiang Delta region with the highest per capita GDP (Guangzhou, Shenzhen, Foshan, Dongguan) had the first batch of independent ADHD outpatient clinics in South China; the peripheral areas of the Zhujiang Delta with a second-tier per capita GDP (Huizhou, Jiangmen, Zhaoqing, Shantou, and other places) only had a few tertiary hospitals capable of diagnosis, and had not yet established a continuous specialty clinic service model; the eastern and western mountainous areas of Guangdong with a third-tier per capita GDP (Heyuan, Meizhou, Qingyuan, Yunfu, and other places) had no independent ADHD clinics, and lacked local diagnostic and treatment resources, necessitating children to travel across cities or even to the Zhujiang Delta region for medical consultation ^{111, 115}.

In general, China has significantly improved its mental health care, especially in major first-line cities. However, in terms of mental healthcare services for ADHD, China still lags behind the world in both contact coverage and effective coverage. Based in Guangdong and considering the broader context of China,

mental health services for ADHD are already quite limited in first-tier cities, let alone in second- and third-tier cities and rural areas. At present, an ADHD mental healthcare service system has been established in first-tier cities such as Guangzhou and Beijing, but its effectiveness remains unverified. There is a lack of implementation research on how to construct and enhance ADHD mental healthcare service levels in second- and third-tier regions, which is the gap that this research aims to fill. Accordingly, the selection of the implementation site and the overall project design presented next session were both driven by this objective.

3.3 Service Design in Shantou, Guangdong, China

This research has chosen to conduct the project in the city of Shantou, a typical middle-sized, prefecture-level Chinese city on the eastern coast of Guangdong province, China. Shantou has a population of 5,391,028 as of 2010, about 1 million of which are children under age 15 ¹¹⁶. According to a recent study, the prevalence of ADHD in primary school students aged 7–12 years old in Shantou was 5.91% ¹¹⁷. Experience gathered in such a typical middle-sized city would be more meaningful for implementation research because of better scalability. Moreover, Shantou has professional child mental service providers and a community-based mental health network. The Shantou government and Shantou Disabled Person's Federation (SDPF) are highly appreciative of importance to improve the local mental health care service ^{118,119}.

SUMHC, where my clinical practice takes place, is a specialized mental health hospital located in Longhu district, Shantou. The center has a child and adolescent developmental service team that works as the primary providers of mental health care for children with ADHD in Shantou since decade ago. The team insists evidence-based principles in clinical practice. ADHD is diagnosed following the DSM-5 criteria and managed following the *Chinese Prevention and Treatment Guideline of ADHD* ¹², which is essentially similar to the fourth edition of the *Canadian ADHD Practice Guidelines* published by the Canadian ADHD Resource Alliance (CADDRA) in 2018 ¹¹. However, due to the limitation

mentioned before, although medications are included as the first-line therapy in our practice, poor treatment adherence and frequent discontinuations are of a significant concern.

Longhu district can be an ideal site to start an implementable exploration in Shantou. Besides of the location of SUMHC, the Longhu district is a typical middle-class district of the city of Shantou with a population of 560,193, which includes 3 urban and 4 rural communities ¹²⁰. The SUMHC has established community mental health service in the district with strong support from the local government. On my initiative, the SUMHC has recently signed an agreement with the Longhu Education Department to provide mental health service to the whole school system of the area. Additionally, the local family/community doctor team building is ongoing. All of these add to the feasibility of the project.

Rather than replicating the Canadian model verbatim, the intervention was adapted to align with local needs, cultural norms, and contextual demands. To elicit these needs, the research team conducted a semi-structured interviews mentioned in the previous “Methodology” chapter, with parents of school-aged children diagnosed with ADHD (detailed questions can be found in Appendix Table 1).

The 2 trained psychiatrists did the interview with 3 pairs of parents, and it was found that their feedback was highly consistent and therefor the interview process was ended. For example, in terms of "disease health knowledge", their answers about “how much you know about ADHD before coming to the clinic” were mostly “only a little”. In terms of “resource acquisition”, when being asked about “where did you obtain information about ADHD before coming to the clinic”, they all mentioned “internet and books, but couldn’t find a lot” and expressed concern about the reliability of the information they’ve got. The ways they knew about ADHD service in STUMHC included school teachers and other parents. In terms of “resource acquisition”, they all expressed that there was a lack of relevant resources locally in Shantou. The interviews were recorded and transcribed, and the keywords were extracted. For “medical service experience”,

all of them believed that the child psychiatrists were professional and provided good health education, but the clinic was far to reach, and the service hour was limited. The most concern they had about medical treatment is about the side effect, even more important than the treatment outcome. For “shortcomings and suggestions”, they mentioned about “parenting training”, “concentration training”, “non-medicine treatment”, “psychotherapy for children”, “online counseling” and “more service hour especially during the weekend”. They were also interested in multiple services such as parent support groups and lectures when the choices were provided, but all expressed concerns about possible higher cost for the complex treatment.

The 3 couples came from Longhu and Jinping, with different educational and professional backgrounds, including primary school teacher, civil servant, and IT engineer with college degree, self-employed with vocational school diploma, and factory workers graduated from polytechnic school. However, the information they provided in the interview seemed extremely identical. This suggested that the mental health service needs of ADHD families in Shantou are not affected by geography, economic conditions, or educational level of the parents, but may be related to the limited level and availability of local services, and the low level of overall social awareness of the disease. These shortcomings fit the subjects that the research aims to solve.

With the acknowledgement of Shantou, the results of the interviews and the experience of the service model in Manitoba, a service model in Shantou was designed. The model emphasizes that interventions must be individualized and family-centered, a stance that diverges sharply from Shantou's traditional, passive model of waiting for patients to seek care spontaneously. Consequently, the researcher designed and implemented a comprehensive workflow (described in detail in the Methodology section) that progressed from team building through service-delivery enhancement, incorporated scheduled evaluations, and embedded continuous quality-improvement cycles; the execution of this process is documented below.

4. Implementation of the Service Model

4.1 Team Building and Contact Coverage Enhancement

4.1.1 The Meaning of Team Building

One key strategy of Manitoba's ADHD service model was a multidisciplinary collaborative professional team. A multidisciplinary team that comprises child psychiatrists, clinical psychologists, psychotherapists, educational specialists, and social workers would ensure holistic evaluation (e.g., psychometric testing, behavioral observation, family interviews) to identify core symptoms and comorbidities. Furthermore, this multidisciplinary team would enable tailored interventions: pharmacotherapy led by psychiatrists, behavioral strategies guided by psychotherapists, and family support coordinated by social workers, which could mitigate the limitations of isolated approaches^{17,18}.

Back to the needs of ADHD families in Shantou, the local service model enhancement basically called for improvement in 2 main directions: public awareness of ADHD and professional service enhancement. Both of which could be worked out better on the basis of a multidisciplinary team. However, like most of the cities in China, Shantou did not have social workers who were working through case management strategy to coordinate the local resources. Thus, this research modified the team structure by passing the role of coordinator to the psychiatrist, and the social workers would play another role in the team. The feasibility of this attempt will be discussed.

4.1.2 The Process of Team Building

As described in the Methodology section, team building was divided into two tiers—core-team development and community-team development—with distinct professional-training curricula designed and delivered according to each tier's responsibilities and the specific roles of its members. Guided by this principle, the team-building activities undertaken in the study and their outcome evaluation are detailed below.

4.1.2.1 STUMHC Core Team Building

The primary objectives of the STUMHC core team building were twofold. First, since the team needs to conduct health education for the general public and provide training for professionals to build up the community team, it must possess the capacity to deliver multiple training programs. Second, in light of the shortage of specialized diagnostic and treatment resources for ADHD in Shantou, the team must demonstrate sufficient clinical expertise to meet ADHD patients' healthcare needs.

Thus, there should be certain requirements for becoming a member of the STUMHC core team. First, they should have training background in psychiatry or psychology and would be better if they were highly related to child and adolescent development. Second, they need to go through training for teaching skills and clinical practice to guarantee their capability to fulfill the team's operational needs.

During the implementation of the research, the core team building primarily focused on expanding the workforce and enhancing the competencies of two key roles: child psychiatrists and psychotherapists. Personnel recruitment was conducted through a combination of internal voluntary applications followed by interview-based screening and external hiring to strengthen the team. In 2018, before the research started, there were 4 child psychiatrists, 2 psychotherapists, and 2 psychological assessors. Following 6 years of team-building efforts, the team now comprises 4 child psychiatrists, 5 psychotherapists, and 2 psychological assessors. At the beginning, 4 child psychiatrists included 1 chief psychiatrist, 1 associate chief psychiatrist, and 2 resident psychiatrists. Till the end of 2024, 4 child psychiatrists included 2 chief psychiatrists, 1 attending psychiatrist, and 1 resident psychiatrist. During the process, there were 1 resident psychiatrist and 1 attending psychiatrist who resigned from STUMHC to pursue a position at other healthcare institutions, while another resident psychiatrist discontinued professional training in the middle of the way. The overall personnel changes of the STUMHC core team are summarized in Table 1 below.

Table 1 . The Overall Personnel Changes of the STUMHC Core Team

Year	Child Psychiatrist	Psychotherapist	Psychological Assessor	Remarks
2018	1 chief psychiatrist, 1 associate chief psychiatrist, and 2 resident psychiatrists	2	2	
2019	1 chief psychiatrist, 1 associate chief psychiatrist, 1 attending psychiatrist, 2 resident psychiatrists (in training)	2	2	1 resident psychiatrist left to work in private practice
2020	1 chief psychiatrist, 1 associate chief psychiatrist, 2 attending psychiatrists	3	2	1 resident psychiatrist discontinued the professional training for the team
2021	1 chief psychiatrist, 1 associate chief psychiatrist, 2 attending psychiatrists	3	2	
2022	1 chief psychiatrist, 1 associate chief psychiatrist, 2 attending psychiatrists	3	2	
2023	1 chief psychiatrist, 1 associate chief psychiatrist, 1 attending psychiatrist, 1	5	2	1 attending psychiatrist left to work in Zhongshan city

	resident psychiatrist		
2024	2 chief psychiatrists, 1 attending psychiatrist, 1 resident psychiatrist	5	2

Note. Table 1 summarized the compositional changes within the STUMHC core team from 2018 to 2024. Through targeted professional training and strategic recruitment, the team enhanced its staffing profile—primarily by upgrading the qualifications of psychiatrists and increasing the number of psychotherapists. Graduates of the program who subsequently accepted positions in other institutions demonstrate the team’s additional function as an external talent pipeline.

Based on the division of responsibilities among team members, the researcher implemented targeted clinical capacity-building initiatives through various approaches. These included organizing sub-specialty training and thematic training within the hospital, as well as facilitating external continuing education opportunities. These measures ensured: 1) child and adolescent psychiatrists could acquire standardized diagnostic and treatment competencies for ADHD; 2) psychotherapists could develop ADHD-specific psychotherapy skills; 3) psychological assessors could obtain specialized ADHD assessment capabilities. Furthermore, all team members should be able to equip with fundamental public education and teaching competencies. A summary of training activities is presented in the Appendix Table 2. Beginning in 2018, every team member completed role-specific training that enhanced individual expertise and overall team capacity, thereby providing a foundational guarantee for the conduction of the implementation study. Building on this foundation, the STUMHC core team members served not only as direct service providers but also as the regional hub, establishing community-based ADHD service teams by training front-line professionals across Shantou's districts. A process of community team building was detailed in the next section.

4.1.2.2 Community Team Building

The primary objectives of community team building were to: 1) enhance ADHD screening capabilities among primary community health services; 2) improve ADHD diagnosis and treatment competencies of the clinicians in general hospitals; 3) strengthen preliminary ADHD intervention skills in mental health practitioners, and 4) establish an efficient bi-directional referral network. Thus, the STUMHC core team mentioned in 4.1.2.1 developed specific training programs for certain targeted groups including psychiatrists, clinicians in general hospitals and community health centers, psychotherapists, and counselors in mental health institutions, and community social workers.

For psychiatrists, the training program included 3 topics: 1) clinical manifestations and diagnosis of ADHD; 2) psychological assessment of ADHD; 3)

pharmacotherapy of ADHD; 4) psychological and physical therapy of ADHD. This program would ensure that after training, psychiatrists can master standardized ADHD diagnosis and treatment methods through 8 lecture sessions and 2 case discussion practical sessions. They would be able to handle typical, uncomplicated ADHD cases and know the referral resources when encountering more complex cases, such as those with comorbidities.

For clinicians in general hospitals and community health centers, the training program included 3 topics: (1) clinical manifestations, psychological assessment, and diagnosis of ADHD; (2) pharmacotherapy of ADHD; (3) psychological and physical therapy of ADHD. Similar to the requirements for psychiatrists, the training objectives for clinicians in general hospitals and community health centers (mostly pediatricians) were also to help them grasp the basic content of ADHD diagnosis and treatment protocols. They should be able to provide diagnosis and pharmacological treatment for typical, uncomplicated ADHD cases and identify more complex cases, such as those with additional mental disorders, for timely referral. However, since they often did not have the qualifications for psychological assessment and psychotherapy, the training only provided a brief introduction to these topics. Compared to the training for psychiatrists, there was less explanation of the theoretical foundations and practical operations, the focus of the course was on clinical diagnosis and pharmacological treatment. Therefore, their curriculum was integrated into 3 topics, 6 lecture sessions, and 2 case discussion practical sessions.

For counselors in mental health institutions, the training objectives were twofold: first, to enable them to identify children suspected of having ADHD and to refer them promptly for professional diagnostic assessment; and second, to conduct psychological assessments and interventions for children with confirmed ADHD. Therefore, for a broader range of community mental health workers, we have established a training program that includes two topics: (1) Clinical manifestations and diagnostic assessment of ADHD; (2) Comprehensive interventions for ADHD: medication, psychotherapy, and physical therapy. By

completing this course, which consists of 6 lecture sessions and 2 case discussion practical sessions, counselors in mental health institutions gained the ability to identify suspect patients for referral and to conduct psychological assessments for children with ADHD.

In specific community mental health institutions where we planned to implement ADHD psychological interventions, we had separately established a course for psychotherapists on group therapy for children with ADHD, which included a 4-session workshop and a whole-process group therapy observation. This ensured they acquired the skills to conduct group therapy aimed at assisting children with ADHD in emotional regulation and behavior management.

Unlike North American and European countries such as Canada, China has a relatively small number of medical social workers, and community social workers are currently more focused on assisting impoverished families and the elderly with their daily lives, rather than working with children with ADHD via case management. However, their clientele also includes individuals with mental health disorders and children in difficult situations, and they are committed to the welfare of the community, often engaging in community activities and having extensive contact with residents. Therefore, we believed that the role of community social workers in China's ADHD mental health service model should be more that of educators and referrers; that is, they could promote ADHD-related health knowledge within the community, identify potential ADHD patients, and make referrals. Consequently, we formulated a single-theme training program for community social workers, which included 2 sessions of theoretical instruction and 1 session of case discussion practice. The objective of this program was to provide them with a comprehensive understanding of the definition of ADHD, its characteristic clinical presentations, and available diagnostic and therapeutic resources. This knowledge could facilitate their role in disseminating information, identifying cases, and making appropriate referrals within their communities. Additionally, we developed informational materials for distribution with the assistance of social workers in designated community settings, such as

neighborhood committees and community activity centers.

From 2019 to 2023, the STUMHC core team executed the aforementioned training programs. Despite the COVID-19 pandemic's influence, which necessitated a reduction in the frequency of training sessions from 2020 to 2021, the program was largely successful in reaching all intended training groups. The training programs that were implemented comprising 3 rounds tailored for psychiatrists, 2 rounds for clinical personnel from general hospitals and mental health facilities, and 1 round for social workers. The training cohort encompassed the entire cadre of psychiatrists at the Shantou University Mental Health Center, as well as pediatricians and mental health specialists from principal tertiary hospitals in Jinping and Longhu districts. Additionally, it included psychological counselors from mental health institutions and community social workers within these regions.

4.1.3 Public Health Education about ADHD

The focus on enhancing contact coverage involves 2 main aspects: one is to expand the scope of service provision, and the other is to ensure that the public is informed about relevant information. Hence, health education about ADHD among community residents is of significant importance. Health education can inform various sectors of society about the clinical manifestations, treatment, interventions, and prognosis of ADHD, as well as raise awareness about available resources within the community. This would thereby be fostering patient engagement in healthcare seeking behavior and enhancing treatment compliance. Consequently, we have included health education as a crucial component in our efforts to enhance contact coverage.

The primary targets for health education regarding ADHD are teachers and parents of school-age children, given their role as the primary observers of symptoms in children with ADHD, the main referrers for medical evaluation, and the key implementers of treatment^{12, 18, 99, 107, 108, 110}. Considering the distinct roles and responsibilities of teachers and parents in the lives of school-age children, the contents of health education about ADHD were tailored to emphasize different

focal points. Health education aimed at teachers focused on identifying children with suspected ADHD from their school performance, communicating with parents, and providing appropriate classroom management and instructional strategies. In contrast, health education for parents was centered on recognizing children with suspected ADHD from their everyday behavior, understanding treatment principles and prognosis, daily life management such as dietary and exercise strategies, as well as basic behavioral management principles. Both of the designs included information on local ADHD diagnostic and treatment resources to assist parents and teachers in seeking services for children when necessary.

Based on the “*Mental Health on Campus*” service agreement signed between the Shantou University Mental Health Center and the education bureaus of various districts in Shantou City, from 2021 to 2024, the STUMHC core team conducted 10 times of specialized training for primary and middle school psychology teachers in Longhu District, Chaoyang District, and Haojiang District of Shantou City (see Figure 6 below and Table 3 in Appendix). A number of primary and secondary school psychology teachers received the aforementioned health education training via lectures. During this period, team members also periodically conducted parent lectures in primary schools and kindergartens in Jinping District and Longhu District.

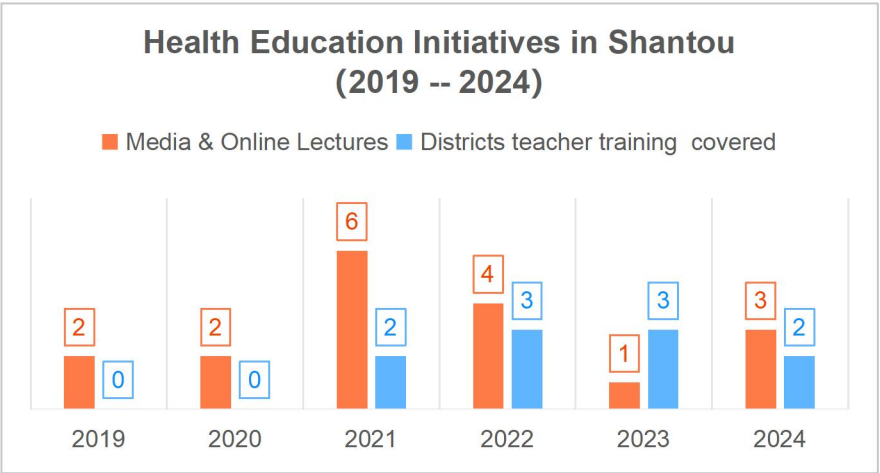


Figure 6. Health Education initiatives in Shantou, 2019–2024.

Orange bars represent the annual number of media and online lectures delivered by

the STUMHC core team; district coverage for teacher-training sessions is indicated by the blue bars. A sharp increase occurred in 2021 ($n = 6$ lectures), coinciding with the first district-wide teacher-training expansion into Longhu and Chaoyang. Output remained elevated through 2022 ($n = 4$) before declining in 2023 ($n = 1$) and rebounding in 2024 ($n = 3$), reflecting a cyclical resource-allocation pattern aligned with school-term planning.

In addition to these efforts, to expand the reach of health education, the STUMHC core team engaged in ADHD public awareness campaigns aimed at a broad audience through local media outlets such as Shantou Radio and Shantou City Television. This includes approximately one-and-a-half-hour live radio programs and approximately half an hour television specials. Considering that in Shantou (and all over China), the primary caregivers of children are not only parents but also many grandparents, and given the generally lower proficiency in Mandarin among local grandparents, portions of the radio and television educational outreach were conducted in the Chaoshan dialect, to ensure that health knowledge about ADHD was effectively communicated to the elderly local residents, who were significant caregivers for school-age children. As the internet and social media increasingly play a significant role in people's lives, the STUMHC core team also endeavored to conduct ADHD health education online, especially during the COVID-19 pandemic when in-person outreach was not feasible. The formats included online lectures and informative scientific pieces, focusing on how to identify children with ADHD at an early stage and general health management strategies, with information about local ADHD diagnostic and treatment resources. From 2019 to 2024, in addition to posting informative scientific pieces online, a total number of 18 educational outreach sessions via traditional media, internet, and social media platforms were conducted (see Figure 6 and Table 3 in the Appendix).

With the initiatives above implemented, the team-building phase was complete; the following session would summarize, evaluate, and analyze the resulting outcomes.

4.1.4 The Results and Efficacy of Team Building and Contact Coverage Enhancement

Through the implementation of a tiered, two-step team-building strategy, this research has established a more mature STUMHC core team, consisting of child and adolescent psychiatrists, psychotherapists, and psychological assessors. It was notable that through this research, a greater number of psychotherapists proficient in ADHD-related psychological and behavioral interventions joined the team. While the overall number of child and adolescent psychiatrists in the team did not increase, there was a marked improvement in their qualifications and the level of ADHD diagnosis and treatment capabilities. The enhancement of the team's clinical capabilities laid a solid foundation for the development of comprehensive ADHD intervention programs in the subsequent phase of the research. In addition to clinical diagnostic and treatment skills, the team also possessed robust teaching and training abilities, which provided a foundation for the construction of the community team.

Through training and networking in this research, it is currently known that there are 4 public hospitals and 1 private mental health institution in Longhu, Jinping, and Chaoan districts of Shantou that are capable of providing diagnosis, treatment, and intervention for ADHD. Pediatricians, psychiatrists, and psychotherapists within these institutions constitute the principal members of the community team, including one child and adolescent psychiatrist who, after completing training at STUMHC, has taken a position in the psychiatry department of a tertiary general hospital. This team maintains periodic contact with the STUMHC core team, which offers case supervision and referral advice. A bi-directional referral network has been formed with these hospitals and institutions, facilitating the transfer of more complex patients from general hospitals and primary practices to STUMHC, while simpler cases or those requiring screening and treatment of physical conditions are referred to general hospitals and primary practices from STUMHC based on the patients' individual needs.

Concurrent with team building and the implementation of health education initiatives, a comparison of data from 2018 to 2024 revealed that since the formal commencement of the research in 2019, there was an upward trend in the total number of clinic visits, re-visits, and first visits of ADHD patients at STUMHC (see Figure 7 below and Table 4 in Appendix). When focusing on ADHD outpatient first visits in school-age children (6 to 12 years old), a similar trend is observed. A detailed year-by-year analysis reveals that the total number of outpatient visits, as well as the number of follow-up and initial visits for ADHD patients, were slightly lower in 2020 compared to 2019 (see Figure 8 below and Table 4 in the Appendix). However, there was an abrupt doubling of the total numbers in 2021, which is considered to be due to the impact of the COVID-19 pandemic. The “isolation and activity restriction policies” during the pandemic prevented patients from seeking medical attention, leading to a "delayed presentation" after the lifting of these policies. That was, some patients who visited in 2021 may have actually been backlog cases from 2020, and would have sought care in 2020 if conditions had permitted.

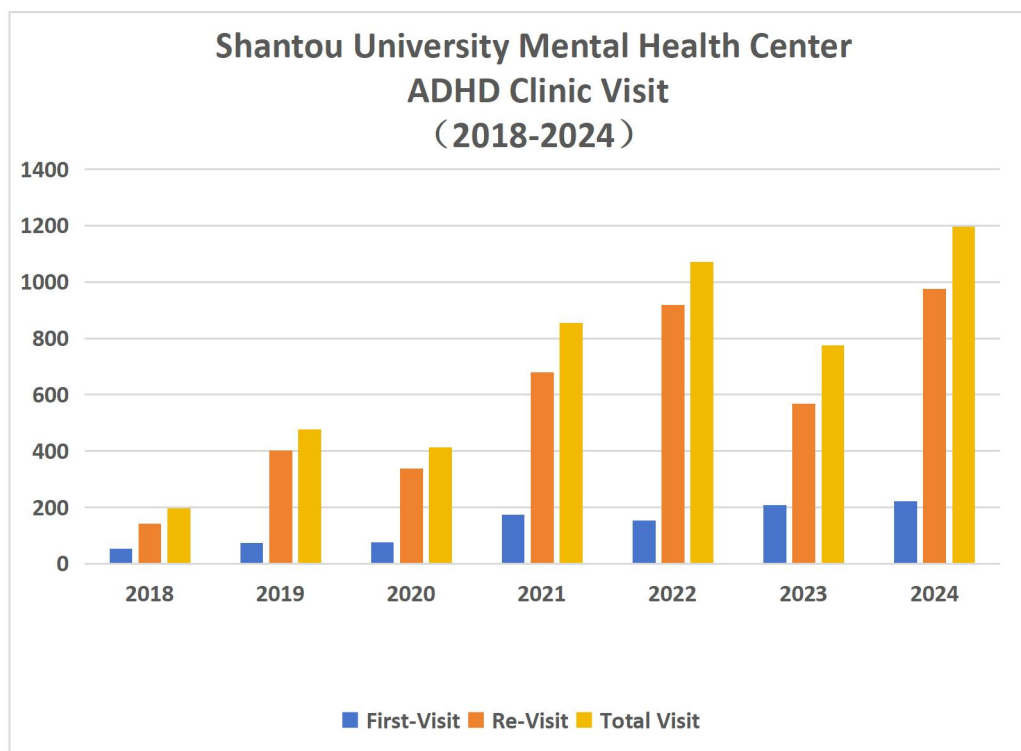


Figure 7. A Comparison of Numbers of Total Visits, First-visits, and Re-visits of

ADHD Patients at the Outpatient Clinic of Shantou University Mental Health Center (2018 – 2024).

As shown in the figure, with the progressive development of the local ADHD service network through team building, the numbers of total visits (yellow bars), first-visits (blue bars), and re-visits (yellow bars) of ADHD patients at the STUMHC clinic during the research period all exhibited an overall upward trend, from 54, 142 and 196 in 2018 to 221, 976 and 1197 in 2024. In 2020, COVID-19 and the associated quarantine policies led to a temporary decline in all visit categories; conversely, delayed healthcare resulted in a sharp rebound in 2021. All the information confirmed both the effectiveness and the sustainability of the team-building efforts.

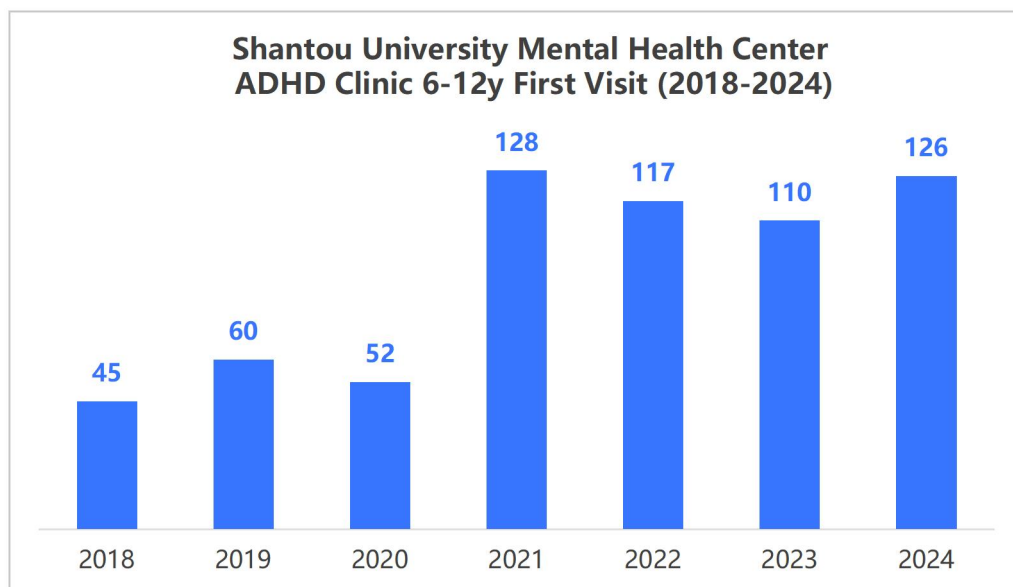


Figure 8. A Comparison of Numbers of 6-to-12-year-old First-visit ADHD Patients at the Outpatient Clinic of Shantou University Mental Health Center (2018 – 2024).

It can be found in the figure that with the team building implementations going on, the numbers of first-visit ADHD patients 6 to 12 years old continued to increase, from 45 in 2018 to 126 in 2024. The unusual peak in 2021 could be the result of delayed healthcare from 2020 due to COVID-19 and the associated quarantine policies. These findings provided additional evidence that the team-building initiative is both effective and sustainable over time.

The analysis of the age at initial consultation for school-age children with ADHD also substantiates this influencing factor. In 2021, the average age (mean $\pm$ standard deviation) of first-time ADHD outpatient visit school-age children was 9.21 ± 1.58 years, whereas in other years from 2018 to 2023, it was distributed between 8.40 ± 1.90 and 8.76 ± 1.85 years. This difference of 0.5 to 0.8 years reflected the increase in the age at first consultation due to delayed presentations (See Table 5 in Appendix). Furthermore, in 2022, 2023 and 2024, with the relaxation of quarantine and epidemic prevention policies, the age of the first-time visitors for ADHD outpatient school-age children gradually returned to the levels observed in 2018 – 2020. It can be observed that with the increase in the total number of first-time ADHD outpatient visits for children aged 6 – 12, the proportion of males among the patients decreased year by year. From an absolute majority proportion of 95.56% in 2018, before the conduct of the implementation part of the research, it decreased to 72.2% by 2024. In 2024, the male-to-female ratio among first-visit ADHD outpatients aged 6 – 12 was 2.6:1, which was within the range of 2:1 to 3:1 found in international studies (see Figure 9 and Table 5 in Appendix). Due to the less typical presentation of ADHD in girls, it was more difficult to identify female patients for their parents, leading to a lower consultation rate among girls and typically an older age at the time of getting into treatment. This change indicated an increased awareness among children's caregivers, especially female children's caretakers, to promptly recognize ADHD and to seek professional diagnosis and treatment for the children, suggesting that the health education efforts of the STUMHC core team were effective.

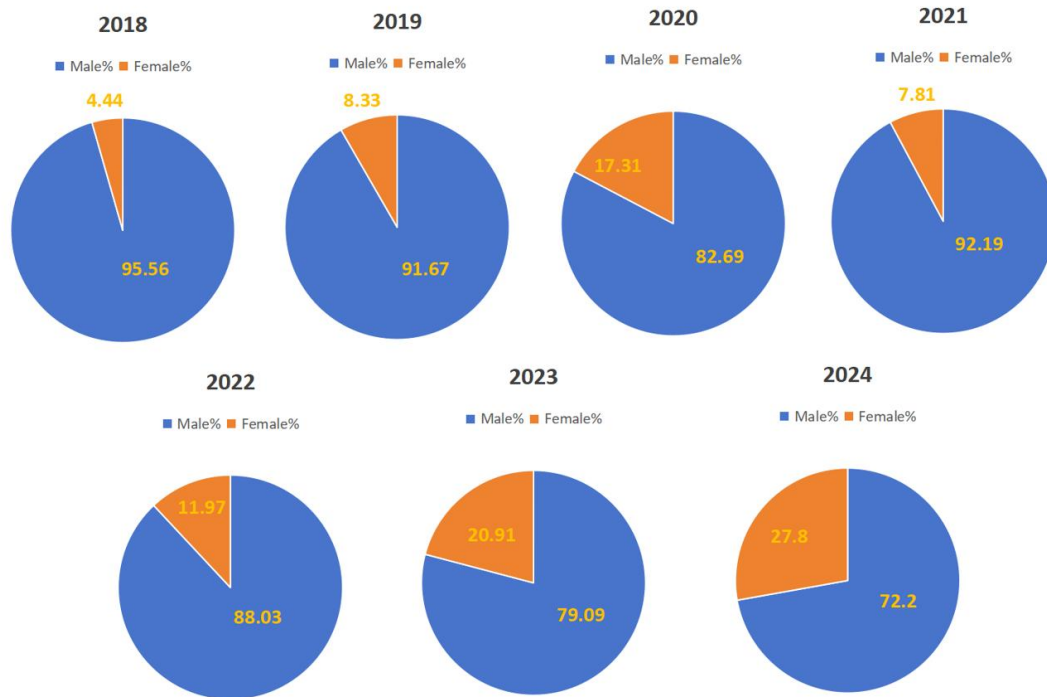


Figure 9. A Comparison of Changes in Sex Ratio of 6-to-12-year-old First-visit ADHD Patients at the Outpatient Clinic of Shantou University Mental Health Center (2018 - 2024).

The figure displays the shift in patient sex ratios between 2018 and 2024, with male percentages present in blue and female percentages present in orange. Before team-building commenced, almost all outpatients were male; as the initiative progressed and the two-way referral network matured, the male-to-female ratio in this group gradually converged toward epidemiological expectations, from 21.52:1 in 2018 to 2.6:1 in 2024. This tendency reflected the increased attendance of historically under-recognized girls—a direct indicator of improved service-contact coverage across the region.

In terms of residence, from 2018 to 2024, the majority of first-time outpatient ADHD visitors aged 6 - 12 at STUMHC were still local visitors from Shantou City, and the total numbers showed an increasing trend, from 36 in 2018 to 86 in 2024. However, the numbers and proportion of patients from other cities within Guangdong Province have also been gradually increasing. Additionally, the number and proportion of patients from other cities within Guangdong Province have also been increasing, rising from 9 individuals (accounting for 20%) in 2018

to 33 individuals (accounting for 26.19%) in 2024. Concurrently, the number of patients from outside the province grew from 0 in 2018 to 7 in 2024 (accounting for 5.56%). Some of these out-of-province patients are from neighboring provinces such as Fujian and Hunan, while others are temporary residents in Guangdong due to their parents' work, with a residence duration of less than half a year. These changes are illustrated in Figure 10 below. All of these suggested that the diagnostic and treatment capabilities and reputation of the STUMHC core team had been progressively enhancing in the surrounding areas over the years.

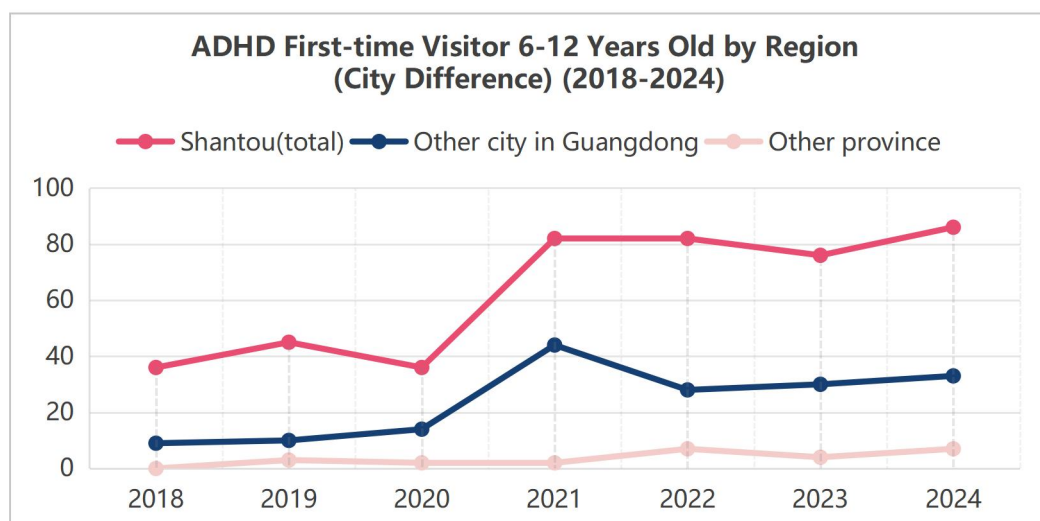


Figure 10. The Number of 6 to 12 years old ADHD Outpatient First-time Visitors Analyzed by Region (2018 – 2024).

Lines represent annual counts for Shantou City (magenta line), other cities in Guangdong (blue line), and other provinces outside Guangdong (pink line). Visits from Shantou dominate across all years; the upward trend remained consistent rising steeply after 2020 and plateauing between 76 and 86 cases per year after 2021 (excluding the “spike” in 2021 attributable to delayed help-seeking during the COVID-19 outbreak), indicating successful local service expansion. First-visit inflows from other Guangdong localities and other provinces also showed a tendency of increasing, reflecting possible extra-regional reach of the Shantou-based intervention programme.

Focusing on the patients’ distribution of residences within Shantou City, the

highest number of patients came from the central urban districts of Longhu and Jinping, with the most significant growth observed in Longhu District, where patient numbers increased from 9 in 2018 to 33 in 2024. The number of patients from Jinping District has consistently remained between 18 and 21, showing little variation; patients from Chaoyang District have shown an upward trend followed by stabilization, remaining at 13 since 2022, marking a significant increase from the 2 patients in 2018. Those from Chaonan District increased from 1 patient in 2018 to 10 in 2023, and maintained a similar higher level of 8 in 2024; patients from Chenghai District have shown a fluctuating growth trend, rising from 5 in 2018 to 15 in 2022, but decreasing to 9 in 2024. Patients from Haojiang District and Nan'ao County have remained at a consistently low level (see Figure 11.). It is important to note that, as previously mentioned, the abrupt and significant changes in the number of ADHD first-time visitors in 2021 were anomalous increases due to the impact of the COVID-19 pandemic; therefore, these figures were not considered in comparative discussions.

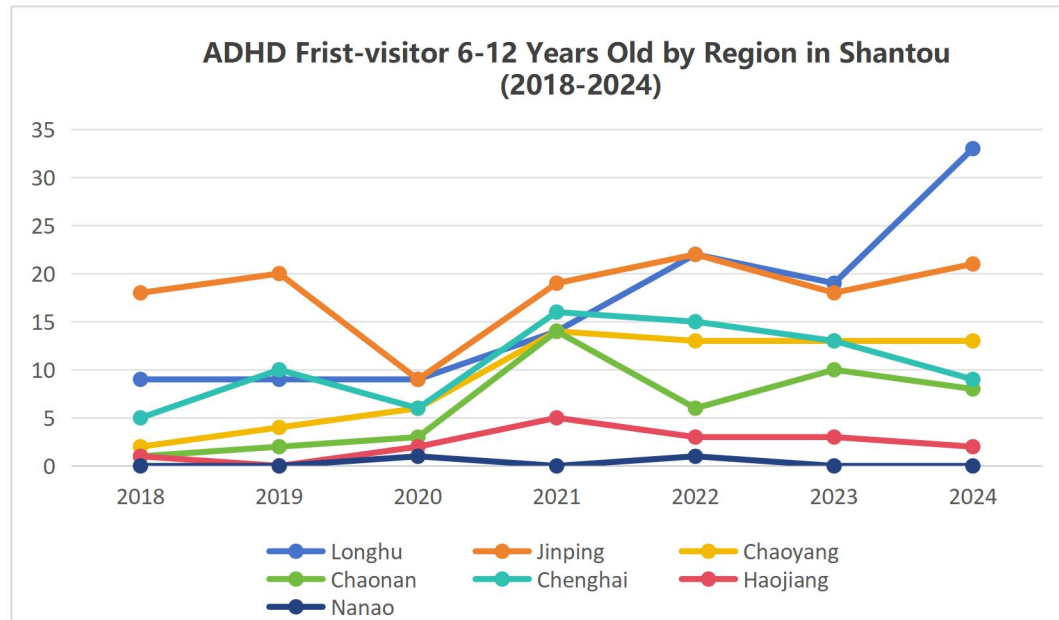


Figure 11. The Number of 6 to 12 Years old ADHD Outpatient First-Time Visitors Analyzed by Region in Shantou (2018 - 2024).

Longhu District (blue line) exhibited the steepest increase, rising from 9 cases in 2018 to 33 in 2024, while Jinping District (orange line) remained stable at 18 to 21 cases per year. Chaoyang (yellow line) increased markedly from 2 (2018) to 13 (since 2022); Chaonan (green line) peaked at 10 in 2023 and stabilized at 8 in 2024. Chenghai (turquoise line) showed fluctuating growth (from 5 to 15 then 9), whereas Haojiang and Nan'ao stayed consistently low. The 2021 spike in all districts reflects delayed help-seeking during the COVID-19 outbreak and was excluded from comparative analyses. This pattern demonstrates the effectiveness of team-building and related initiatives within the target districts, while also revealing that identical measures produced divergent outcomes across different areas of Shantou.

Following team establishment, the delivery of public health education emerged as a critical strategy for enhancing service-contact coverage. When the number of public-education activities delivered by the STUMHC core team and selected community team members (including public education through media/internet and teacher-training workshops) were plotted against monthly first-visit ADHD patients among 6- to 12-year-olds in the STUMHC clinic (see Figure 12.), a clear pattern emerges: even after excluding the customary summer-peak months of July and August, almost every educational initiative is followed by an increase in first-visit cases within the same or the subsequent month. The cumulative impact of repeated health-education efforts is also evident: apart from the periods most severely affected by COVID-19 (2020 and late 2022), second-half-year caseloads consistently exceed those in the first half of the year, with the highest monthly figure occurring in November 2024, when a media campaign and district-wide teacher training were conducted simultaneously.

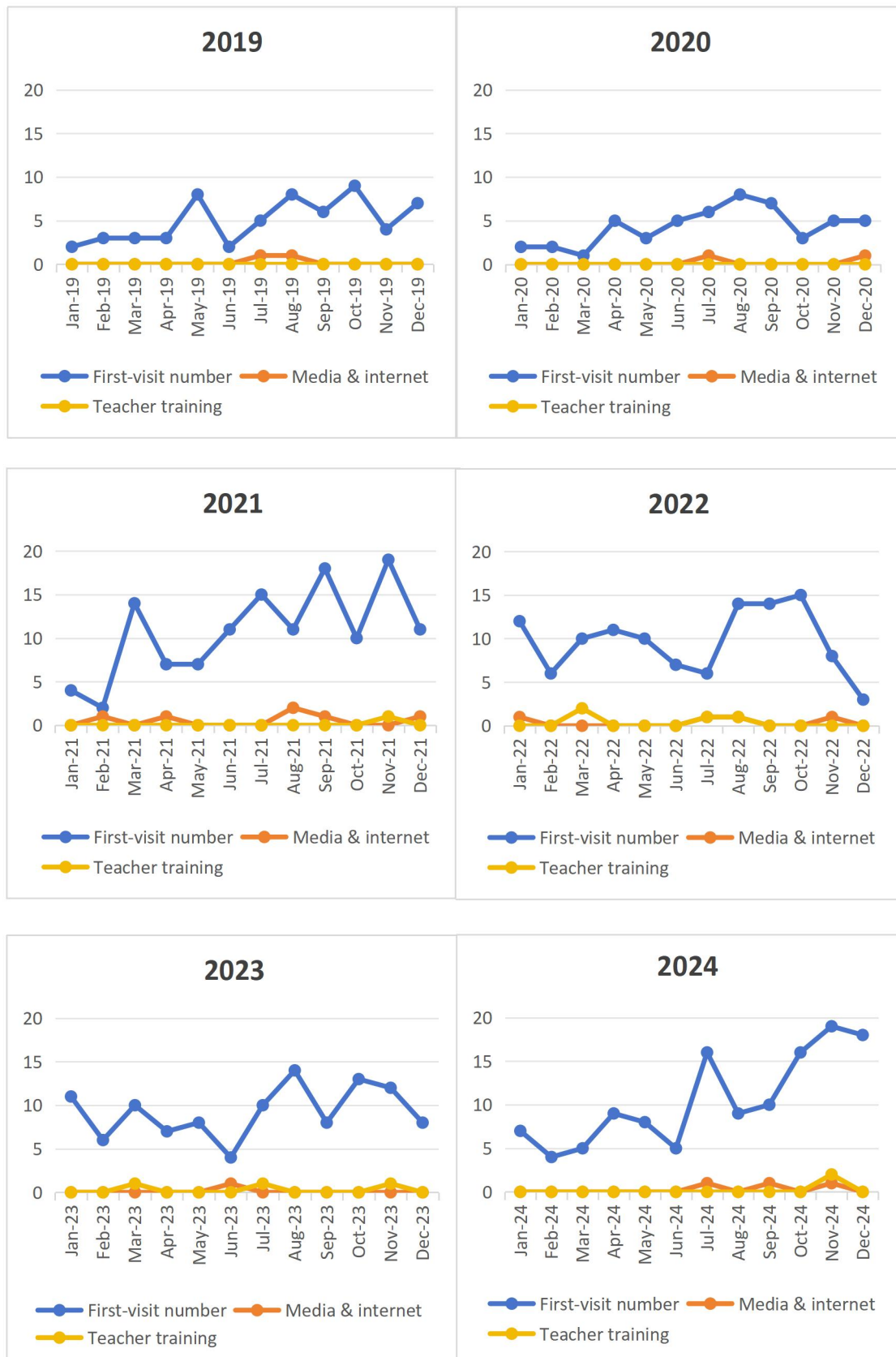


Figure 12. Monthly First-visit ADHD Outpatients (Ages 6–12) in Relation to Public Health Education Activities, 2021–2024.

Besides school-summer peaks (July–August), almost every public-education event (media lectures or teacher-training workshops) was followed by an increase in first-visit cases within the same or next month. Cumulative effects are evident: outside the heavily COVID-affected periods of 2020 and late 2022, second-half-year visits consistently exceeded first-half-year visits. A simultaneous media campaign and district-wide teacher training in November 2024 produced the highest monthly caseload observed during the study period. The foregoing trends demonstrate the effectiveness of the implemented measures in increasing the number of school-age first-time ADHD visits.

Additionally, to verify the impact of the construction of a two-way referral network and health education measures on patient consultation behavior, we conducted random follow-up surveys with 216 parents of 6- to 12-year-old ADHD outpatient first-time visitors from 2021 to 2024 (N between 49 and 56 per year), to understand how they learned about the ADHD treatment services at STUMHC (see Figure 13 and Table 6 in Appendix). Over these 4 years, the number of first-time ADHD clinic visitors who learned about STUMHC's ADHD treatment resources through “school teacher recommendations” and “clinician referrals” and subsequently visited the clinic showed a gradually increasing trend. Meanwhile, it was noted that the primary means of information acquisition was still through “friends/families recommendations”, with a number of 36 (64.29%) in 2021, 25 (51.02%) in 2022, 31 (55.36%) in 2023, and 29 (51.73%) in 2024. Most respondents indicated that their decision to seek treatment was influenced by "trust in the referrer," suggesting that the level of trust among friends and family is the highest among various sources of information. The number of first-time patients' visiting after obtaining information through media and online sources has been decreasing year by year from 2021 to 2023 and then heading back in 2024, showing a trend that corresponds with the decreasing frequency of media and online educational outreach activities conducted in these years. This corroborates

the trends discussed earlier and depicted in Figure 12. Moreover, the proportion of first-visit patients who self-reported being referred by clinical physicians increased markedly and has remained stable since 2021, providing further evidence of the successful establishment of the two-way referral network.

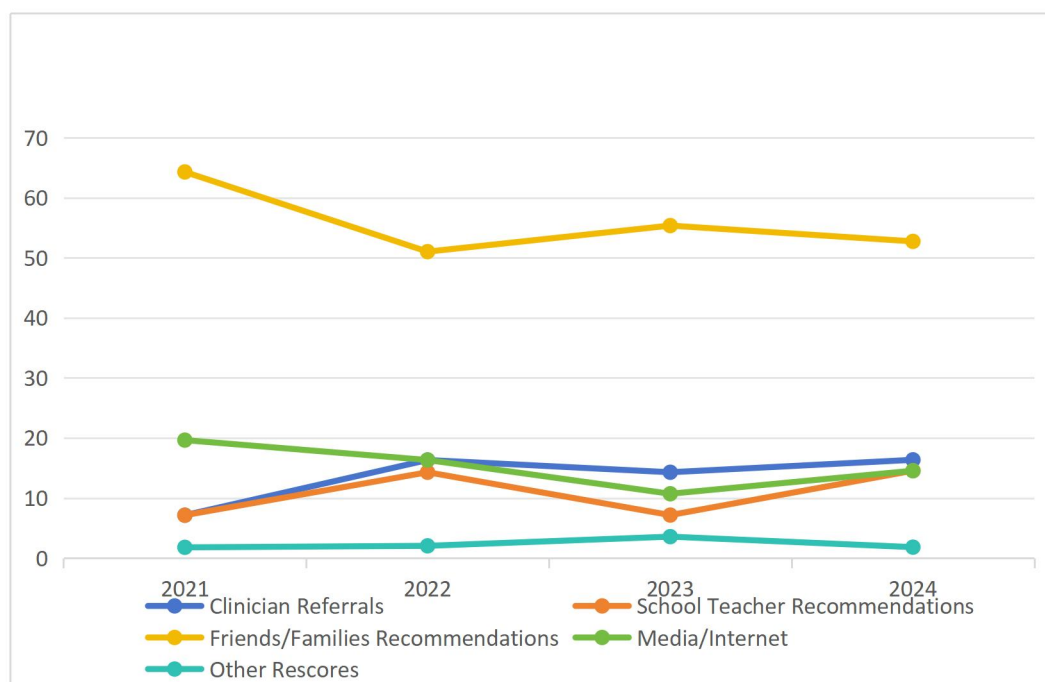


Figure 13. Care-Seeking Pathways to STUMHC Services Among Families of School-Age ADHD First-Visit Outpatients, 2021–2024.

Percentages Based on Annual Follow-Up Surveys, N = 49 – 56 per year. “Clinician Referrals” (blue line) and “School-Teacher Recommendations” (orange line) increased steadily over the 4 years, corroborating the success of the two-way referral network. “Friends/Family Recommendations” (yellow line) remained the dominant source (51.02%-64.29%), with most respondents citing “trust in the referrer” as the decisive factor. Visits prompted by “Media/Internet” declined from 2021 to 2023, rebounding slightly in 2024, mirroring the reduced frequency of online outreach activities during that period. Taken together, the data confirm that the team’s public-education strategy effectively expanded service-contact coverage.

Looking at the referral networking specifically, according to the STUMHC records, the proportion of 6-12 years old first-time ADHD outpatients referred

from community sources (primary care facilities or pediatric/psychiatric departments in general hospitals) was 12% (n=14) in 2022, 7% (n=8) in 2023, and 10% (n=13) in 2024 (see Figure 14). All of these referrals involved children with comorbidities, including childhood emotional disorder, autism spectrum disorder, tic disorders, and conduct disorder. This result fits the objective for the referral networking that the community primary care facilities and pediatric departments within general hospitals are equipped to diagnose and treat typical ADHD children, whereas individuals with complex clinical features, comorbidities, or severe manifestations are referred to the STUMHC via the established referral network.

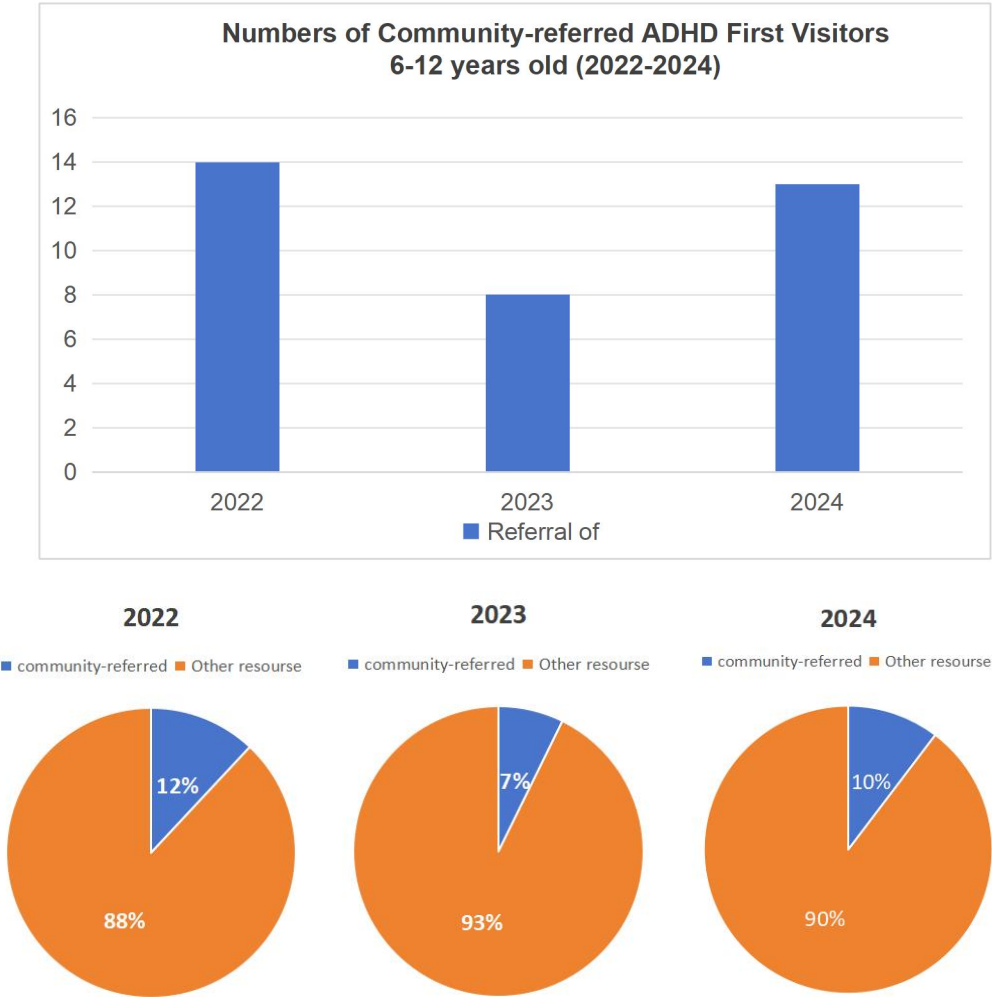


Figure 14. Analysis of Community-referred ADHD Outpatient First Visitors 6 - 12 Years Old in STUMHC (2022 - 2024).

Percentages (and raw counts) represent children referred from primary-care

facilities or general-hospital pediatric/psychiatric departments. Community referrals (blue color) constituted 12% (n = 14) in 2022, 7% (n = 8) in 2023, and 10% (n = 13) in 2024. All referred cases presented complex phenotypes (e.g., comorbid emotional disorders, autism-spectrum disorder, tic disorders, or conduct disorder), consistent with the network's objective: community providers' management of uncomplicated ADHD while stepping up patients with severe or multimorbid manifestations to the specialty center (e.g. the STUMHC).

Taken together, the previous data indicate that the team's public-education initiatives constitute an effective outreach strategy for expanding service-contact coverage. The next section integrates these findings with on-the-ground realities to examine their broader implications.

4.1.5 Innovation, Advantage, and Limitation in Team Building and Contact Coverage

From the aforementioned findings, it is evident that the team-building and coverage expansion efforts conducted in Shantou City from 2018 to 2024 have achieved certain progress and effectiveness; however, there are areas that require improvement. The following analysis will examine the effective measures, innovations, and shortcomings in team building and contact coverage enhancement initiatives from geographical, cultural, and economic perspectives. Given that the primary objective of this study is to establish a service system for school-age children with ADHD in Shantou City, the discussion of the implementation outcomes will be centered on Shantou City, with an elaboration that distinguishes between central urban areas and non-central urban areas.

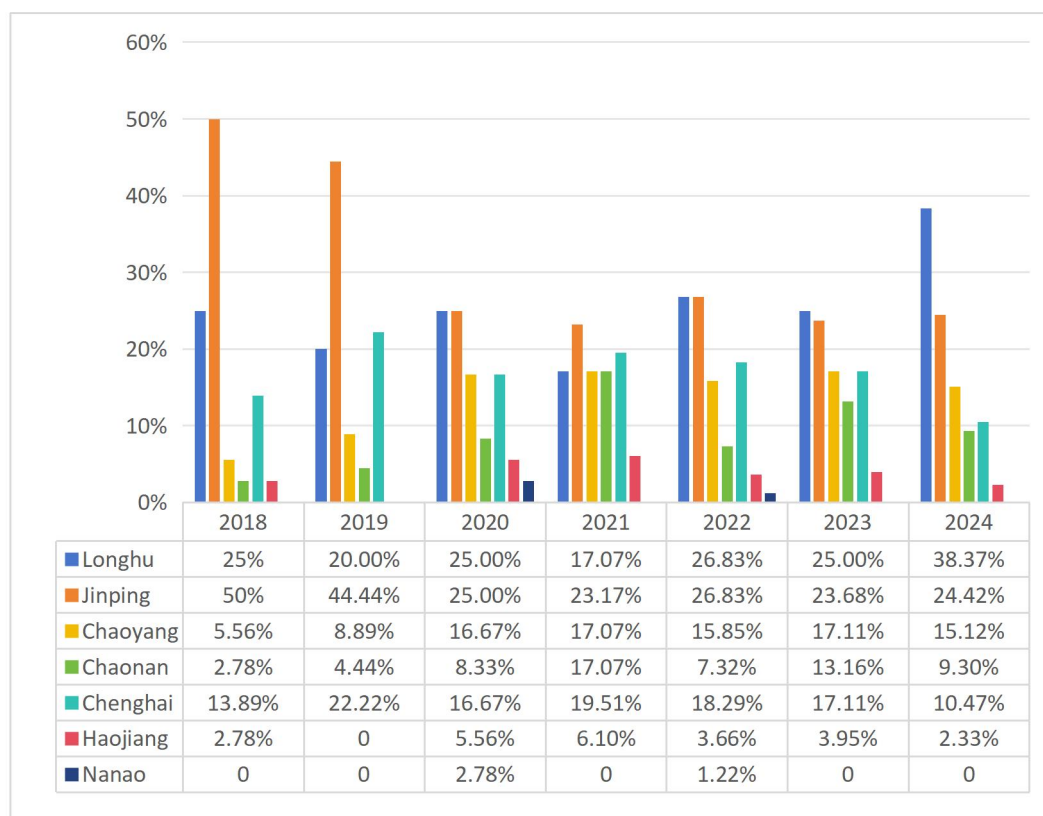


Figure 15. Distribution and Proportion of Residences of STUMHC ADHD First-visitors from Shantou (2018 - 2024).

Percentages are derived from annual clinic registers (N = 45–126). Longhu District's share rose steadily from 9% (2018) to 38% (2024), reflecting both the highest absolute increase and the team's proximity-based outreach. Jinping maintained the largest single-district contribution (= 24–50%) across all years, while Chaoyang, Chaonan, and Chenghai each gained 5–10 percentage points between 2018 and 2021, consistent with the phased expansion of teacher-training workshops. Haojiang and Nan'ao remained $\leq 4\%$ throughout, consistent with their smaller pediatric populations and greater geographic distance from the hospital. More detailed information of the certain number of each area is in Table 7 in the Appendix.

4.1.5.1 The Efficacy of the Implementations in Central Urban Areas

The increase in the number of first-time outpatient visitors for school-age children with ADHD indicates that the two-step team building and extensive health education have achieved significant results in 4 of the 7 administrative

districts of Shantou City, with particularly notable effects observed in Longhu District.

Longhu District, one of the 3 central urban districts of Shantou City, recorded 9 first-time outpatient visits for school-age children with ADHD in 2018, which was second only to another central urban district, Jinping District, with a difference of 9 visits. Starting in 2021, the number of first-time outpatient visits for school-age ADHD patients from Longhu District has increased year by year, significantly aligning with the timeline when the STUMHC core team began conducting teacher training sessions in Longhu District. Even after excluding the potential influence of patients from 2020 who may have delayed their visits due to the pandemic, the number of first-time outpatient visits for school-age ADHD patients from Longhu District continued to rise from 2022 to 2024. Since 2023, Longhu District has surpassed Jinping District, becoming the most significant source of first-time outpatient visitors for school-age ADHD patients at STUMHC, with 33 individuals (38.37%). There was no doubt that the implementations made a great effect in the Longhu District.

In comparison with Longhu District, another central urban district—Jinping District—experienced a marginal increase in the number of first-time ADHD outpatient visits for school-age children from 2018 to 2024, with minimal overall variation, fluctuating between 18 and 22 individuals, except for nine visits in 2020 (believed to be influenced by the COVID-19 pandemic). In 2018, school-age first-time ADHD visitors from Jinping District were the predominant group in this age category.

According to the “Shantou Statistical Yearbook 2024”, the land areas of Jinping and Longhu districts are similar (Jinping District covers 141.23 square kilometers, while Longhu District covers 125.57 square kilometers), with the permanent population at the end of the year being 772,300 in Jinping District, which is 121,900 more than the 650,400 in Longhu District. Unlike Jinping District, which has been the city center since the establishment of Shantou City, approximately one-fourth of Longhu District consists of rural areas that have

gradually been expanded into urban regions during subsequent urban development¹²¹. This may explain why Jinping District has been a significant source of school-age children with ADHD from the outset: As an old town with a long history, residents place a high value on education and child development, and being an area where education has developed early, it also has a greater number of key elementary schools. Consequently, when a child's academic performance is affected by ADHD and they do not perform well at school, parents are more likely to take it seriously and bring their children for a consultation, hoping to address the issue, indicating a consistent level of attention to education and healthcare services in this area. In contrast, Longhu District, also a central urban area, includes regions that have been transformed from rural areas, and does not have as high a coverage rate of key elementary schools as Jinping District. Overall, these may make the emphasis on education in Longhu District become relatively lower compared to Jinping District. From a geographical perspective, the STUMHC is located in Longhu District, near the junction with Jinping District. Residents from both districts would be more convenient to visit the STUMHC. Consequently, after obtaining relevant information, it would also be more convenient for them to take corresponding actions such as seeking a clinic visit.

In contrast, Haojiang District—also classified as a central urban area—exhibited a distinct pattern: between 2018 and 2024, the number of first-time outpatient visits for school-age ADHD children originating from this district remained consistently low. The peak occurred in 2021 (5 cases), a year marked by COVID-19–related delays in treatment-seeking; thereafter, the figure plateaued at 2 to 3 cases annually. Although the STUMHC core team initiated the teacher-training programs in Haojiang District beginning in 2022, these interventions have not yet yielded a discernible increase in first-time visits. Geographic factor, cultural factor, and health-care resource factor likely exert a synergistic influence on this outcome.

Haojiang District is located in the southeastern part of Shantou, surrounded by the sea on three sides, bordered by Chaoyang District to the west, and separated

by a bay from Jinping and Longhu Districts to the north. Consequently, it is geographically distant from the STUMHC (about 1 hour drive), and the local residents prefer to seek medical care from the Shantou Central Hospital, which is more convenient to reach and also provides diagnosis and treatment for ADHD. Notably, in 2022, a child and adolescent psychiatrist who had graduated from STUMHC and completed standardized ADHD training joined the Shantou Central Hospital mental health team, thereby establishing a bidirectional referral network between the two facilities. From the cultural perspective, although Haojiang District is administratively designated as a central urban area, its economy is dominated by industry, agriculture, and fisheries, and it encompasses numerous townships and fishing villages ¹²¹. Consequently, local cultural norms more closely resemble those of Chaoyang District, resulting in levels of parental attention to primary-school children's academic and daily functioning that align with Chaoyang District rather than with other urban districts. Meanwhile, by 2023, Haojiang District enrolled 24,585 primary-school students — substantially fewer than Jinping (72,193) and Longhu (68,008) ¹²¹ — which naturally constrains the patient pool; however, the observed consultation rate remains disproportionately low. In addition, although teacher training was implemented in all 3 districts, the programs in Chaoyang and Chaonan District incorporated not only didactic sessions but also practical workshops and on-site practicums, whereas the training in Haojiang District was limited to theoretical instruction. This curricular discrepancy may have diminished the effectiveness of the Haojiang program. Regrettably, no in-session evaluation questionnaires were administered to assess training efficacy, representing a limitation of the present study.

4.1.5.2 The Efficacy of the Implementations in Non-Central Urban Areas

Chaoyang District, which is more than an hour's drive from the city center and was formerly a county-level city, has also seen a significant increase in the number of first-time outpatient visits for school-age children with ADHD, rising from 2 (5.56%) in 2018 to 13 (15.12%) in 2024, maintaining a stable level of 13 to 14 individuals per year since 2021. This area was also one where the STUMHC

core team-initiated teacher training programs started in 2021. Adjacent to Chaoyang, Chaonan District, another non-central urban area, experienced an increase in the number of first-time outpatient visits for school-age children with ADHD from 1 (2.78%) in 2018 to 14 (2.78%) in 2021, followed by a fluctuating decline to 8 (9.30%) in 2024. However, excluding the increase in the number of visits in 2021 due to delayed medical consultations caused by the COVID-19 pandemic, overall, there has been a fluctuating upward trend during this period.

Chaoyang District and Chaonan District, being the most populous administrative districts in Shantou City ¹²¹, should theoretically have the largest number of school-age children and, by extension, a higher number of school-age ADHD patients. However, the number of patients seeking medical attention is quite low. In addition to the issue of geographical distance, this may also be related to the cultural and economic characteristics of these areas. The region of these two districts is vast, with the majority of residents engaged in light industry, agriculture, fishing, and forestry ¹²¹. The convenience of self-employment and local work opportunities supports a diverse range of employment choices. In this case, there is less pressure for children to excel academically and secure better jobs through university education, leading to a relatively lower emphasis on academic performance compared to urban areas, though academic achievement is still valued. On another note, most families in this area have more than two children, with some having 4 to 7 or more ¹²¹, which may result in a lower level of attention and management of daily behaviors in school-age children by parents compared to those in central urban areas where families typically have one to two children. This diminished daily oversight may render ADHD symptoms less likely to be detected and addressed promptly, thereby influencing help-seeking and treatment rates negatively. Lastly, as areas that are more traditionally conservative within the broader Shantou City context, parents in Chaoyang and Chaonan Districts may have a stronger stigma associated with mental health issues and seeking treatment at specialized psychiatric hospitals, which could also be a factor hindering them from bringing their children for medical consultation. Despite

these numerous adverse factors, the number of first-time outpatient visits for school-age ADHD in STUMHC from Chaoyang and Chaonan districts exhibited a significant and stable increase during the implementation period. Although this increment remains modest relative to the large population of school-age children in these districts, it nevertheless underscores the effectiveness of the teacher training and public awareness enhancement.

Notably, among the 7 administrative districts, 2 of the 3 that exhibited no significant increase in 6-12 years old first-time ADHD outpatient visits—Chenghai, Haojiang, and Nan'ao—are rural areas; however, their underlying determinants differed. Although no targeted outreach activities such as teacher lectures or community seminars were implemented in Chenghai, the district has consistently maintained a markedly higher number of first-time visits for school-age ADHD than Haojiang and Nan'ao.

Economically, Chenghai resembles Chaoyang and Chaonan in its well-developed light-industry and agricultural base ¹²¹, which offers diverse and flexible employment opportunities and thereby reduces the decisive role of academic performance on future livelihoods. Yet, Chenghai households typically have 2 to 3 children ¹²¹, which may result in comparatively high levels of parental attention to children's education and daily life in rural contexts, reflecting a stronger local emphasis on schooling and learning. Geographically, Chenghai borders Longhu District and enjoys convenient transportation to the hospital via private car, taxi, and public bus. Chenghai District represents one of the regions in which the number of first-time outpatient visits for ADHD among school-age children did not exhibit sustained growth. The number of initial visitors from this area was low in 2018 but increased in fluctuating increments in the following years, peaking during 2021 to 2022 before subsequently declining. This pattern reflected a tendency of the region's family to access information about ADHD and health-care resources in an ad hoc and non-sustained manner. Thus, we can infer that if targeted ADHD awareness initiatives could be subsequently introduced in Chenghai, it is reasonable to anticipate a further increase in first-time outpatient

visits from this district.

Nanao, the only island county in Guangdong Province, is approximately a two-hour drive from central Shantou. It has the smallest land area among Shantou's six districts and one county, and its economy relies predominantly on tourism and small-scale fisheries and agriculture ¹²¹. In 2023, the county enrolled 4,303 primary-school students; applying a conservative prevalence estimate of 7.5%, the expected number of school-age children with ADHD is roughly 323 ¹²¹. The team did not implement targeted ADHD outreach in Nanao. Given its geographic remoteness, limited economic resources, and small population, the low absolute number and rate of first-time ADHD consultations are comprehensible. Given Nanao County's unique circumstances, future efforts should consider targeted, on-island health education initiatives. Tele-health and itinerant service delivery draw upon Canadian models could also be considered to enhance the accessibility of specialized care.

In sum, the team-building and public health education strategies implemented in this study have yielded outcomes consistent with initial projections, producing the most pronounced effects in districts—particularly the Longhu District—where targeted interventions were delivered, while simultaneously identifying clear directions for future refinement. With the team established according to local needs and resources, the research proceeded smoothly to the next stage: service enhancement, which is described in the following section.

4.2 Service Enhancement

4.2.1 The Process of Service Enhancement

To enhance the clinical interventions for school-age (6 to 12 years old) children with ADHD in Shantou City, the research planned to introduce the multidisciplinary team and comprehensive intervention model from Manitoba, Canada, while also making necessary adjustments based on the actual conditions of Shantou City. For instance, in terms of team building, unlike the case management model coordinated by social workers in the Manitoba approach ¹⁸, the

STUMHC core team was led by child and adolescent psychiatrists and included psychotherapists and psychological assessors. Regarding comprehensive interventions, we have also designed a comprehensive intervention program for school-age children with ADHD, taking into account the team's capabilities and the needs reflected in parent interviews, and have gradually implemented it from 2019 to 2024.

To reflect a patient-centered approach, the team utilized the Quality Function Deployment (QFD) tool based on service group needs ^{89,90} as described before. Drawing on the multidisciplinary team comprehensive service model from Manitoba and integrating the actual conditions of Shantou and the outcomes of the parents interviews mentioned above, a brainstorming session was conducted to construct the “Shantou City School-Age ADHD Children’s Mental Healthcare Service Quality Improvement House” (see Table 2).

Table 2. Shantou City School-Age ADHD Children's Mental Healthcare Service Quality Improvement House

Shantou City School-Age ADHD Children's Mental Healthcare Service Quality Improvement House																																					
Quality/technical characteristics			Reasonable, open, and transparent pricing			High quality multi-disciplinary treatment											Enhancing the convenience of medical resources								Timely feedback acquisition				Evaluation of importance	Competitive evaluation			Quality planning		Planning goal		Ranking
			Adheres to regulated pricing (Y/N)	Insurance coverage (types of services)	Price publicized (Y/N)	Comprehensive outpatient evaluation & individualized treatment plan formulation (Y/N)	Implementation of child group therapy (types)	Implementation of parenting group therapy (types)	Implementation of parent-child group therapy (types)	Implementation of family therapy (Y/N)	Implementation of individual therapy (Y/N)	Implementation of biofeedback therapy (Y/N)	Implementation of rTMS therapy (Y/N)	Provision of individualized and integrated specialty medical treatment	Implementation of specialized summer camps (Y/N)	Providing online outpatient services (Y/N)	Establishing specialized outpatient services (Y/N)	Providing online psychotherapy (Y/N)	Internet-based medication dispensing (Y/N)	Green channels for ADHD treatment (Y/N)	Hotline for consultation (Y/N)	Health education brochures (Y/N)	Patient follow-up phone calls (Y/N)	Regular feedback on treatment outcomes (Y/N)	Patient satisfaction surveys (Y/N)	STUMHC	Other hospital A	Other hospital B		Objective for improvement	Rate of level improvement	Attractive quality	Absolute Weight	Relative Weight			
Level 1	Level 2	Level 3	1	2	3	4	5	6	7	8	9	11	12	13	14	21	15	10	16	17	18	19	20	22	23	24											
Reasonable charges	Equitable price	Not higher than other medical service/training institutions	4	5	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4			4		4		5	4	4	4	5	1.25	1.5	9.38	8.41%	2	
		Openness and transparency	5	5	5	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4		1	1	4		4		4	4	4	4	5	1.25	1.5	7.50	6.73%	4
High quality service	Multiple services	Individualized pharmacological treatment	5	5	3	4							4	5		4	5		4	4	1	1	3	4	5	4	5	3	3	3	4	1.33	1.5	10.00	8.97%	1	
		Individual psychotherapy	5	4	3	4					5	1	1	4			4	5		1	1	3	4	5	4	4	3	3	3	4	1.33	1.0	5.33	4.79%	13		
		Group psychotherapy	5	4	3	4	4	5	5					3		3		4	4		1	1	3	4	5	4	4	4	4	4	5	1.25	1.5	7.50	6.73%	0	
		Parenting training	5	5	3	4	4	4	4	4	4			5	4	3	3	5	5		1	1	4	4	5	4	4	3	3	3	4	1.33	1.2	6.40	5.74%	9	
		Family therapy	5	5	3	4			4	5	2			4		3		3			1	1	4	4	5	4	3	2	2	2	3	1.50	1.0	4.50	4.04%	16	
		Physical therapy	5	5	3	4	3					1	5	5	1		2		4			1	1	3	4	5	4	4	3	3	2	3	1.00	1.2	4.80	4.31%	14
		Rehabilitation training	5	5	3	4	3					1	5	5	2		2		4			1	1	3	4	5	4	4	2	3	2	3	1.50	1.2	7.20	6.46%	8
		Summer camp	5	5	3	4	4							1		5		2				1	1	3	4	2	4	2	1	1	1	1	1.00	1.0	2.00	1.79%	17
	Service convenience	Easy access to doctors				5	2	2	2	2	3	2	2	5	5		5	4	5	5	5	5	5	1	4	4	4	3	3	3	3	4	1.33	1.2	4.80	4.31%	14
		Easy access to medical service				5	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	3	4	3	4	4	5	4	3	3	4	1.00	1.5	7.50	6.73%	4
		Easy access to medication				5	1							5		5	4		5	5	3	2	4	2	4	4	4	4	4	4	5	1.25	1.5	7.50	6.73%	4	
		Easy access to disease and health				5	1	4	4	4	4	4	3	3	4	4	4	4	4	1	5	5	5	4	5	4	4	3	2	2	4	1.33	1.2	6.40	5.74%	9	
		Timely feedback																																			
Timely feedback	Feedback convenience	Satisfaction survey	3	3	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	4	5	5	3	4	4	4	5	1.25	1.5	5.63	5.05%	11	
		Outpatient feedback	3	3	3	5	3		3	3	3	3	3	3	3	3	3	5	3	3	4	3	2	4	5	4	5	4	3	3	5	1.25	1.5	9.38	8.41%	2	
		Telephone follow-up	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	2	5	5	4	3	4	3	4	5	1.25	1.5	5.63	5.05%	11	
Importance of quality/technical characteristics			3.37	3.34	2.51	4.12	2.53	2.06	2.47	2.18	2.45	2.27	2.27	3.27	2.89	2.46	2.81	4.12	2.74	2.47	2.34	2.14	2.54	4.05	3.81	4.05							111.4	1			
STUMHC			1.00	2.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00									89.00			
Other hospital A			1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	70.00									
Other hospital B			1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	75.00										
Quality design targeted value			1.00	3.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	95.00											
Difficulty Level analysis			1.00	5.00	1.00	1.00	4.00	4.00	4.00	3.00	1.00	1.00	8.00	4.00	1.00	10.00	9.00	5.00	9.00	10.00	8.00	8.00	2.00	3.00	1.00	3.00											

Relationship-matrix symbols
Relationship strength: 1 (weak) / 3 (medium) / 5 (strong)
Product-characteristic points
●:1.5 ○:1.2 ■:1

Note. Created by the STUMHC core team members through brainstorming, the house translated patients' needs (left) into technical service features (roof) via an inter-relationship matrix. Using this QFD House, the team can systematically translate caregiver-identified needs into prioritized service specifications, and allocate resources to high-impact interventions (e.g., comprehensive assessment, individual pharmacotherapy, media lectures), and alliteratively refine the ADHD care pathway through

continuous PDCA cycles.

After discussion and analysis, it is believed that the mental intervention model for school-age children with ADHD in Shantou City should focus on three aspects: reasonableness of fees, quality of service (enhancing service forms and improving service convenience), and timeliness of feedback. Based on the quality house established for these three aspects, a bottleneck analysis was performed, as depicted in Figure 16.

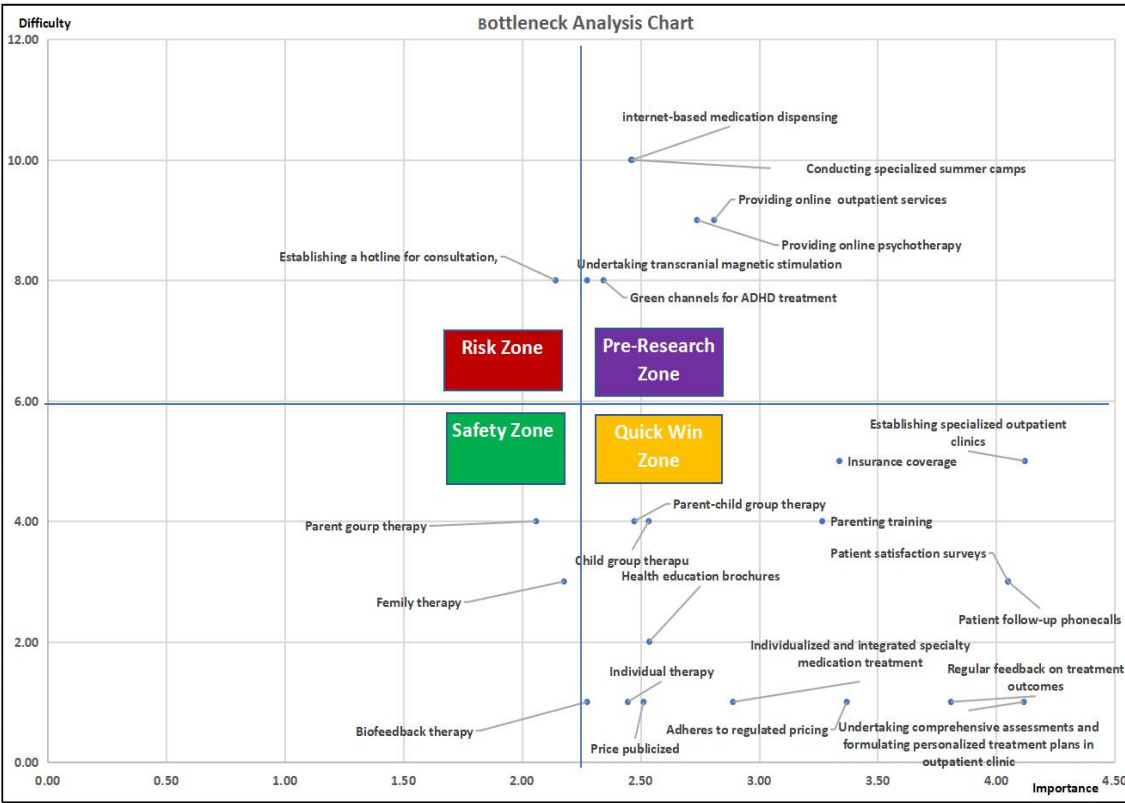


Figure 16. Bottleneck Analysis Chart for Shantou City School-age ADHD Children's Mental Healthcare Service.

Items are plotted by implementation difficulty (y-axis) versus importance for quality improvement (x-axis) as rated by the STUMHC core team. This bottleneck matrix will function as a dynamic decision-aid for the next phase of implementation. By anchoring resource allocation to the “Quick-Win” quadrant, the team can achieve rapid gains in service quality while generating early evidence of effectiveness. Simultaneously, the “Pre-Research Zone” delineates a phased investment pipeline—high-importance features (e.g., transcranial magnetic stimulation, and an online outpatient platform) can be scheduled for later years

once funding, staffing, and regulatory approvals are secured, thereby minimizing risk and ensuring sustainable scale-up.

The bottleneck analysis chart measured the difficulty (vertical axis) in terms of resources required for service implementation (such as technology, personnel, funding) and operational complexity, with higher values indicating greater difficulty; importance (horizontal axis) reflects the critical degree of service in enhancing the quality of clinical care for attention deficit hyperactivity disorder, with higher values having a more significant impact on patient experience and treatment outcomes^{89, 90}. By intersecting the two axes, service initiatives were categorized into four quadrants: Risk Zone, Pre-Research Zone, Quick Win Zone, and Safety Zone, accurately pinpointing the priority level for improvement.

The Pre-Research Zone, representing "high importance, high difficulty", encompassed quality characteristics such as "conducting specialized summer camps", "internet-based medication dispensing", "providing online psychotherapy" and "online outpatient services", "green channels for ADHD treatment" and "undertaking transcranial magnetic stimulation". These initiatives are significant for optimizing the clinical service ecosystem; for instance, specialized summer camps can deeply intervene in patients' behaviors, and internet-based medication dispensing enhances the convenience of medical visits. However, their implementation requires overcoming challenges such as the technical integration of online and offline services, the cross-domain allocation of human resources, venues, equipment, and other resources from schools and hospitals. After comprehensive evaluation, the team unanimously agreed that these initiatives would be difficult to implement within 5 years, hence they will not be carried out within the research timeframe.

The Quick Win Zone, indicating "high importance, low difficulty", included initiatives such as "establishing specialized outpatient clinics", "undertaking comprehensive assessments and formulating personalized treatment plans in outpatient clinic", "individualized and integrated specialty medication treatment",

"parent-child group therapy", "insurance coverage", "parenting training", "child group therapy", "parent-child group therapy", "individual therapy", "biofeedback therapy", "regular feedback on treatment outcomes", "adheres to regulated pricing", "patient satisfaction surveys", "health education brochures", "patient follow-up phone calls", and "price transparency". It means that these measures were easier to implement and yielded quick results, directly addressing patients' "precision treatment needs" and enhancing service reputation rapidly. After comprehensive evaluation, the team members agreed that these initiatives matched the capabilities of team members, were reasonably resource-allocatable in the local context, and were highly feasible for future implementation, thus unanimously agreeing to gradually implement them during the study period, and some of them could even be prioritized for rapid execution.

The Safety Zone, representing "low importance, low difficulty," included services such as "parent group therapy" and "family therapy". From the perspective of patients and their families, these measures, while ensuring service quality, had a limited impact on core treatment quality. Therefore, after comprehensive discussion, the team concluded that these services can continue as they are currently conducted, with periodic evaluations through patient satisfaction surveys and telephone follow-ups to assess their value. If there was no positive feedback on the service consistently, these processes could be streamlined (e.g., combining parent group therapy, family therapy with parent training, or parent-child group therapy) to free up resources for the implementation of services with higher value and priority.

Lastly, the Risk Zone, representing "low importance, high difficulty," included only one quality characteristic: "establishing a hotline for consultation". This service, which would require substantial resource investment (requiring dedicated staff to man the service) but had a weak impact on enhancing core clinical treatment effectiveness, potentially even diverting efforts from more valuable services. After reassessment by the team members, it was concluded that considering the current needs of the ADHD patient population, the necessity for this service is relatively low, while the human resources required are substantial.

Overall, the service is deemed inefficient, and alternative resources can be sought through routine outpatient consultations and health education brochures; hence, it was not adopted for implementation in this research.

After the necessary directions for work to be carried out had been clarified, a Plan-Do-Check-Act (PDCA) quality-improvement approach was employed and conducted.

4.2.1.1 Plan

In June 2019, the STUMHC core team formulated a PDCA (Plan-Do-Check-Act) work plan targeting the implementation of initiatives in the Quick Win Zone, which included:

- 1) By improving the ADHD outpatient process, compiling diagnostic and treatment protocols, and conducting training, complete the construction of specialized outpatient clinics to enhance the quality of outpatient services, enabling comprehensive assessments and the formulation of personalized treatment plans and individualized, integrated specialty medication treatment for patients in the outpatient setting;

- 2) Gradually initiate various forms of psychotherapy and parent training for children, parents, and parent-child groups, complementing existing biofeedback rehabilitation training and basic psychological treatment services to provide patients with a comprehensive range of treatment options;

- 3) Produce and distribute health education materials to make it more convenient for patients and their families to obtain health information about the disease;

- 4) Conduct satisfaction surveys and follow-up calls to implement a regular feedback mechanism for doctors, ensuring timely collection of patients' opinions and suggestions for continuous improvement;

- 5) Develop new technologies and communicate with medical insurance departments to expand the scope of insurance coverage, further alleviating the financial burden on patients' families.

Types of services provided, patient satisfaction, and efficacy assessments will

be monitored as metrics for evaluating the outcome of the implementation of clinical standardized diagnostic and treatment services. This will assess the effectiveness of the improvement measures, analyze deficiencies, and clarify directions for further enhancement. The specific implementation timeline was detailed in the Gantt chart (Figure 17).

Step \ Time		2019.1-3	2019.4-6	2019.7-9	2019.10-12	2020.1-3	2020.4-6	2020.7-9	2020.10-12	2021.1-3	2021.4-6	Members	Methods
Plan	Investigating Current Situation for targetted field											SUMTHC core team	Specialized meeting Brainstorming QFD
	analyze causes and needs, develop plan											SUMTHC core team	Brainstorming Work assignment Table Gantt chart
Do	Improve outpatient process for ADHD, including developing diagnostic standards, conduct training, complete specialty clinic construction											Outpatient clinic team	Inspection table Process flowchart Meeting Training
	Gradually implement various forms of psychological therapy and parent training for children, parents, and parent-Child Groups											Psychotherapy team	Inspection table Process flowchart Meeting Training
	Produce and distribute health education materials											SUMTHC core team	Meeting Inspection table
	Conduct satisfaction surveys and follow-up calls, implement regular outpatient feedback											Patient satisfaction team	Survey questionnaire Outcome analysis
	Introduce and implement new technology, communicate with insurance department, expand insurance coverage scope											SUMTHC core team	Meeting Training
Check	Outcome evaluation											SUMTHC core team	Inspection table Outcome analysis Meeting
Act	Standardize, consolidate improvement outcomes, recirculation											SUMTHC core team	Meeting Inspection table
Process		P			D				C		A	/	/

Figure 17. Gantt Chart for the Implementation of Enhancing Shantou City School-age ADHD Children's Mental Healthcare Service.

The chart depicts the phased execution of the PDCA (Plan-Do-Check-Act) cycle across 10 quarterly time-blocks. Core-team tasks include QFD-based planning, outpatient-process redesign, and outcome evaluation; parallel community-team activities cover psychological-therapy rollout, public-education production, and satisfaction surveys. Vertical milestones mark the completion of specialty-clinic construction (2019 Q4) and the first full-cycle outcome audit (2021 Q2), illustrating iterative quality improvement in real

time.

During the implementation of the plan, from 2020 to 2022, the global community faced a persistent and severe COVID-19 pandemic, and local measures in Shantou, such as quarantine and prohibitions on gatherings, also impacted the delivery of clinical services to varying degrees, thus preventing the original plan from being executed. Consequently, in 2020 and 2021, in response to the in-changing COVID-19 pandemic and the alterations in prevention and control measures, the team also held 2 additional discussions and formulated new plans. To ensure the implementation of improvement measures. However, this also led to a significant delay in the completion of the entire plan compared to the original schedule.

4.2.1.2 Do - Carrying the Plan Out

In the second half of 2019, the STUMHC core team referred to the Manitoba ADHD service model, “*Canadian ADHD diagnosis and treatment guidelines*”¹¹, “*Chinese Prevention and Treatment Guideline of ADHD*”¹², as well as the “*Standardization of Attention Deficit Hyperactivity Disorder Outpatient Clinic Construction and Standardized Management*”¹²² to carry out rectification work on outpatient services. This included: developing hospital ADHD treatment protocols and conducting training across the hospital; creating ADHD outpatient standardized treatment pathways and assessment packages; improving the process for prescribing extended-release methylphenidate tablets to facilitate patient medication access while preventing potential drug abuse risks; and increasing the consultation time for child and adolescent psychiatrists.

Regarding comprehensive treatment, the team attempted to cooperate with community mental health service organizations, and launched ADHD children's groups and ADHD parent groups in Jinping District, collecting feedback from participants and planning to launch related services at the hospital in 2020.

However, the COVID-19 pandemic and the subsequent quarantine policies that emerged in 2020 had a significant impact on the implementation of the plan.

Starting from January 2020, due to the impact of COVID-19 prevention and control measures, it was impossible to organize activities that would require group gatherings. In this case, the group therapy for children with ADHD and parent training could not be carried out as originally planned, and the work of the psychiatric outpatient clinic and general psychotherapy was also significantly affected. By the second half of 2021, outpatient services had gradually resumed, but there were still restrictions on group activities within the hospital. Therefore, after evaluation and analysis of the work plan implementation, the team concluded that it was necessary to carry out a variety of intervention activities, including online services and community-based services, and the original plan was modified to fit the situation as mentioned before in 4.2.2.1. During the years 2021 and 2022, due to the fluctuating situation of the COVID-19 pandemic, in-person group activities in mental health institutions remained challenging to conduct. Consequently, from July to August 2021, the team collaborated with community mental health service organizations to conduct a combination of offline child group therapy and online parent group therapy, which received positive feedback from both parents and children. In 2021, the SCUMHC core team conducted a study on the anxiety levels and parental stress among parents of outpatient children with ADHD. The results indicated that caregivers of children with ADHD in the Chaoshan region experienced higher levels of anxiety and parental stress compared to caregivers of typically developing children. This was a consequence of caregivers facing challenges across multiple domains, including personal characteristics, family environment, and societal context. Therefore, in addition to treatment targeted at children, providing more psychological support and guidance on parenting approaches for parents is also crucial. Based on these findings, in the years 2021 and 2022, ADHD health education and family intervention lectures were conducted online and through media to disseminate and promote health knowledge about ADHD, family education, and school-based strategies. This approach helped to fill the gap left by the reduction of face-to-face activities while enhancing the visibility of the hospital's specialty outpatient services and the team's

reputation.

Moreover, since 2020, the hospital has collaborated with the local education system to implement mental health services in schools. This initiative included regular psychological screenings for primary and secondary students, mental health knowledge training for teachers, and mental health science lectures for students and parents, exploring a collaborative mechanism involving families, schools, and professional mental health institutions. As of December 2024, the project has served 735 schools, providing psychological screening services to over 1.347 million students, with a cumulative service reach of nearly 2.343 million teachers, students, and parents. Seizing this opportunity, the team integrated ADHD-related psychological screening projects, disease health knowledge, and teaching strategies into the service plan, creating educational materials on ADHD teaching strategies for use, to advancing local ADHD in-campus services.

On the other hand, to compensate for the lack of face-to-face training, many diagnostic and treatment skill training sessions began to be conducted online, which also provided team members with the opportunity to engage in online training. From 2022 to 2023, one psychotherapist from the STUMHC core team underwent training in the “New Forest Parenting Program (NFPP)” and completed the assessment, obtaining certification as a New Forest Parenting Program Therapist issued by NFPP officially. This enabled the team to launch the New Forest Parenting Program services in 2024, offering personalized family parenting adjustments for parents of children with ADHD.

Starting in 2021, team members began conducting random telephone follow-ups with first-time ADHD outpatients to understand their consultation pathways and reasons for seeking care, as well as to focus on their medical experience and satisfaction levels. This information serves as evidence and reference for evaluating and improving the services provided.

In 2024, after 2 years of integrated clinical operations, the team has more fully established the construction of a comprehensive standardized ADHD outpatient clinic. On the basis of the original psychiatry outpatient service, a children and

adolescents clinic and a learning difficulties clinic have been established to facilitate more precise consultations for patients with ADHD.

A significant advancement is that, due to improvements in national policies, outpatient psychotherapy was also included in the medical insurance coverage starting in 2024. Leveraging the influence of the STUMHC and the core team in the local mental health specialty, team members were invited as industry experts by the local medical insurance bureau, to provide policy implementation references on how psychological treatment could be included in medical insurance and how reimbursement rates could be implemented in hospitals. After actively communicating with medical insurance bureau staff, the STUMHC took the lead in Shantou to initiate the inclusion of psychological treatment in medical insurance, thereby alleviating some of the financial burden on patients and their families.

4.2.1.3 Check and Act—The Results and Efficacy of Service Enhancement

As previously mentioned, the types of services, patient satisfaction, and efficacy assessments are utilized to test the effectiveness of the work plan implementation. Patient satisfaction is assessed annually through satisfaction surveys and telephone follow-ups, while the types of services are monitored on an annual basis.

In terms of the number of service items, in 2018, prior to the start of the study, the STUMHC only provided basic services and did not have a specialized systematic service model for ADHD. School-age children with ADHD were treated alongside adult patients or those with severe mental illnesses. As the research progressed, the number of service items gradually increased to 4 in 2019, 5 in 2021, and ultimately led to the establishment of a specialized pediatric psychiatry clinic and specialized outpatient clinics by 2024. With 2 categories of outpatient services available for patients to choose from, along with 5 types of non-pharmacological comprehensive treatments, the outpatient services for school-age children with ADHD have been effectively advanced. The growth trend of service items and their specific content can be found in Table 3 and Figure 18.

**Table 3. Number and Name of Services Provided for ADHD Children
6 – 12 Years Old by STUMHC Core Team (2018 – 2024)**

Year	Number of service	Service provided
2018	3	1. Psychiatric clinic 2. Individual psychotherapy 3. Biofeedback therapy
2019	4	1. Psychiatric clinic 2. Individual psychotherapy 3. Biofeedback therapy 4. Group therapy (external outreach)
2020	3	1. Psychiatric clinic 2. Individual psychotherapy 3. Biofeedback therapy
2021	5	1. Psychiatric clinic 2. Individual psychotherapy 3. Biofeedback therapy 4. Group therapy (external outreach) 5. Health education and family intervention guidance
2022	5	1. Psychiatric clinic 2. Individual psychotherapy 3. Biofeedback therapy 4. Group therapy (external outreach) 5. Health education and family intervention guidance
2023	5	1. Psychiatric clinic 2. Individual psychotherapy 3. Biofeedback therapy 4. Group therapy (external outreach) 5. Health education and family intervention guidance
2024	7	1. Psychiatric clinic 2. Specific clinic 3. Individual psychotherapy 4. Biofeedback therapy 5. Group therapy (external outreach) 6. Health education and family intervention guidance 7. “New Forest Parenting Program (NFPP)”

Note. Table summarizes the PDCA-driven expansion of ADHD services for children aged 6–12 years. The portfolio grew from 3 basic interventions in 2018 (before the PDCA cycle) to 7 distinct services by 2024 (after the PDCA cycle), most notably the addition of parenting training (NFPP), health education, the convenience-oriented “specific clinic”, and an external outreach group therapy—all aligned with locally identified needs. Despite COVID-19-related delays that extended the overall cycle, the iterative

Plan-Do-Check-Act process ultimately achieved its predetermined objectives, demonstrating the model's resilience and adaptability under pandemic conditions.

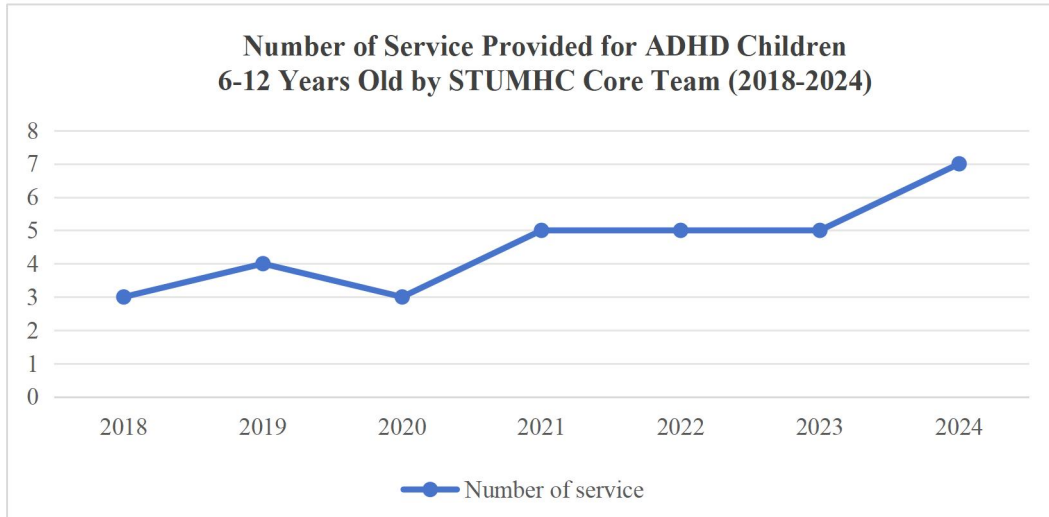


Figure 18. Number of Services Provided for ADHD Children 6 - 12 Years Old by STUMHC Core Team (2018 - 2024).

A baseline of 3 modalities in 2018 rose incrementally to 7 distinct services by 2024, demonstrating iterative expansion aligned with each Plan-Do-Check-Act cycle. The steep increase between 2020 and 2021 coincides with post-lockdown service resumption and the completion of specialty-clinic infrastructure, illustrating the impact of systematic quality-improvement efforts on the clinical offer.

To evaluate the treatment efficacy, as mentioned in the Methodology session, following the principle of voluntary participation and informed consent, researchers recruited 26 children aged 6 to 12 years who were first-time ADHD outpatients in STUMHC between 2023 and 2024, along with their primary caregivers. The mean age of these children was 8.77 years; 20 were boys and 6 were girls, yielding a male-to-female ratio of 10:3. This age and sex distribution is consistent with the demographic profile of school-age ADHD outpatients seen in the clinic during that period, hence would be capable for evaluating treatment efficacy of school-age children with ADHD who first visited the outpatient clinic at the STUMHC during the period when the new service model was relatively mature.

These children's parents/primary caregivers finished the ADHD Diagnostic Scale-Parent Version (ADHDDS-P) (Chinese version) and the Conners' Behavior Rating Scales (CBRS) (Chinese version) ^{93,123}, while the children took the Integrated Visual and Auditory Continuous Performance Test (IVA-CPT) ^{124,125} before and 6 months after the treatment started to evaluate the changing level of ADHD symptoms. Meanwhile, the children also took the Family Environment Scale Chinese Versions (FES-CV) ^{93,123} before and 6 months after the treatment started to evaluate the family environment changes with interventions.

To analyze the result of the ADHDDS-P, since the sample (N=26) was smaller than 50, a Shapiro-Wilk test was chosen to test the normality of the Post-Pre difference of the ADHDDS-P results. The result indicated a positive difference with $p > 0.05$, confirming a normal distribution (see Table 4).

Table 4. Results of Normality Test of ADHDDS-P

	Shapiro-Wilk		
	Statistic	df	Sig. (<i>p-value</i>)
Difference (ADHDDS-P)	0.932	26	0.087*

Note. * $p > 0.05$, the difference is statistically significant. N=26. A Shapiro-Wilk test was used.

Therefore, a paired-sample t test was used for the inferential analysis. With a result of $0.05 < p \leq 0.01$, the paired-sample test and the descriptive statistics result indicated that before and after treatment, there were significant changes in the severity of ADHD symptoms, which showed improvement of the ADHD core symptoms according to parent's observation (see Table 5 & 6). With a large within-subject effect size (Cohen's $d_z = 0.85$) and a 95% confidence interval for the mean difference of [1.145, 3.239], the paired t-test indicates both a statistically significant and practically meaningful intervention effect. However, the small sample ($n = 26$) yields a wide confidence interval, leaving considerable uncertainty

about the true magnitude. These results suggested that future studies should recruit larger samples to refine the estimate and enhance reproducibility.

Table 5. Results of Paired-sample Test of ADHDDS-P

Pairing (Post - Pre)	Mean	SD	95% CI (LL, UL)	t	Df	<i>p-value</i> (two-tailed)
ADHDDS-P	-2.192	2.593	-3.239, -1.145	4.312	25	0.000**

Note. * $p \leq 0.05$, the difference is statistically significant; ** $p \leq 0.01$, the difference is statistically significant. N=26. A paired-sample t test was used.

Mean = -2.192 states that the severity of parent-reported ADHD symptoms miners. Cohen's $d_z = 0.85$.

Table 6. Results of Descriptive Statistics of ADHDDS-P

Pair	Scale	Mean	N	SD	SE
1	ADHDDS-P (Pre)	9.92	26	2.465	0.483
	ADHDDS-P (Post)	7.73	26	2.721	0.534

Note. Mean scores decreased from 9.92 (SD = 2.47) to 7.73 (SD = 2.72), reflecting reduced parent-reported ADHD symptom severity after 6 months of intervention.

Additionally, with the same sample ($N = 26$), a Shapiro-Wilk test was first conducted to test the normality of the post-pre treatment difference of the CBRS results. The result indicated a positive difference with $p > 0.05$ with the sub-scales of conduct problems, study problems, impulsive-hyperactive problems, anxiety, and the hyperactivity index, confirming normal distributions, while the sub-scale of psychosomatic problems showed a p value < 0.05 , confirming non-normal distribution (see Table 7).

Table 7. Results of Normality Test of CBRS

Difference (Post-Pre)	Shapiro-Wilk		
	Statistic	df	Sig. (<i>p-value</i>)
Conduct problems	0.985	26	0.960*
Cognitive problems	0.979	26	0.845*
Psychosomatic problems	0.706	26	0.000
Impulsive-hyperactive problems	0.944	26	0.163*
Anxiety	0.944	26	0.163*
Hyperactivity index	0.956	26	0.320*

Note. $N=26$. Shapiro-Wilk tests were performed on the post-pre difference scores. $*p > 0.05$ indicates that the difference scores did not significantly deviate from a normal distribution.

Therefore, the psychosomatic problems sub-scale was analyzed using the Wilcoxon signed-rank test, while other sub-scales and the hyperactivity index were analyzed using the paired-samples t test. With a result of $p \leq 0.01$, the paired-sample test indicated that before and after treatment, there were significant changes in sub-scales including conduct problems, cognitive problems, impulsive-hyperactive problems, and the hyperactivity index, while no significant difference was found in anxiety sub-scales, while the Wilcoxon signed-rank test indicated that there was no significant changes in the sub-scale of psychosomatic problems (see Table 8 & 9).

Table 8. Results of Paired-sample Test of CBRS

Pairing (Post-Pre)	Mean	SD	95% CI (LL, UL)	t	Df	<i>p-value</i> (two-tailed)
Conduct problems	-0.3269	0.5703	-0.5573, -0.0966	2.923	25	0.007**
Cognitive problems	-0.4654	0.7589	-0.7719, -0.1589	3.127	25	0.004**
Impulsive-hyperactive problems	-0.6962	0.7795	-1.0110, -0.3813	4.554	25	0.000**
Anxiety	-0.0885	0.2582	-0.1927, -0.0158	1.747	25	0.093
Hyperactivity index	-0.5154	0.5312	-0.7299, -0.3008	4.947	25	0.000**

Note. * $p \leq 0.05$, the difference is statistically significant; ** $p \leq 0.01$, the difference is statistically significant. N=26. A paired-sample t test was used.

Cohen's d_z (Hyperactivity index) = 0.97.

Table 9. Results of the Wilcoxon signed-rank test of CBRS

Psychosomatic problems (post-pre)	
Z	-0.666 ^b
Asymptotic significance (two-tailed)	0.506

Note. * $p \leq 0.05$, the difference was statistically significant; ** $p \leq 0.01$, the difference is statistically significant. N=26. A Wilcoxon signed-rank test was used.

Integrating the analyses above with the descriptive statistics (see Table 10), it was evident that according to parents' observations, before and after treatment, there were no significant changes in the levels of anxiety and psychosomatic problems, while the severity of ADHD children's study problem, impulsive-hyperactive problem, and conduct problem decreased. The general level of ADHD problem (presented by the hyperactivity index) was also declined.

Table 10. Results of Descriptive Statistics of CBRS

Pair	Sub-scale	Mean	N	SD
1	Conduct problems (Pre)	1.712	26	0.4520
	Conduct problems (Post)	1.385	26	0.5112
2	Cognitive problems (Pre)	2.573	26	0.6667
	Cognitive problems (Post)	2.108	26	0.5878
3	Impulsive-hyperactive problems (Pre)	2.642	26	0.7420
	Impulsive-hyperactive problems (Post)	1.946	26	0.4356
4	Hyperactivity index (Pre)	2.185	26	0.4977
	Hyperactivity index (Post)	1.669	26	0.4203

Note. N=26. All four sub-scales showed reductions after six months of intervention; the largest mean decrease occurred on the Impulsive-Hyperactive Problems sub-scale (2.64 to 1.95), followed by the Hyperactivity Index (2.19 to 1.67), indicating clinically meaningful improvement in parent-rated behavioral symptoms.

Overall, the results showed an functioning improvement in attention and response control, with improvements in most ADHD and relative symptoms after the treatment. On the other hand, the lack of change in additional symptoms sub-scales such as anxiety and psychosomatic sub-scales suggests the model excels in core ADHD symptoms but may need adjunct interventions such as anxiety-focused and/or emotion management treatments.

Focusing on the “Hyperactivity index” sub-scale that captures changes in core ADHD symptom severity, the post-pre contrast yielded Cohen’s $d_z = 0.97$ (very large effect) with a 95% CI for the mean difference of [0.3008, 0.7299]. Key strengths are (1) the effect is large enough to outweigh sampling error despite N = 26; (2) the interval excludes zero and spans 0.30–0.73, meeting criteria for substantive improvement. The principal limitation is the wide CI (≈ 0.43) produced by the small sample; therefore, enlarging the sample (e.g., $n \geq 50$) is warranted to narrow the interval and confirm replicability. Nonetheless, the observed difference already satisfies published benchmarks for clinical significance and can serve as preliminary evidence of intervention efficacy.

To examine whether concentration and inhibitory control improved from pre- to post-intervention, pretest and post-test scores on the three primary indices of the IVA-CPT: integrated control quotient (ICQ), integrated attention quotient (IAQ), and hyperactivity quotient (HQ), were analyzed and compared.

Table 11. Results of Normality Test of IVA-CPT

Difference (post-pre)	Shapiro-Wilk		
	Statistic	df	Sig. (<i>p-value</i>)

ICQ	0.982	26	0.921*
IAQ	0.943	26	0.159*
HQ	0.965	26	0.498*

Note. N=26. Shapiro-Wilk tests were performed on the post-pre difference scores. *p > 0.05 indicates that the difference scores did not significantly deviate from a normal distribution.

According to Table 11, it can be found that with a small-size sample (N = 26), the post-pre difference of all three indices showed statistically significant with the Shapiro-Wilk test. These results indicated that all 3 datasets were normally distributed; therefore, paired-samples t tests were conducted to analyze the post-pre test difference scores, with results presented in Table 12.

Table 12. Results of Paired-Sample Test of IVA-CPT

Pairing (post-pre)	Mean	SD	95% CI (LL, UL)	t	Df	<i>p-value</i> (two-tailed)
ICQ	16.5	29.303	5.747, 4.664	2.871	25	0.008**
IAQ	30.269	22.563	4.425, 21.156	6.841	25	0.000**
HQ	1.500	2.531	-3.712, 6.712	0.593	25	0.559

Note. * $p \leq 0.05$, the difference is statistically significant; ** $p \leq 0.01$, the difference is statistically significant. N=26. A paired-sample t test was used.

Cohen's d_z (ICQ) = 0.56, Cohen's d_z (IAQ) = 1.34, Cohen's d_z (HQ) = 0.59.

Paired-sample t-tests were conducted to examine pre-to-post changes in the IVA-CPT quotient scores (ICQ, IAQ, and HQ). Results revealed statistically significant improvements in both control and attention functions following the intervention. For the ICQ index, the mean post-pre difference was 16.50, 95% CI [5.747, 4.664], with a significant test result, $t(25) = 2.871$, $p = 0.008$, corresponding to a moderate-to-large effect size, Cohen's $d_z = 0.56$. For the Integrated Attention Quotient, the mean post-pre difference was 30.27, 95% CI [4.425, 21.156], and the improvement was highly significant, $t(25) = 6.841$, $p < .001$, with a large effect size, Cohen's $d_z = 1.34$. By contrast, no significant post-pre change was observed for the HQ, mean difference = 1.50, 95% CI [-3.712, 6.712], $t(25) = 0.593$, $p = 0.559$, with a moderate effect size, Cohen's $d_z = 0.59$. These findings indicate that the intervention effectively enhanced participants' overall attentional capacity and inhibitory control, while producing no statistically significant reduction in hyperactivity-related symptoms at the post-assessment time point. In this case, interventions, including both pharmacological and psycho-social treatments that aim at improving hyperactivity-related symptoms should be further strengthened in the future.

Looking at the family functioning perspective, since the sample size was smaller than 50, the Shapiro-Wilk test method was conducted to test the normality of the pre-post difference of the FES-CV results. The result indicated a positive difference with $p > 0.05$ with the sub-scales of conflict, intellectual-cultural orientation, active-recreational orientation, moral-religious emphasis, organization and control, confirming normal distributions, while the sub-scales of cohesion, expressiveness, independence, and achievement orientation showed a p value < 0.05 , confirming non-normal distribution (see Table 13).

Table 13. Results of Normality Test of FES-CV

Difference (Post-Pre)	Shapiro-Wilk		
	Statistic	df	Sig.(<i>p-value</i>)
Cohesion	0.821	26	0.000
Expressiveness	0.903	26	0.019
Conflict	0.966	26	0.528*
Independence	0.887	26	0.008
Achievement orientation	0.921	26	0.047
Intellectual-cultural orientation	0.924	26	0.057*
Active-recreational orientation	0.961	26	0.410*
Moral-religious emphasis	0.925	26	0.060*
Organization	0.941	26	0.145*
Control	0.964	26	0.466*

Note. N=26. Shapiro-Wilk tests were performed on the post-pre difference scores. * $p > 0.05$ indicates that the difference scores did not significantly deviate from a normal distribution.

Therefore, the sub-scales with normal distributions were analyzed using the paired-samples *t* test for the inferential analysis, while other sub-scales were analyzed using the Wilcoxon signed-rank test (see Table 14 & 15).

Table 14. Results of Paired-Sample t Test of FES-CV

Pairing (Post-Pre)	Mean	SD	95% CI (LL, UL)	t	Df	<i>p</i> -value (two-tailed)
Conflict	0.692	.074	-0.145, 1.530	1.702	25	0.101
Intellectual-cultural orientation	-2.423	.788	-3.549, -1.297	-4.431	25	0.000**
Active-recreational orientation	-1.423	.656	-2.496, -0.350	-2.732	25	0.011*
Moral-religious emphasis	-2.000	.117	-2.855, -1.145	-4.818	25	0.000**
Organization	-1.423	.419	-2.400, -0.446	-2.999	25	0.006**
Control	1.500	.627	0.439, 2.561	2.912	25	0.007**

Note. * $p \leq 0.05$, the difference is statistically significant; ** $p \leq 0.01$, the difference was statistically significant. $N=26$. A paired-sample t test was used. Cohen's d_z (Conflict) = 0.33; Cohen's d_z (Intellectual-cultural orientation) = 0.87; Cohen's d_z (Organization) = 0.59; Cohen's d_z (Moral-religious emphasis) = 0.94.

Table 15. Results of the Wilcoxon Signed-Rank Test of FES-CV

	Cohesion (Post-Pre)	Expressiveness (Post-Pre)	Independence (Post-Pre)	Achievement (Post-Pre)	Orientation
Z	-0.399 ^a	-0.671 ^a	-0.522 ^a	-0.772 ^a	
Asymptotic significance (two-tailed)	0.162	0.502	0.601	0.440	

Note. * $p \leq 0.05$, the difference is statistically significant; ** $p \leq 0.01$, the difference was statistically significant. N=26. A Wilcoxon signed-rank test was used.

With a result of $p \leq 0.05$, the paired-sample test indicated that before and after treatment, there were significant changes in the sub-scales of intellectual-cultural orientation, active-recreational orientation, moral-religious emphasis, organization and control, while no significant difference was found in the sub-scales of conflict. Additionally, the results of the Wilcoxon signed-rank test showed that there were no significant changes in the cohesion, expressiveness, independence, and achievement orientation sub-scales before and after treatment

Focusing on sub-scales that are more related to ADHD symptoms, such as the “conflict”, “intellectual-cultural orientation”, “organization” and “moral-religious emphasis” sub-scales, based on the within-subjects comparisons across these four sub-scales of the same instrument, the intervention effects demonstrated marked dimension specificity, with differential responsiveness across domains. The overall pattern indicated significant improvement in select dimensions, whereas stable effects were not detected in others. For the conflict sub-scale, the pretest-posttest difference was not statistically significant, with a small effect size and a 95% confidence interval crossing zero, suggesting no detectable stable or reliable intervention effect in this dimension. Constrained by the limited sample size, the true direction and magnitude of the effect remain undetermined, necessitating verification with an expanded sample.

For the intellectual-cultural orientation sub-scale, the pretest-posttest difference was statistically significant, with a medium effect size and a 95% confidence interval that did not contain zero, indicating a stable effect direction and clear, practically meaningful improvement in this dimension. The organization sub-scale demonstrated an upper-medium effect size, whereas the moral-religious emphasis sub-scale exhibited a large effect size; both sub-scales yielded confidence intervals that did not cross zero with statistically significant differences, suggesting prominent and stable intervention effects in these two core dimensions.

Although the small sample size ($n=26$) resulted in relatively wide confidence intervals for the significant dimensions, limiting precise estimation of the true population effects, the convergence of statistical significance with medium-to-large

effect magnitudes supports the existence of genuine intervention effects rather than random error.

Collectively, these findings indicate that the employed intervention possesses clear targeting specificity and selectivity, producing stable and significant improvements across multiple assessment dimensions, while no significant effect was observed for a single dimension. This dimensional discrepancy aligns with both the mechanistic characteristics of the intervention and the differential sensitivity of the instrument's various dimensions to intervention-induced change, providing empirical grounding for subsequent refinement of intervention content (such as adding interventions targeted to family conflict resolution), prioritization of key improvement dimensions, and enhancement of intervention precision and effectiveness, as well as preliminary reference for the application and dissemination of this intervention class.

In general, the results of the post-pre test confirmed the clinical efficacy of the mental health service model for ADHD children in the STUMHC, while the function of the family improved with the treatment.

Regarding patient satisfaction, a specific patient satisfaction survey was conducted once at the end of each year by a professional satisfaction research company, targeting outpatients' medical process at the STUMHC. Information is collected through on-site electronic questionnaires and random sampling, gathering 160 – 180 valid anonymous responses annually. The questionnaire assesses 8 service dimensions and 26 service nodes, including doctor-patient communication, technical level, service attitude, privacy protection, environmental facilities, medical expenses, medical process, and logistical services. Satisfaction is measured using a 5-point Likert scale, and the analysis report converts the scores into a percentage to derive satisfaction values.

Results of this survey from 2018 to 2024 at the STUMHC indicate that overall satisfaction among outpatients has shown a significant improvement since 2019 (Figure 19).

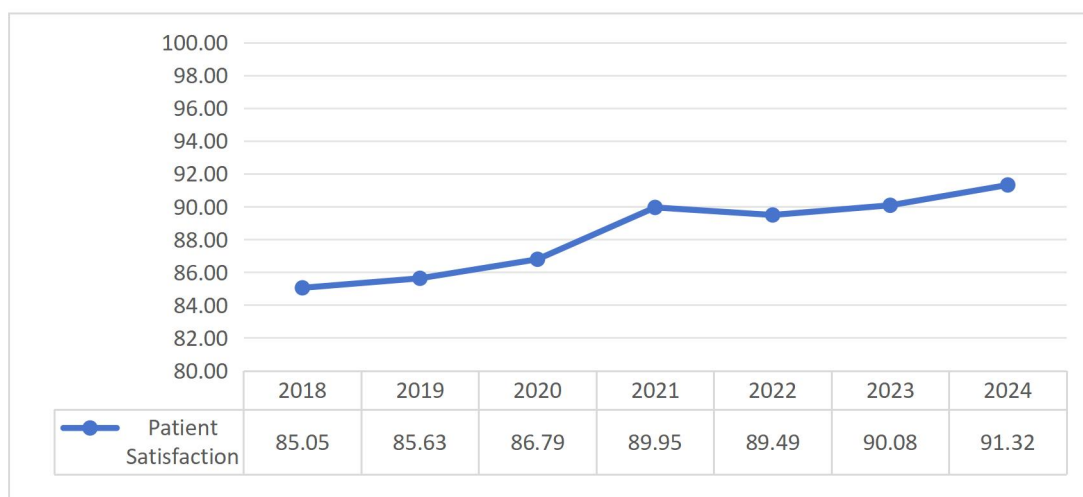


Figure 19. Results of Outpatient Satisfaction Surveys of STUMHC (2018 - 2024)

Overall satisfaction rose from 85.05% (2018) to 91.32% (2024); the 2022 dip did not fall below the 2021 level. Since 2023, feedback has highlighted limited appointment availability, yet parallel comments praise the patience and extended hours of child-and-adolescent specialists, indicating that quality gains coexist with capacity constraints.

Although there was a slight decline in 2022, it essentially remained at the same level as in 2021. In the detailed feedback from patients, starting from 2023, there were comments regarding the limited clinical appointments available for child and adolescent specialists and the difficulty in securing appointments, which persisted into 2024. Concurrently, there were also positive remarks about the patience and meticulous service of the child and adolescent specialists, as well as appreciation for their extended working hours.

Since the aforementioned survey includes all outpatient patients, to further understand the experience of school-age ADHD children and their families' experience with the child and adolescent psychiatry outpatient ADHD services, the STUMHC Core Team also collected ratings from the children's family members on their service experience during telephone follow-ups. Patients and their family members rated their service experience using a Likert 5-point scale, with a maximum score of 5 points. The average score was calculated as the annual patient experience satisfaction score. Patients and their families were also invited to list

specific reasons for their satisfaction and dissatisfaction and to provide suggestions for improving service quality.

The survey results indicated that from 2021 to 2024, outpatient visitors' satisfaction with the ADHD treatment services for school-age children had shown an upward trend (Figure 20).

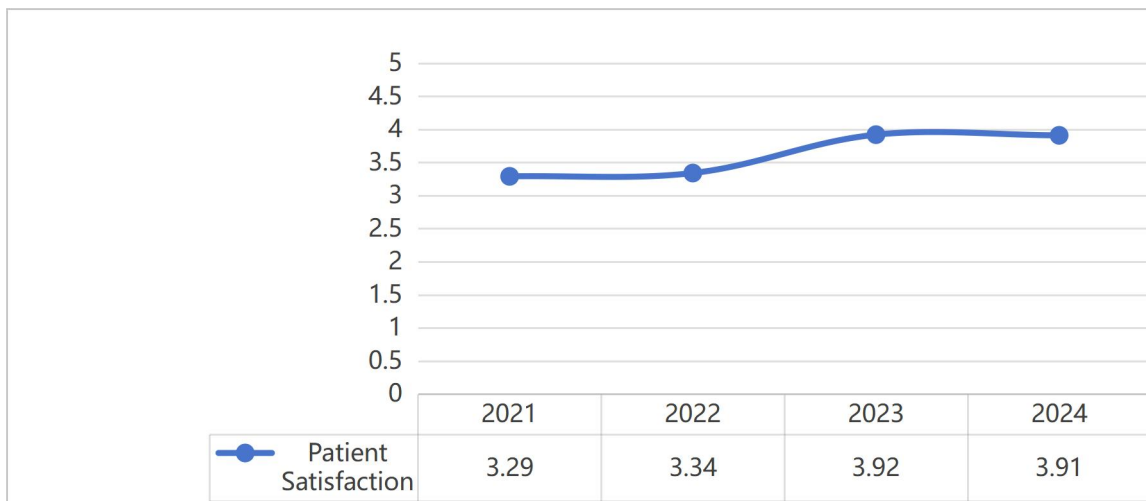


Figure 20. Results of Outpatient Satisfaction Surveys among 6-12 Years Old ADHD Outpatient First-visitors of STUMHC (2021 – 2024).

Mean satisfaction rose from 3.29 (2021) to 3.91 (2024). Qualitative feedback confirmed resolution of 2021 – 2022 requests for parent psychological support, parent/teacher education, and physician up-skilling (absent 2023 – 2024); yet persistent calls for insurance coverage, lower fees, shorter wait times, and extended consultation hours underscore ongoing economic and resource constraints.

Specifically, the 3 suggestions made in 2021 and 2022 regarding the need for “more psychological support for parents”, “ADHD health education for parents”, and “enhancement of physician professional levels” did not reappear in 2023 – 2024. Additionally, suggestions made in 2023 about “enhancing health education for teachers” and “improving the clinic environment” did not reappear in 2024. All of these suggested that improvements had been made in these areas of service. However, since 2022, there has been a continuous presence of feedback regarding “the desire for treatment to be covered by medical insurance”, “reducing fees to

alleviate financial burdens”, “decreasing waiting time for appointments”, and “extending doctor's consultation time”, indicating that economic and healthcare resources remain key areas of focus for improvement in the medical service model.

4.2.2 Innovation, Advantage, and Limitation in Service Enhancement

From the results above, it can be observed that following the implementation of the research, the ADHD treatment model at the STUMHC has made significant progress. Both team building and clinical service systems have seen a noticeable improvement compared to before the implementation of the research in 2018, bringing the local ADHD service model closer to the Manitoba service model.

Concurrently, the effectiveness of the treatment has been well ensured, the ADHD children's core symptoms declined while both their social function and their family environment improved. The intervention protocol demonstrated targeting specificity, producing significant improvements in specific assessment dimensions. These findings may inform subsequent intervention refinement and precision implementation. According to the feedback through telephone follow-up and the satisfaction survey, from the perspective of the patients and their families, the professional level of the core team, the group therapy, and the individualized treatment model in the STUMHC clinic were highly valued and gaining more and more advantage over the years. These indicated that the measures implemented in the study have achieved relatively satisfactory results in enhancing professional service capabilities and improving the variety of service offerings, which can meet the needs of local patients in Shantou. One of the innovative aspects of this study phase was the reference to the Manitoba model, which introduced new clinical services and models such as group therapy and individualized treatment model which included providing patients with a range of intervention options. And the positive feedback from patients and their families on these services suggested the success of the innovative implementation. However, the small sample size limited the credibility of some treatment-outcome evaluations; future studies should therefore enlarge the sample to verify the stability of the findings and enhance the

persuasiveness and impact of the research.

On the other hand, regarding the feedback about service experience that may require for improvement, the most frequently mentioned issues by patients and their families were the long distance to medical facilities, limited clinic availability, and extended waiting times, suggesting that in terms of service convenience, the new model has not yet met the expectations of the patients. To address this issue, potential future actions may include expanding the core team members, increasing outpatient service hours reasonably, and scheduling treatment times flexibly (such as arranging more intervention activities during school vacations) to better accommodate patients' needs. Moreover, strengthening collaboration with community clinics and enhancing the diagnosis and treatment levels of ADHD at the primary level are also potential directions for future action.

It was worth mentioning that in terms of advancing the coverage of ADHD treatment costs by the medical insurance in Shantou City, the team has also made efforts and achieved results. In 2023, the STUMHC Core Team provided materials and suggestions for the consultation and justification of including psychotherapy in the medical insurance for Shantou City. This provided significant evidence for the eventual implementation of the insurance coverage of psychotherapy in Shantou in 2024¹²⁶, which was an important part of non-medical treatment for ADHD. More discussion about the affordability of the service model will be presented in the next session.

5. Evaluation of the Service Model

As described above, after 6 years of implementation (including 2 years during the COVID-19 pandemic), the new service model for school-age children with ADHD has achieved good results in terms of treatment efficacy and service quality enhancement and has contributed to the improvement of local health policies such as medical insurance policies in Shantou City. However, in addition to establishing an effective service model, another purpose of this implementation study is to ensure that the model is feasible and scalable, applicable to other similar regions in Guangdong Province and across China, and can provide more references

and suggestions for health policy improvement. Therefore, we also analyzed and discussed the feasibility and scalability of this service model.

5.1 Feasibility and Scalability of the Service Model

According to the “*Guangdong Provincial Statistical Yearbook 2024*”, in 2023, the per capita disposable income of Shantou City residents ranked ninth among the 21 cities in the province, and the per capita consumption expenditure ranked 12th among the 21 cities in the province, both at a moderate level ¹²⁷. Therefore, the services implemented in Shantou City well should be able to possess the flexibility to be promoted upwards and adjusted downwards simultaneously. To determine the feasibility and scalability of this service model, economic costs and personnel costs of the model were evaluated.

5.1.1 Economic Costs

For evaluating the economic costs, the average cost per visit for ADHD patients of both across all-age groups and school-age group was calculated, and the annual cost per person was estimated based on the frequency of 1 follow-up clinic visit per month (see Figure 21-1-3 and Table 8-1-2 in Appendix).

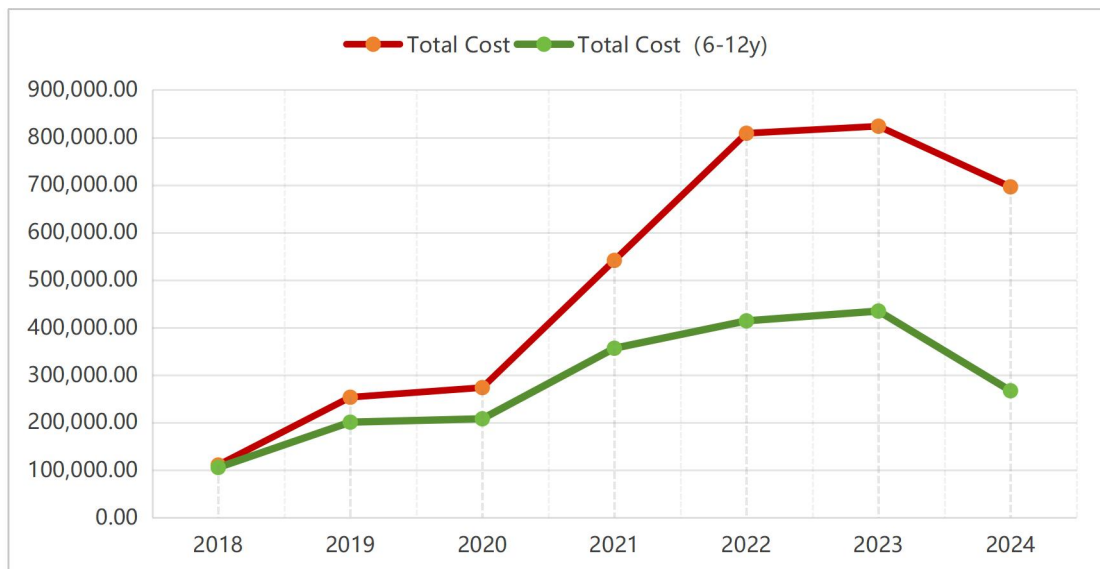


Figure 21-1. Total Cost of ADHD Outpatient Visitors in STUMHC (2018 – 2024)

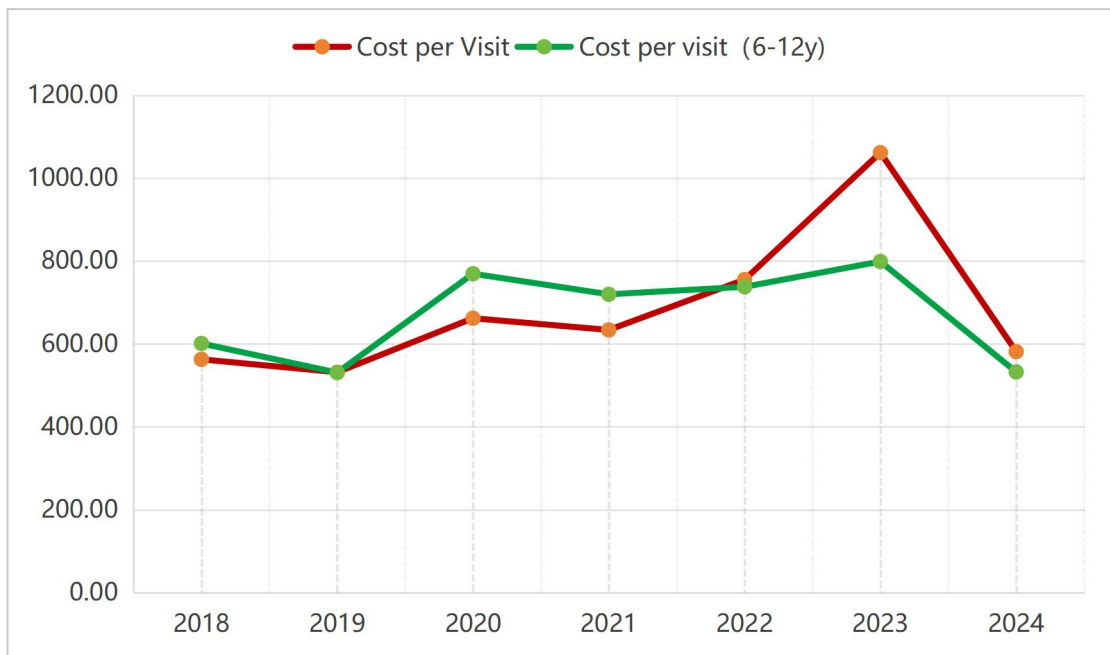


Figure 21-2. Cost per Visit of ADHD Outpatient Visitors in STUMHC (2018 - 2024)

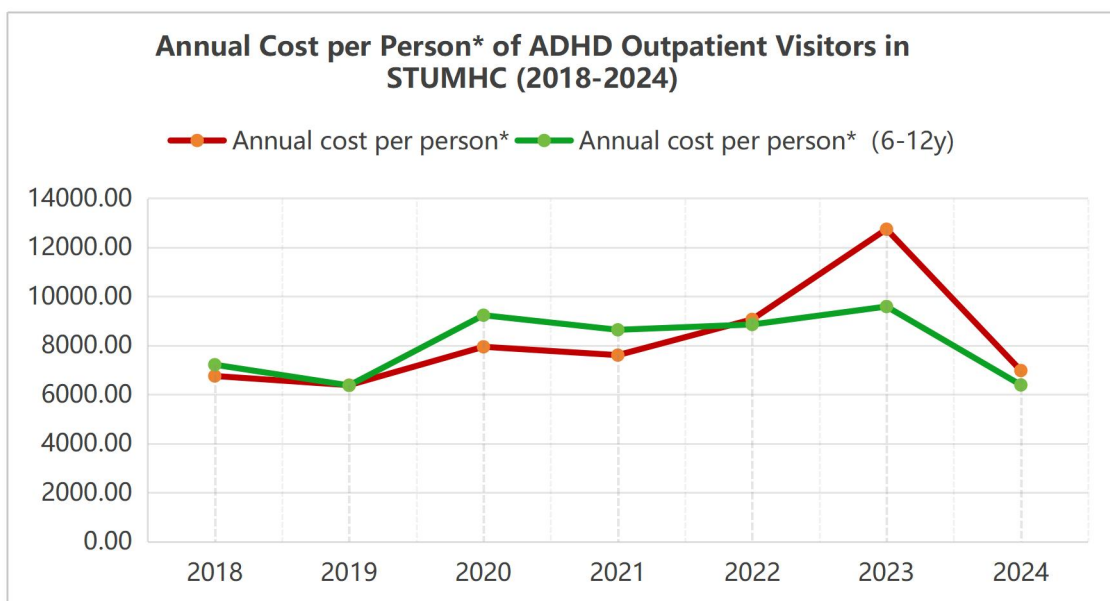


Figure 21-3. Cost per visit of ADHD outpatient visitors in STUMHC (2018 - 2024).

The “annual cost per person” is calculated as 12 visits per year (1 visit each month). Figure 21-1 displays total costs for all ADHD outpatients (red line) and for the 6- to 12-year subgroup (green line); Figure 21-2 shows cost-per-visit, and Figure 21-3 annual cost-per-person (12 monthly visits) for both groups. Across all metrics, the school-age subgroup mirrors the all-patient trend: steady increases to a 2023 peak, followed by a sharp 2024 decline coinciding with generic-atomoxetine introduction and expanded

insurance coverage, while the level of decline of the subgroup is less than the general group.

The results indicated that for both the all-age and school-age ADHD patients, the total cost of diagnosis and treatment, as well as the cost per visit and annual costs gradually increased from 2018 to 2023, with a significant decrease in 2024. Starting from 2022, the average cost per visit and annual costs for school-age children were lower than those for the all-age group, with this disparity reaching its peak in 2023, but significantly narrowing in 2024. The introduction of new treatment methods that gradually increased since 2019 can explain the rise in costs. However, two significant changes in 2024 led to a substantial reduction in ADHD treatment costs: the withdrawal of the original drug atomoxetine from the Chinese market and the full implementation of domestically produced medications, which caused the cost of atomoxetine medical treatment to plummet to one-tenth of the original value; additionally, the inclusion of psychotherapy in medical insurance reimbursement policies (800 CNY per year). Consequently, the reduction in out-of-pocket expenses for both pharmacological and non-pharmacological treatments for dual patients ultimately led to a decrease in overall costs.

The trend of changing in costs indicates that, comparatively, the reduction in atomoxetine costs had a lesser impact on the costs for the school-age patients than on the all-age patients. This suggested that adolescents and adult ADHD patients use atomoxetine for pharmacological treatment more frequently and in greater quantities than school-age children, which aligns with the recommendations for pharmacological treatment of adult ADHD in the Chinese ADHD treatment guidelines. This once again confirmed the standardization of the STUMHC Core Team's clinical practice.

So, is this cost a bearable economic expenditure for the residents of Shantou City? Referring to the “*Shantou Statistical Yearbook 2024*”, the per-capita disposable income in Shantou City was 24,428 CNY in 2018 and 33,653 CNY in 2023, 34,847 CNY in 2024; the per-capita medical and health care expenditure was

820 CNY, 942 CNY and 1,435 CNY in the same years, respectively, while the per-capita expenditure on education, culture, and entertainment was 852 CNY, 958 CNY, and 1,871 CNY, respectively ¹²¹. It was evident that the annual cost per person for ADHD treatment constituted a significantly high proportion of the per-capita disposable income. On the other hand, even if the costs associated with ADHD were included in both educational-related expenses and medical expenses due to the close relationship between the severity of ADHD and academic performance, the annual cost of treatment per person still significantly exceeds the sum of these 2 categories. However, it can be observed that in 2024, the per capita expenditures on medical care and education, culture, entertainment by the residents of Shantou increased significantly compared to previous years, while the cost of disease treatment decreased. In fact, due to the vigorous promotion of new medical insurance policies within Shantou in 2024, the costs for the diagnosis and treatment of various diseases have been reduced compared to the past, while the per capita expenditure has increased. This indicated that the public may be more able to afford health services, and the demand for health services is growing in importance, with increased utilization of medical services compared to previous years. This could also be found in the ADHD service in this study.

Looking at the provincial data from Guangdong Province in Table 14, according to the “2024 Guangdong Provincial Economic and Social Development Statistical Bulletin”, the per capita disposable income of the province's residents in 2024 was 51,474 CNY, with per capita medical and health care expenditure at 2,310 CNY, and per capita expenditure on education, culture, and entertainment at 3,962 CNY, all significantly higher than the levels in Shantou during the same period ¹²⁸. It can be inferred that the overall affordability of implementing services following the same model within Guangdong Province should be higher than in Shantou. Looking into certain cities, this model should be undoubtedly more easily implementable in cities with higher living standards in Guangdong, such as Guangzhou, Shenzhen, and Zhongshan ¹²⁸. However, can it maintain at least the same or similar level of feasibility and scalability in areas with a lower standard of

living than Shantou? When focusing on cities with a lower standard of living than Shantou, such as Shaoguan in northern Guangdong (ranking 10th in per capita disposable income among the 21 cities), Yunfu in western Guangdong (ranking 20th in per capita disposable income among the 21 cities), and Jieyang in eastern Guangdong (ranking 21st in per capita disposable income among the 21 cities), we can find that their per capita expenditure on medical and health care and education, culture, and entertainment was not lower than Shantou in 2023 (See Table 14) ¹²⁸. Therefore, promoting this service model in areas with a lower standard of living should be acceptable, and would not impose additional economic burdens on the local residents.

Table 16. Selected Cities' Per Capita Disposable Income and Specific Expenditure Situations in Guangdong Province (2023)

Per Capita Disposable Income Ranking	City	Per Capita Disposable Income (CNY)	Per Capita Health Care Expenditure (CNY)	Per Capita Education, Culture, and Entertainment Expenditure (CNY)
1	Shenzhen	76910	2513	5034
2	Guangzhou	74837	2583	6056
6	Zhongshan	62379	2642	4010
9	Shantou	33653	942	958
10	Shaoguan	32966	1739	2409
20	Yunfu	27188	1317	1611
21	Jieyang	25797	949	1477

Note. This table presents financial report data aggregated from representative cities across eastern, central, northern, and western regions of Guangdong Province, sourced from “*Shantou Statistical Yearbook 2024*”¹²¹ and “*2024 Guangdong Provincial Economic and Social Development Statistical Bulletin*”¹²⁸. The per capita disposable income of Shantou ranks at the upper-middle level within the province; however, its per capita expenditures on healthcare and the per capita education, culture, and entertainment are comparatively lower than other cities. Given that comprehensive ADHD intervention is associated with these two expenditure categories, the affordability of this service model for Shantou residents suggests its economic viability and acceptability across other cities in the region.

5.1.2 Personnel Costs

The personnel costs of the service model were calculated by
$$\frac{\text{Child and Adolescent Mental Health Care Specialists}}{\text{local Child and Adolescent Population}} \text{ (per 100,000 0-14 years old population).}$$

According to geographical location, the STUMHC is situated on the edge of Longhu District, close to Jinping District. As observed in the previous statistical results, the majority of outpatient visitors were patients from Longhu and Jinping Districts. Therefore, based on these two areas, the ratio of child and adolescent mental health care specialists per 100,000 0-14 years old population (which is considered as the “child and adolescent client” age group) was calculated.

According to the results of the seventh national population census in Guangdong Province in 2020, the population aged 0 – 14 in Shantou accounts for approximately 22.28% ¹²⁹. Based on this proportion, the permanent population in Jinping and Longhu districts in 2023 was about 1,427,000 ¹²¹, which means that the population aged 0 – 14 in these 2 areas was approximately 317,000. So the

personnel costs of this service model is
$$\frac{11}{31.7000} \approx 0.35 \text{ (per 10,000 0-14 years old population)}$$

This still falls far short of the 1.14 per 10,000 0-14 years old population standard in the United States in 2018 ¹³⁰, but is significantly higher than the national average in China in 2018, which was 0.002 per 10,000 0-14 years old population (calculated based on 500 professionals for a population of 220 million) ¹³¹. Even when considering only child and adolescent psychiatrists included, with 317,000 children aged 0 – 14 having 4 child and adolescent psychiatrists, this amounts to approximately 0.13 child and adolescent psychiatrists per 10,000 children, which is also higher than the national level in 2018.

It is important to note that the child and adolescent psychiatrists in this data not only treat ADHD but also handle the diagnosis and treatment of other mental health disorders among children and adolescents in the region. Therefore, if the team were dedicated exclusively to serving children with ADHD, its service

capacity could be further enhanced. Yet this also highlights, from another perspective, the current constraints on the team's service capability.

At this point, this implementation study has successfully completed a full cycle of service model design, multidisciplinary team building, service delivery, and outcome evaluation, establishing a comprehensive ADHD mental health service delivery model tailored to the needs of medium-sized cities in China. Drawing on all empirical data and findings, the following discussion provides a holistic evaluation of this work, examining its innovations, strengths, and limitations, followed by targeted recommendations for ADHD-related health policy in China and directions for future sustained research.

6. Discussion

6.1 Innovation and Limitation of the Service Model

6.1.1 Innovation

The first innovation of this study lies in its comprehensive and holistic research perspective. Since 2018, growing national attention to child and adolescent mental health—coupled with the rollout of the “*Healthy China 2030 Action Plan*”—has prompted an increasing number of Chinese cities and regions to launch ADHD-related intervention and treatment initiatives¹¹⁰. For example, in 2019, Jin Xingming and Yu Dongchuan in Shanghai published the book “*Standardization of Attention Deficit Hyperactivity Disorder Outpatient Clinic Construction and Standardized Management*”, offering a blueprint for establishing standardized ADHD clinics nationwide¹²²; in 2024, Yang Letian, Hong Danping, and colleagues in Guangzhou conducted a randomized controlled trial demonstrating the efficacy of attention and emotion-regulation training for children with ADHD¹³²; in 2020, Yao Zheng reported that the heritability of ADHD symptoms in Chinese youth increases significantly with age (weak in early childhood, strong in middle childhood), while shared environmental influences wane. Compared with Western populations, shared environmental factors such as family and community play a more prominent role, whereas genetic influences are relatively smaller¹³³. Meanwhile, professional teams from several medical institutions in China

conducted research to evaluate the efficacy of multiple ADHD assessment tools and treatment modalities, providing additional evidence base for clinical practice¹³³⁻¹³⁹. Nevertheless, these studies address only isolated aspects of ADHD healthcare, none of which has taken the comprehensive approach adopted in the present study — namely, simultaneously building professional capacity, constructing referral networks, implementing health education, and standardizing diagnosis and treatment — to articulate how an effective and culturally sensitive service system can be established in China from a holistic perspective.

The second innovation of this study is the indigenization of the service model. As an implementation study, although this research referenced the successful and mature ADHD mental health service model of Manitoba, Canada, it did not simply replicate the Manitoba model. Instead, it conducted in-depth adaptations based on the cultural characteristics and mental health service system features of Shantou, Guangdong, China, to meet local needs, ensuring its effectiveness and scalability. For instance, in the absence of social workers, psychiatrists were designated as the primary coordinators and case managers; in terms of clinical interventions, resource-intensive projects were excluded, while non-pharmacological interventions with higher local acceptability were prioritized. At the same time, measures from Canada, which were also strictly implementable and effective in Shantou — such as building a multidisciplinary team, adhering to individualized comprehensive treatment, and developing guidance manuals for parents and teachers — were faithfully executed by the STUMHC Core Team to insure the benefit outcome for the ADHD patients. This indigenization process was accomplished by the research team through the use of a quality-management tool — the innovative Quality Function Deployment (QFD) circle — thereby further validating the important role of QFD tools in the implementation of construction of mental health service models.

The third innovation of this study is the development of a comprehensive and effective training program for professionals. Drawing on the Manitoba model's role-specific competencies of multidisciplinary team members, the STUMHC core

team designed and implemented a tiered training curriculum that spans specialists in psychiatric hospitals, pediatricians in general hospitals, and staff in community mental health agencies. This represents the first initiative in China to offer such a diverse, wide-reaching training program within an implementation study. As the study progressed, the impact of training became evident through increased outpatient ADHD caseloads, effective operation of the referral network, and higher patient satisfaction with and trust in professionals. During the study period, 3 psychiatrists who completed training at the hospital moved to other cities and regions to specialize in child and adolescent psychiatry, further demonstrating the effectiveness of the training program. The competencies acquired by these professionals extended beyond ADHD diagnosis and treatment to encompass the management of common disorders in child and adolescent psychiatry. These outcomes also underscored the scalability and generalizability of the training model used in this study.

The fourth innovation of this study is the development of a localized health-education model. Drawing on the parent- and teacher-toolkit components of Canadian ADHD clinical guidelines and integrating recommendations from Chinese ADHD practice parameters with survey-derived parental needs and Chaoshan cultural characteristics, the STUMHC core team produced a suite of educational resources in multiple formats, including teacher workshops, parent seminars, and dialect-language multimedia materials. These resources comprise standardized slide sets, training curricula, and professionally recorded audio-visual clips that have been culturally adapted for China (e.g., emphasizing the impact of attention deficits on academic performance and rule compliance for education-focused parents and teachers; providing explanations about ADHD in the local Chaoshan dialect to ensure comprehension by older caregivers with limited Mandarin proficiency). Iterative implementation during the study period yielded positive outcomes; several videos disseminated online have received favourable feedback from viewers across Guangdong, Beijing, Jiangsu, Shanghai, and other provinces, indicating their potential applicability nationwide.

6.1.2 Limitation

Although the present study introduced several innovations and achieved favorable outcomes, it is not without limitations.

Regarding team composition, the multidisciplinary team in STUMHC assembled for this study comprised psychiatrists, psychotherapists, and psychological assessors, but still lacked key personnel such as nurses, social workers, and other professionals. Nurses are indispensable members of a mental-health service team and play vital roles in case management, health education, and daily care. During the study, the implementation operated exclusively within a child-and-adolescent psychiatry outpatient clinic, and the hospital did not allocate dedicated nursing staff for sub-specialty outpatient clinics. In this case, nursing professionals were not included in the STUMHC Core Team. Meanwhile, the absence of social workers in the STUMHC Core Team led to an undermined capacity for case management and resource linkage. Although psychiatrists assumed these responsibilities after role reallocation, their heavy workloads and limited availability yielded less optimal outcomes than would be achieved with full-time personnel. Moreover, because the primary functional impairment of ADHD concerns learning, and to improve patient's academic performance is a chief reason causing the Chinese ADHD patients to seek help, a team composed chiefly of medical professionals, as that in the study, can offer only limited assistance in this domain. Including educational specialists who could provide timely pedagogical guidance in the team would markedly increase both the efficiency and the effectiveness of the team's work. However, these gaps should be resolved in the near future: in 2026, the STUMHC will open a child-and-adolescent psychiatric inpatient unit, and a sub-specialty team including nurses and medical social workers will be formed. Staff assigned to the ward will then be able to participate in the comprehensive ADHD mental-health service, thereby strengthening the team's composition and capacity.

The COVID-19 pandemic exerted destabilizing effects on social life in China from 2020 to 2022, including disruptions to face-to-face medical visits, group

interventions, and training activities, which significantly impeded the progress of this study. Consequently, the research spanned an extended duration with uneven workflow, and data from certain years (e.g., the years 2020 and 2021) exhibited extreme values or anomalous fluctuations. Although these observations were addressed as outliers in the results analysis, they nonetheless introduced limitations to the study. These experiences underscore the necessity of incorporating contingency protocols for emergent circumstances—such as pandemics and natural disasters—into future service model development. Potential strategies include expanding remote intervention modalities leveraging internet and smart device technologies to enhance the accessibility and continuity of ADHD mental health services.

Regarding the evaluation of research findings, the limited sample size and potential selection bias in the satisfaction survey may have exerted certain influences. The small sample size in this study limited the precision of effect estimation. Subsequent research may be improved through the following strategies: 1) conducting power analyses based on the large effect sizes observed in this study to expand sample size and enhance statistical power and estimation precision; 2) employing randomized controlled designs with parallel control groups to control for confounding factors such as time effects and natural recovery; 3) expanding research centers and participant sources to improve sample representativeness, and 4) extending follow-up duration and incorporating repeated measurements to verify the sustainability of intervention effects. To ensure further sample collection, solutions targeted to the insufficient completion of case-management and linkage tasks mentioned above as well as to the residents' conservative—or even resistance—toward participating in research and being “study subjects” in local Chaoshan cultural attitudes must be presented. We believe that this situation can be improved in future research by optimizing team building and strengthening health education.

This study employed telephone interviews and questionnaires to assess patient satisfaction, which may have introduced selection bias. Non-response bias likely

arose from patients who could not be contacted, declined participation, or experienced difficulty completing the survey. Voluntary response bias may have occurred as patients with higher compliance and stronger communication skills were more readily included. Additionally, telephone and questionnaire assessments relied on retrospective recall, yielding a biased sample toward individuals with clear memory and articulate expression; furthermore, memory bias among respondents may have compromised the accuracy of the results.

To mitigate these biases, subsequent research may implement the following strategies: 1) conducting multitimepoint, multichannel follow-ups to improve response rates; 2) employing stratified random sampling to enhance sample representativeness; 3) standardizing survey procedures and implementing third-party anonymous data collection; and 4) objectively delineating the applicable scope of research conclusions to improve reliability and generalizability.

6.2 Prospective of the Service Model

The fundamental value of implementation research lies in its capacity to identify problems during the research process, refine practical outcomes, accelerate multidisciplinary integration, and furnish policy makers with evidence to guide decision-making, thereby advancing the field. The present findings may speak to 2 questions: 1) how to better promote the development and dissemination of the ADHD mental health service model in China, and 2) how national policies can provide stronger support for mental-health services for children with ADHD.

6.2.1 The Promotion of Development and Dissemination of ADHD Mental Health Service Model in China

This implementation study demonstrates that in the City of Shantou, more precisely, the model radiates outward from a central core comprising Longhu and Jinping Districts to cover the entire Shantou municipality. The ADHD service contact coverage was significantly increased, and the local ADHD patients within the STUMHC referral network were guaranteed access to standardized, effective care by simultaneously building a multidisciplinary team, establishing a referral network, conducting public education, and delivering integrated clinical services.

Whether this model can be replicated in other parts of Guangdong—or elsewhere in China—appears promising. As analyzed in Sections *Feasibility and Scalability of the Service Model* and *Innovation and Limitation of the Service Model*, the cost of receiving comprehensive service from the multidisciplinary team is affordable across areas with different economic profiles in Guangdong, and the trained child and adolescent psychiatrists can function effectively in other provincial regions, attesting to the scalability and generalizability of the professional-training component.

6.2.1.1 Implications for Team Building

It should be noted, however, that practical experience in this study reveals a clear ceiling on what a single specialized team can deliver. The research data about group service load reveal a clear ceiling effect. During the first half of the implementation period (2018–2021), the numbers of first-visit 6- to 12-year-old ADHD patients rose steadily (with some visitors in 2021 being considered to belong to a group of delayed visitors from 2020 by COVID-19), but from 2022 to 2024, the annual counts of the same patient group were plateaued at 110–126 without further increase. This plateau does not indicate saturated community demand; rather, patient-satisfaction surveys consistently report long waiting times and difficulty securing appointments, providing a decisive negative answer. The evidence suggests that, fueled by public-education campaigns, media coverage, improved social awareness, and word-of-mouth, local demand for ADHD mental-health services continues to grow, whereas the team’s service capacity has reached saturation.

To address this issue, two remedies are available: 1) increase the proportion of clinician time devoted specifically to ADHD, or 2) expand the overall child-and-adolescent psychiatric workforce. Because ADHD is only one component of these specialists’ caseloads—who must also serve children and adolescents with autism-spectrum disorders, tic disorders, anxiety and mood disorders, intellectual disability, and other conditions—option 1 would inevitably reduce access to those other services. Given the documented, continuing rise in the prevalence of child

and adolescent mental disorders, workforce expansion is clearly the preferable solution. Our experience also underscores the need for a more diverse and multidisciplinary team composition. Specifically, the inclusion of child and adolescent psychiatric nurses, medical social workers, and education specialists would allow for finer, standardized role delineation, thereby improving both service efficiency and effectiveness while simultaneously enhancing patient experience. For example, at STUMHC, the proportion of outpatient visits by patients under 18 years of age has risen rapidly—from 7.26% in 2019 to 16.31% in 2024. In line with the hospital’s strategic plan, the existing child and adolescent psychiatric outpatient service (currently 2.5 sessions per week) is scheduled to expand to 5 sessions per week — i.e., a doubling of current capacity. This will require twice as many psychiatrists, 0.5 times more psychotherapists and psychological assessors, and one additional nurse, increasing the child and adolescent mental health team by 9 professionals to a total of approximately 20 staff members in order to meet projected service demand.

6.2.1.2 Implications for Referral Networking

Nevertheless, expanding the size of the regional core team alone is insufficient to guarantee increased service-contact coverage nor improved regional ADHD diagnostic and treatment standards. Consequently, an effective referral network such as the one described in this study is essential. It extends ADHD services into the community, enabling residents to undergo screening and receive treatment for uncomplicated cases in a relatively convenient manner, while more complex or severe cases are referred upward to specialty hospitals served by the comprehensive team. This arrangement aligns with China’s current health-system reform agenda, which mandates that tertiary hospitals lead the formation of medical consortia that would establish collaborative, tiered relationships with community health centers and community clinics. Within the medical consortium, two-way referral pathways must be streamlined, service continuity between community and tertiary institutions must be strengthened, and a hierarchical diagnosis-and-treatment system must be

implemented — community first contact for routine care, referral upward for complex or acute conditions, and referral downward for recovery or chronic-disease management — supported by tertiary hospitals providing priority access and technical guidance. The referral network evaluated in this study, although without a formal medical consortium, demonstrates that such a model is feasible and can be replicated in municipalities across the country. In the future, medical consortium focusing on child and adolescent mental health service may be established by the STUMHC for further expanding the referral network and enhancing the quality of referral services.

6.2.1.3 Implications for Public Education

Public-oriented ADHD education and awareness campaigns are also crucial for increasing service-contact coverage. Community residents must understand what ADHD is, why treatment is necessary, whether it can be treated, and where relevant medical resources are located; only then will those in need be guided to seek mental health care proactively and appropriately.

The health-education materials developed in this study are comprehensive in scope and broad in reach. Drawing on Canadian dissemination experience and adapting content to the Chinese context, the STUMHC core team tailored key messages to the distinct needs of teachers, parents, and children. Materials were delivered via the internet, schools, communities, television, radio, and print, achieving city-wide coverage across all districts and counties of Shantou. Mandarin-language online and broadcast content extended beyond Guangdong Province, receiving high levels of acceptance and positive feedback. Segments focusing on ADHD clinical features and treatment options are highly generalizable and suitable for nationwide dissemination.

The present study demonstrates that health education programs delivered in the local Chaoshan dialect were exceptionally well-received by older generations, particularly grandparents of children in need of care. In the Chaoshan region, where multi-generational living arrangements are common and grandparents hold substantial decision-making authority within the family, their attitudes and beliefs

strongly influence families' willingness to seek professional assessment and treatment for children. Many parents in this study reported that they had long intended to seek professional care but faced persistent resistance from grandparents. Notably, after listening to dialect-based health radio programs, more older adults developed improved awareness of children's health conditions and became supportive of, and even proactive in, seeking formal clinical services from "the clinicians featured in the broadcasts".

These findings highlight the critical role of linguistically and culturally appropriate health communication in reducing barriers to care. The current study adds to the growing body of evidence that reliance solely on standardized Mandarin may create significant inequities in health information access, especially for older adults with limited proficiency in the national language. By delivering health education in the local dialect, this approach effectively reduces language barriers, enhances understanding among all family members, strengthens intergenerational consensus, and promotes timely and appropriate care-seeking.

From a health equity and translational perspective, the findings of this study have important implications for practice and policy. The use of regionally specific dialects represents a feasible, scalable, and culturally responsive strategy to improve health literacy, engage historically marginalized or less reachable groups, and reduce disparities in access to accurate health information. This study demonstrates that culturally adapted, dialect-specific health media can serve as a trusted and effective bridge between communities and formal healthcare services. Therefore, integrating local dialects into routine health education and public health campaigns is not only beneficial but essential to achieving equitable health communication, supporting family-centered decision-making, and improving access to care for vulnerable populations in linguistically diverse settings.

Notably, these public-education efforts also raised the STUMHC Core Team's profile. Coupled with team members' strong clinical expertise, they generated noticeable impact among patients. For example, 2 psychiatrists in the team were listed in the "Mainland China Clinicians and Institutions Able to Diagnose Adult

ADHD and ASD” published by “Qingshan”, one of the largest “double-A (ASD and ADHD)” mutual-support social-media platforms in China. Patients have shared their clinic visit procedures and experiences via this outlet. Since 2024, first-visit adult ADHD cases in STUMHC outpatient clinic have risen markedly, with most reporting that they decided to attend after reading posts on this platform. In the era of booming social-media platforms, future health-education initiatives must also leverage the influential role of user-generated content.

6.2.1.4 Implications for Further Refinement

Beyond the insights gained from successful practices, this study also identified shortcomings in the current ADHD mental-health service model in Shantou, as well as points to directions for future improvement. In addition to the team-building and two-way referral improvements noted above, several issues raised in patient-satisfaction surveys and telephone follow-ups point to other areas of the service model requiring refinement.

Broadly, concerns voiced by ADHD patients and their families centered on two domains: treatment cost and convenience of accessing mental health services. Although adjustments to insurance coverage and reductions in medication prices have been implemented, the cost component is largely tied to national medical-insurance policies and will be analyzed in the next section; the convenience of service access, however, merits closer examination here.

To address complaints about long appointment waiting times and requests for additional clinic hours, future plans include expanding the team and adjusting service schedules, for example, offering weekend and holiday clinics tailored to children and adolescents’ timetables. Yet an internal audit of STUMHC shows that the routine child and adolescent outpatient appointment waiting time is currently 2–4 weeks, while the average wait for psychotherapy is about 1 month. Compared with waiting times reported in North America—1 to 4+ months for psychiatric and approximately 1 month for psychological appointments in Canada, and 1.5 to 3 months for child psychiatry plus 2 to 8 weeks for psychotherapy in the United

States—these intervals are not excessive. Meanwhile, in metropolitan areas such as Guangzhou, Shanghai, and Beijing — where child and adolescent psychiatric resources are relatively well developed — waiting times for specialist outpatient appointments range from 2 to 4 weeks, while waiting times for psychotherapy appointments range from 3 to 6 weeks, which is essentially equivalent to the waiting times observed in Shantou. Therefore, patient feedback regarding excessively long waiting periods may be related to local health-seeking habits and expectations. Mental health care has unique characteristics, requiring longer duration and cycles compared to other specialties. It is necessary to enhance the public awareness of these aspects and adjust their expectations regarding reasonable waiting times. On the other hand, the service model could introduce the concept of tiered appointments, conducting pre-visit assessments at the time of patient scheduling, and adjusting appointment waiting periods based on the severity of the condition to ensure that patients with urgent and severe conditions receive timely treatment. When face-to-face clinical services cannot meet patient demand, telemedicine technologies such as internet-based platforms, multimedia tools, and AI techniques can be integrated into the service model. These innovations enhance treatment convenience for patients while simultaneously reducing the workload of clinical staff.

Another critical consideration when implementing the new ADHD mental health service models is cultural variation. In this study, identical outreach strategies yielded markedly different attendance numbers of clinic visitors across administrative districts within the same city—underscoring that cultural differences are magnified across cities and provinces. Whether the task is public education, service delivery, or treatment planning, cultural competence and individualized, comprehensive care must guide every step. For example, in regions where parents juggle multiple children and prioritize behavioral compliance over academic achievement, services should emphasize parenting-support resources and target behavioral management rather than scholastic improvement. Developing and flexibly deploying culturally adapted service strategies is therefore an essential

direction for future refinement of the new ADHD mental health service models.

6.2.2 Recommendations for Government Policy Formulation

A core objective of implementation research is to generate evidence that informs policy, thereby driving systemic and legislative improvements. The findings of the present study yield actionable reference points for both concrete recommendations for medical-insurance policy and national mental-health strategic goals.

6.2.2.1 Recommendations for Medical-Insurance Policy

Medical-insurance policy affects 2 constituencies simultaneously: patients' rights and hospital operations. Throughout the implementation period, the STUMHC Core Team continually received patients' feedback concerning treatment costs, regarding "the desire for treatment to be covered by medical insurance", "reducing fees to alleviate financial burdens" and so on. As mentioned in 5.1.1, despite official adjustments to insurance coverage and reductions in medication prices in 2024, the annual cost of around 6,000 to 7,000 CNY per person for ADHD treatment in STUMHC constituted a significantly high proportion of the per-capita disposable income in Shantou ^{121, 127}. In Shantou, the resident medical-insurance reimbursement cap for general outpatient treatment is 100 CNY per person per month, with an annual ceiling of 505 CNY. For specific diseases — such as schizophrenia, hypertension, and diabetes—monthly special allowances range from 300 to 1,000 yuan. ADHD is not classified as a "specific disease" and is therefore reimbursed under the general outpatient benefit. Given its chronic course and potential for serious social impairment, ADHD requires long-term treatment that can impose a substantial financial burden on families. Accordingly, policy makers should consider designating ADHD a chronic psychiatric condition eligible for the special outpatient reimbursement schedule. Given the 2024 cost reduction from 9,584.99 CNY to 6,388.81 CNY post-insurance changes, designating ADHD as a "specific disease" could further reduce burdens by 50%, which would be about 3194 CNY, considering it to be more affordable with a per capita disposable income of 33,653 CNY ^{121, 127}.

Regarding commercial insurance, ADHD outpatient treatment is not widely covered in mainland China. Only a few high-end medical plans provide partial reimbursement, and only when 1) no ADHD-related history exists prior to enrollment, 2) an optional outpatient rider is purchased, and 3) visit-frequency or monetary caps are accepted. Families with an existing ADHD diagnosis are effectively excluded from outpatient benefits under mainstream commercial products. Households without a diagnosis but with foresight may purchase qualifying high-end plans, yet must carefully weigh product restrictions against premium costs. To strengthen commercial insurance as a complement to national medical insurance and to support patients' access to mental health care, we recommend that the China Banking and Insurance Regulatory Commission and the National Healthcare Security Administration jointly issue ADHD-specific commercial health-insurance guidance. Such guidance should: 1) define reimbursable outpatient services (including pharmacotherapy and psychological interventions), 2) prohibit blanket exclusions of ADHD under generic “mental-illness” clauses, and 3) eliminate restrictive pre-existing condition requirements such as “no prior outpatient visit”. Mid-tier products should be encouraged to include basic ADHD outpatient coverage, while high-end plans could extend to family therapy, social-skills training, and other evidence-based interventions. Clinically stable, previously diagnosed cases should also qualify for coverage with an appropriate premium surcharge. These measures would reduce patients' out-of-pocket costs, ensure access to individualized comprehensive mental health care, and provide hospitals with sustainable revenue to maintain and expand full-spectrum ADHD services.

6.2.2.2 Recommendations for National Mental-Health Strategy

Although recent national policies have emphasized the development of pediatrics and psychiatry, documents such as the “*National Programme for Child Development (2021 – 2030)*” and the “*Guidelines on Strengthening and Improving Mental Health Services*” only specify “1.12 pediatricians (including assistant

pediatricians) per 1,000 children”, while “pediatricians” refers to general pediatricians only and does not include specialized “child and adolescent psychiatrists”^{140, 141}. Likewise, the target of “56,000 psychiatrists by 2025 nationwide (4.0 per 100,000 population)” refers to the entire psychiatric workforce and does not differentiate between adult and child and adolescent sub-specialties^{140, 141}; it therefore cannot be used to infer the specific staffing needs of the child population. The present implementation study may thus provide empirical reference for formulating such targeted indicators.

As discussed in the Personnel Costs session, the personnel costs of this service model are 0.35 general child and adolescent mental health specialists per 10,000 0-14 years old population, with 0.13 child and adolescent psychiatrists per 10,000 0-14 years old population. Given that this team is responsible for the operation of the entire Child and Adolescent Psychiatry outpatient service and also undertakes the diagnosis and treatment of various other mental illnesses in children and adolescents, this data can therefore be applied as a reference value for the number of regional child and adolescent psychiatrists and other professionals. As revealed by the study, the service volume that this team size can provide has approached saturation, yet it still fails to meet the current mental health needs of children and adolescents aged 0 – 14 in the region. Therefore, the currently planned and more reasonable size of the child and adolescent psychiatric specialty team may be 20 child and adolescent mental health specialists (including 8 child and adolescent psychiatrists). According to the formula, the reference value after expanding the team size can be obtained as 0.63 general child and adolescent mental health specialists per 10,000 0-14 years old population, with 0.26 child and adolescent psychiatrists per 10,000 0-14 years old population. Therefore, a reasonable range for the personnel cost of child and adolescent mental health services in Shantou City is likely to fall between 0.35 to 0.63 general child and adolescent mental health specialists per 10,000 0-14 years old population, with 0.13 to 0.26 child and adolescent psychiatrists per 10,000 0-14 years old population. Whether the latter ratio is reasonable will, of course, require further longitudinal verification;

nevertheless, as discussed in Section 6.2.1.4, the lower-bound estimate still yields service waiting times that fall within an acceptable range. These figures can therefore serve as empirical reference points for regional child-and-adolescent psychiatric services and inform the formulation of more granular national targets for the number of child-and-adolescent psychiatrists.

On the other hand, unlike adult mental illness, the treatment of child and adolescent mental disorders usually requires comprehensive interventions that integrate pharmacological, psychological, family, and social approaches. Consequently, a multidisciplinary team comprising psychiatrists, psychotherapists, psychological assessors, nurses, social workers, and other professionals is essential. Relying solely on psychiatrists for diagnosis and treatment would markedly limit prognosis. National policy should therefore avoid targeting only child-and-adolescent psychiatrists; instead, it should incorporate manpower planning for all professional groups, strengthen training of qualified personnel—especially certified child-and-adolescent psychotherapists and medical social workers—and create corresponding employment opportunities while establishing industry standards (e.g., standardized training, examination, and certification). All of these should be able to ensure that children and adolescents receive more professional, comprehensive, and robust mental health protection.

Finally, mental health services for children and adolescents should not be confined to clinical facilities; instead, a tripartite collaboration among families, schools, and health care providers is essential to create an ecological environment that fosters healthy psychological development. For ADHD, a disorder that markedly disrupts classroom behavior and academic performance, integrated medical-educational management is particularly critical. During the initial phase of the study, we found that direct outreach from hospitals to schools was insufficient to secure acceptance of neither in-school education nor sustained collaboration with medical teams. Only after formal partnerships were established with district- and county-level education bureaus in Shantou did the medical-educational model operate smoothly. Consequently, inter-sectoral collaboration at the government

level plays a pivotal role in scaling this service model. We recommend that relevant governmental agencies — health department, education department, civil affairs department, and others — should jointly build a collaborative governance mechanism that dismantles sectoral silos and establishes a “medical-educational” case-management system, thereby achieving maximum impact with minimum effort.

7. Conclusion

In summary, the present study translated, culturally adapted, and implemented the Manitoba ADHD service delivery model to establish China’s first integrated, city-wide mental health service system specifically designed for school-age children with ADHD in a typical medium-sized urban setting. This work represents a pioneering effort to develop a comprehensive, practice-ready service delivery framework that is grounded in international best practices while being responsive to local health system structures and cultural contexts. The proposed model demonstrated strong feasibility and scalability, indicating that with modest cultural and structural adaptations, it can be readily replicated and scaled across other medium-sized cities in Guangdong Province and throughout mainland China.

By systematically evaluating service coverage, clinical outcomes, cost-effectiveness, and policy-relevant impacts, this project provides rigorous empirical evidence to inform the refinement of provincial and national health insurance policies, as well as the establishment of evidence-based, precision workforce planning targets for child and adolescent mental health services. These contributions are particularly timely given the growing national emphasis on early identification, integrated care, and service accessibility for pediatric mental health conditions.

Furthermore, given the shared core principles across many child and adolescent mental health conditions, the modular components of this model—including multidisciplinary team collaboration, stepped-care and tiered referral pathways, culturally adapted health education, and individualized integrated support—are highly transferable to other neurodevelopmental and

mental health conditions, such as autism spectrum disorder, tic disorders, and dyslexia, with appropriate contextual modifications. Future implementation research can formally examine and validate this cross-condition generalizability, thereby expanding the public health impact of the current framework.

Several limitations of this study, including incomplete role definition within multidisciplinary teams and a relatively modest evaluation sample, provide clear directions for continuous improvement in the next phase of research and practice. Notably, the current model was developed exclusively within an outpatient service structure. The upcoming launch of the STUMHC child and adolescent inpatient unit in 2026 will enable the expansion of this work into a full-chain, integrated “ward–clinic–community” implementation framework, which will generate further high-quality empirical evidence to advance the sustainable development of child and adolescent mental health services in China.

Collectively, this study advances both practice and policy by establishing a replicable, culturally responsive, and integrated service delivery model for school-age ADHD patients, with far-reaching implications for strengthening system capacity, reducing disparities, and paving the way for ADHD service scaling nationwide.

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Appendix

1. Tables

1.1 Design Process of the Service Model in Shantou

Table 1. Questions for semi-structured parent interview

Question		Dimension
1	What is your child visiting our clinic for?	Disease health knowledge
2	How much did you know about ADHD before coming to the clinic?	
3	Where did you obtain information about ADHD before coming to the clinic?	Resource acquisition
4	Where did you obtain information about our ADHD service?	
5	What is your child's treatment right now?	Medical service experience
6	How you feel about the treatment? (e.g., any concerns, expectations, treatment outcome so far...)	
7	What kind of service did you and your child receive, except medical/psychosocial treatment?	
8	How do you feel about our mental health service in general?	Shortcomings and suggestions

Note. This table presents the semi-structured interview guide developed by the investigators. The questions and their sequence were designed to elicit, from parents of

school-age children with ADHD, comprehensive information across all relevant dimensions of the local ADHD service landscape and unmet needs. Interviews captured parental perspectives on 4 domains: (a) disease health knowledge, (b) resource acquisition, (c) medical service experience, and (d) shortcomings and suggestions. These data allowed the researcher to understand the current status, strengths, weaknesses, and needs of ADHD-related services in Shantou from the perspective of the patients and their parents, thereby informing the indigenization of the Manitoba ADHD service model.

1.2 Team Building Implementation for STUMHC

Table 2. Summary of Team Training Implementation for STUMHC

Training Modality	Main Content	Targeted Position	Training Hours
Sub-specialty training	Clinical practice of C & A psychiatry including ADHD	Resident Psychiatrist	1 year
Thematic training	Diagnosis and treatment (medical and psychotherapy), psychological assessment of ADHD	Psychiatrist, Psychotherapist, Psychological assessor	≥18 hours per year
ADHD thematic workshop outside the hospital	The latest progress in the diagnosis and treatment of ADHD	Psychiatrist, Psychotherapist	≥12 hours per year
Thematic training for ADHD intervention outside the hospital	Diagnosis and treatment (medical, physical, and psychotherapy), psychological assessment of	Psychiatrist, Psychotherapist	≥7 days per year

	ADHD		
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Note. Beginning in 2018, all members—according to their specific roles in the team—completed a standardized curriculum delivered through in-house courses and external workshops to ensure mastery of: (a) evidence-based ADHD assessment and treatment, (b) multidisciplinary collaboration, and (c) teaching and public-education skills. This systematic training framework underpins the professional quality of services and training provided by STUMHC.

Table 3. Health education initiatives from 2019 to 2024

Year	Media & Online Lectures	District Teacher Training covered
2019	2	N/A
2020	2	N/A
2021	6	Longhu, Chaoyang
2022	4	Longhu, Chaoyang, Haojiang
2023	1	Longhu, Chaoyang, Haojiang
2024	3	Longhu, Haojiang

Note. N/A = not applicable (no teacher-training workshops conducted that year). The table documents the stepped expansion of district coverage between 2021 and 2022, with most focus on the Longhu District. Output remained elevated through 2022 (n = 4) before declining in 2023 (n = 1) and rebounding in 2024 (n = 3), reflecting a cyclical resource-allocation pattern aligned with school-term planning described in the Methodology section.

1.3 Outcome Evaluation of the Team Building Process

Table 4. Numbers of total visits, first-visits, and re-visits of ADHD patients at the Outpatient Clinic of Shantou University Mental Health Center (2018 – 2024)

Year	First-Visit	Re-Visit	Total Visit	6 – 12y first visit
2018	54	142	196	45
2019	74	402	476	60
2020	75	338	413	52
2021	174	680	854	128
2022	153	918	1071	117
2023	209	567	776	110
2024	221	976	1197	126

Note. This table summarizes changes in ADHD outpatient visit volumes to STUMHC outpatient clinic from 2018 (before the team-building process) through 2024, when the team-building initiative matured and was operating continuously. As the local ADHD service network matured through phased team building, STUMHC recorded a steady, long-term rise in total, first-time, and follow-up visits, as well as those who were aged between 6 and 12: from 54, 142, 196 and 45 in 2018 to 221, 976, 1,197 and 126 in 2024. A transient drop occurred in 2020 (COVID-19 lock-downs), followed by an acute rebound in 2021 (delayed presentations). These patterns collectively evidence the enduring impact and success of the capacity-building initiative.

Table 5. Analysis of Outpatient First-visitors of ADHD Age 6 – 12 years old at STUMHC from 2018 to 2024

		2018	2019	2020	2021	2022	2023	2024
First-visitor (Number)		45	60	52	128	117	110	126
Gender (Male%)		95.56	91.67	82.69	92.19	88.03	79.09	72.20
Age (Year)		8.53±1.95	8.40±1.90	8.58±1.75	9.21±1.58	8.76±1.85	8.52±1.75	8.58±1.72
Resid- -ence	Longhu, Shantou	9 (20%)	9 (15.5%)	9 (17.3%)	14 (10.9%)	22 (18.8%)	19 (17.3%)	33 (26.19%)
	Jinping, Shantou	18 (40%)	20 (34.5%)	9 (17.3%)	19 (14.8%)	22 (18.8%)	18 (16.4%)	21 (16.17%)
	Chaoyang, Shantou	2 (4.4%)	4 (6.9%)	6 (11.5%)	14 (10.9%)	13 (11.1%)	13 (11.8%)	13 (10.32%)
	Chaonan, Shantou	1 (2.2%)	2 (3.4%)	3 (5.8%)	14 (10.9%)	6 (5.1%)	10 (8.3%)	8 (6.35%)
	Chenghai, Shantou	5 (11.1%)	10 (17.2%)	6 (11.5%)	16 (12.5%)	15 (12.8%)	13 (11.8%)	9 (7.14%)
	Haojiang,	1 (2.2%)	0	2 (3.8%)	5 (3.9%)	3 (2.6%)	3 (2.7%)	2 (1.59%)

	Shantou							
	Nanao, Shantou	0	0	1 (1.9%)	0	1 (0.9%)	0	0
	Other cities within Guangdong	9 (20%)	10 (17.2%)	14 (26.9%)	44 (34.4%)	28 (23.9%)	30 (27.3%)	33 (26.19%)
	Other Provinces	0	3 (5.2%)	2 (3.8%)	2 (1.6%)	7 (6.0%)	4 (3.6%)	7 (5.56%)

Note. This table presents the number and demographic characteristics of first-time outpatient visits for ADHD among children aged 6–12 years at STUMHC from 2018 to 2024. Age is reported as mean $\pm$ standard deviation, with values ranging from 8.52 to 9.21 years across years. The proportion of male first-visitors remained consistently high (72.20%–95.56%), reflecting the well-documented male predominance in ADHD clinical referrals. Residency data shows a notable increase in first-visitors from other cities within the region, rising from 20.0% (9/45) in 2018 to 26.19% (33/126) in 2024, indicating expanding service reach beyond the immediate Shantou districts. Among Shantou districts, Longhu, Jinping, and Chaoyang consistently accounted for the largest shares of local first-visitors. Percentages for each residency category are calculated relative to the total number of first-visitors in the corresponding year.

Table 6. Pathways of awareness regarding the STUMHC service among families of the first-time ADHD outpatient visitors (by number) according to the results of follow-up surveys (2021 – 2024)

Pathways	2021	2022	2023	2024
Clinician Referrals	4	8	8	9
School Teacher Recommendations	4	7	9	8
Friends/Families Recommendations	36	25	31	29
Media/Internet	11	8	6	8
Other Rescores	1	1	2	1

Note. This table presents the number of first-time ADHD outpatient visitors at STUMHC (2021–2024) by the primary pathways through which their families became aware of the clinic’s services. Across all years, friends/families recommendations consistently represented the most common pathway, accounting for the largest proportion of referrals (e.g., 75.0% in 2021, 48.4% in 2022), indicating that interpersonal, community-based networks remain the dominant source of service awareness. By contrast, clinician referrals and school teacher recommendations showed modest growth over time, suggesting incremental improvements in formal care coordination between medical and educational systems. Media/internet referrals declined slightly from 2021 to 2023 before stabilizing in 2024, while “Other Rescores” remained a negligible pathway throughout the

study period. These trends highlight the critical role of social networks in driving service uptake, as well as the potential for targeted outreach to strengthen formal referral pathways in future service expansion.

Table 7. Distribution and Proportion of Residences of STUMHC ADHD Outpatient First-visitors from Shantou (2018 – 2024)

	2018	2019	2020	2021	2022	2023	2024
Longhu	9 (25%)	9 (20.00%)	9 (25.00%)	14 (17.07%)	22 (26.83%)	19 (25.00%)	33 (38.37%)
Jinping	18 (50%)	20 (44.44%)	9 (25.00%)	19 (23.17%)	22 (26.83%)	18 (23.68%)	21 (24.42%)
Chaoyang	2 (5.56%)	4 (8.89%)	6 (16.67%)	14 (17.07%)	13 (15.85%)	13 (17.11%)	13 (15.12%)
Chaonan	1 (2.78%)	2 (4.44%)	3 (8.33%)	14 (17.07%)	6 (7.32%)	10 (13.16%)	8 (9.30%)
Chenghai	5 (13.89%)	10 (22.22%)	6 (16.67%)	16 (19.51%)	15 (18.29%)	13 (17.11%)	9 (10.47%)
Haojiang	1 (2.78%)	0 (0%)	2 (5.56%)	5 (6.10%)	3 (3.66%)	3 (3.95%)	2 (2.33%)
Nanao	0 (0%)	0 (0%)	1 (2.78%)	0 (0%)	1 (1.22%)	0 (0%)	0 (0%)

This table presents the absolute number and proportional distribution of first-time ADHD outpatient visitors at STUMHC (2.g., 38.37% in 2024), while Jinping remained the second-largest contributor (e.g., 24.42% in 2024). Districts like Chaoyang, Chenghai, and Chaonan showed gradual increases in their share of visitors, particularly after 2021, suggesting improved service accessibility across suburban and rural areas. By contrast, Haojiang and Nanao consistently accounted for the smallest proportions of local first-visitors, indicating persistent geographic disparities in service utilization. Percentages for each district are calculated relative to the total number of first-time visitors from Shantou in the corresponding year.

**Table 8-1. Economic cost for ADHD outpatient visitors in STUMUC (2018
– 2024)**

Year	Total Cost (CNY)	Total Visits	Cost per Visit (CNY)	Annual cost per person* (CNY)
2018	110,314.65	196	562.83	6,753.96
2019	253,106.44	476	531.74	6,380.83
2020	273,402.78	413	661.99	7,943.91
2021	541,183.34	854	633.70	7,604.45
2022	808,762.80	1071	755.15	9,061.77
2023	823,622.85	776	1061.37	12,736.44
2024	695,927.50	1197	581.39	6,976.72

The "annual cost per person" is calculated as 12 visits per person per year (1 visit each month). These tables present the economic costs associated with ADHD outpatient services at STUMHC from 2018 to 2024, including total annual costs, total visits, cost per visit, and annual cost per person (in Chinese Yuan, CNY). Table 8-1 reports costs for all ADHD outpatient visitors, while Table 8-2 focuses specifically on the subgroup of children aged 6–12 years. Across both tables, total costs and service utilization generally increased from 2018 to 2023, reflecting the growing demand for ADHD care. Cost per visit and annual cost per person also trended upward during this period, peaking in 2023 (e.g., 1,061.37 CNY per visit and 12,736.44 CNY per person in Table 8-1; 798.75 CNY per visit and 9,584.99 CNY per person

in Table 8-2). Notably, a substantial reduction in both cost metrics was observed in 2024 for both the overall sample and the 6-12-year-old subgroup. This decline can be attributed to the large-scale clinical adoption of domestic generic medications replacing imported alternatives, as well as expanded insurance coverage for psychological therapy services, which collectively reduced the financial burden for patients accessing ADHD outpatient care.

2. Psycho-Assessment Tools for Treatment Efficacy of School-age Children with ADHD

2.1 ADHD Diagnostic Scale-Parent Version (ADHDDS-P)

The ADHD Diagnostic Scale-Parent Version (ADHDDS-P) was developed by the Institute of Mental Health at The Second Xiangya Hospital of Central South University, in collaboration with 12 institutions across China, based on the DSM-IV 18 symptom criteria of ADHD. It is a scale presenting in Chinese, to be completed by parents, with scores reflecting the severity of core ADHD clinical symptoms in children as parents' observation. The scale underwent nationwide norming and reliability testing in 2006 and can be used for the auxiliary diagnosis of ADHD in Chinese children^{93, 123, 142, 143}. In this study, the ADHDDS-P was used before treatment started and 6 months after treatment. By comparing the before and after treatment assessments, the study evaluated the changes in the severity of core ADHD symptoms after 6 months of treatment.

2.2 Conners' Behavior Rating Scales (CBRS) (Chinese version)

The Conners' Behavior Rating Scales (CBRS) (Chinese version) is a

standardized parent-report instrument designed for assessing behavioral problems in children aged 3–17 years. It has been demonstrated satisfactory screening and tracking properties for ADHD symptoms—especially externalizing behaviors. The scale comprises 48 items loading on 5 sub-scales: study problems, conduct problems, psychosomatic problems, impulsive-hyperactive problems, anxiety, and a hyperactivity index. Each item is rated on a 4-point severity scale (0 = not at all, 1 = just a little / occasionally, 2 = often/moderately severe, 3 = very often/very severe); sub-scale scores are computed by averaging the item responses within each factor. The CBRS exhibits strong psychometric properties and is used worldwide for clinical screening and treatment-outcome monitoring of ADHD ^{93, 123}.

2.3 Integrated Visual and Auditory Continuous Performance Test (IVA-CPT)

The IVA-CPT is a psychological test that helps evaluate both visual and auditory attention and response control functioning. Briefly, subjects will be seated in front of a computer monitor about 40–50 cm away from the screen. The center of the monitor is 3 – 5 cm below eye level. A two-button ergonomic mouse will be placed in front of the computer screen, and the left button will be used to record responses. The subject's arm will be allowed to rest on the table in a comfortable position. The visual stimuli (1 or 2) will be green in color, 4 cm high, and will be presented for 167 ms inside a rectangle positioned in the middle of the computer screen. The auditory stimuli (1 or 2) will be presented with headphones attached to the computer and lasted for 500 ms. The rectangle on the computer screen will be

blank during auditory presentation. The response result of each stimulus will be saved on the computer for analysis. During analysis, IVA raw score variables for subjects in both groups will be converted to standard scores ($M = 100$ and $S.D. = 15$) based upon the normative data from the IVA. The participant's ability to concentrate is evaluated through three indices: Integrated Attention Quotient (IAQ), Integrated Control Quotient (ICQ), and Hyperactivity Quotient (HQ)^{93, 125, 144}. The test is used routinely in the STUMHC clinical practice.

2.4 Family Environment Scale (FES)

The Family Environment Scale (FES) was developed by Moss et al. in 1981 as a self-report inventory designed to describe family characteristics and functioning under both normal and crisis conditions, to evaluate changes in the family environment following interventions, and to compare the family environment with other aspects of family life. The scale comprises 90 true–false items distributed across three dimensions: 1) relationship (cohesion, expressiveness, conflict, and organization), 2) personal growth (intellectual-cultural and active-recreational orientation), and 3) system maintenance (achievement orientation, organization, and control). These dimensions yield scores on 10 family-environment characteristics: 1) Cohesion—the degree to which family members are committed to, help, and support one another; 2) Expressiveness—the extent to which family members are encouraged to act openly and to express their feelings directly; 3) Conflict—the amount of openly expressed anger, aggression, and conflict among family members; 4) Independence—the extent to which family members are

assertive, self-sufficient, and make their own decisions; 5) Achievement orientation—the extent to which activities (such as school or work) are cast into an achievement or competitive framework; 6) Intellectual-cultural orientation—the level of interest in political, social, intellectual, and cultural activities; 7) Active-recreational orientation—the extent of participation in social and recreational activities; 8) Moral-religious emphasis—the emphasis on ethical and religious values and beliefs; 9) Organization—the degree of organization and structure in planning family activities and responsibilities; 10) Control—the extent to which family life is guided by fixed rules and procedures^{93, 123}.

In the present study, we used the third edition of the Chinese version of the FES (FES-CV), translated and revised by Dinghui Zou and Lipeng Fei in 1991. Its psychometric properties were evaluated, showing that the overall Cronbach's α was 0.860, and the dimension-specific α coefficients were 0.427, 0.614, 0.459, 0.344, 0.650, 0.225, and 0.695, respectively. These values indicated acceptable internal consistency for the total scale, with comparable higher reliability for the sub-scales of cohesion, conflict, intellectual-cultural orientation, active-recreational orientation, and organization, moderate reliability for the sub-scales of achievement orientation, active-recreational orientation, and control, but poor reliability for the independence and moral-religious emphasis sub-scales. The poor reliability was likely due to cultural inappropriateness of some items. Interpretations should therefore be made in conjunction with the clinical context^{94, 123}.

3. Informed Consent Form

知情同意书

改进中国 ADHD 儿童精神卫生服务模式的研究

您好，我是汕头大学精神卫生中心的李艾医师，也是加拿大曼尼托巴大学的在读博士生，我正在开展一项关于改进中国 ADHD 儿童精神卫生服务模式的研究，若您和您的孩子有意参与本项目，请详细阅读以下信息。感谢您对本项目的关注！

一、研究项目简介

注意缺陷多动障碍（Attention Deficit Disorder with Hyperactivity, ADHD）是儿童期最常见的神经发育障碍，主要表现为与年龄发育不相称的多动，冲动行为和注意力持续性和集中困难，提高了家长的养育难度。本项目旨在通过学习加拿大曼尼托巴先进有效的 ADHD 精神卫生服务模式，结合汕头本地情况，改进我国的 ADHD 儿童精神卫生服务模式。我们希望通过本项目，能及时有效地帮助这些孩子们，让他们能更好地适应学校，更好与同伴和家人相处，更好地学习和生活。

二、参加条件

- 1) 6-12 岁儿童，性别不限；
- 2) 经儿童精神科医生诊断为 ADHD；
- 3) 学生无重大躯体疾病、重性精神疾病、智力障碍和孤独谱系障碍；其家长无未经治疗的严重精神病性障碍、近期经历严重家庭应激事件；
- 4) 学生家长/或其监护人知情同意，愿意遵循研究方案并同意接受诊疗。

三、研究过程

- 1) 入组儿童将接受为期 6 个月的 ADHD 治疗；
- 2) 入组儿童在治疗开始和结束时将进行下列测试：**Conners** 儿童行为量表、注意力缺陷多动障碍诊断量表—家长版(ADHDDS -P)、家庭环境量表(FES-CV)、视听整合持续性操作测验(IVA-CPT)，用于评定患儿的病情严重程度，评估其治疗效果。

四、自愿参加

您是在完全自愿的情况下参加本项研究的。您有权拒绝参加，也有权在研究过程中任何时候退出，绝不会影响您和医务人员的关系及今后的诊治。如果您决定退出此项研究，请与研究人员联系。

五、终止研究

如果您在参加研究的过程中出现了不良事件，或者您的一些情况变化超出了入选条件，研究人员也可在任何时候终止此项研究。

六、研究可能的风险

该研究未对患者造成额外的医疗损伤。通过该研究，ADHD 儿童可以获得专业人员规范化的治疗干预，家长可以获得专业的育儿指导。在治疗全程工作人员都会遵循 ADHD 诊疗原则，保障治疗的规范。

七、可能的利益

您可以从该研究的免费访谈、精神检查以及相关的心理测验中获得有关孩子及家长心理健康状况的信息，获得相关的资讯与服务。

八、保密

您参加研究及在研究中的个人资料均属保密，档案将妥善保存，仅供研究人员查阅且资料仅限于科学研究使用。

九、联系人及联系方式：

如果您本人对此项研究有任何疑问，可直接与汕头大学精神卫生中心李艾医生联系，联系电话：0754-88900598。

知情同意书签字处

作为参加者的法定监护人及参加者，我已阅读上述信息并理解该研究的目的以及参加该研究所带来的潜在益处。我对研究程序、研究内容提出的所有问题均已得到令我满意的答复。我自愿签署这份知情同意书，并自愿参加这项研究。

参加者签字：_____

参加者的法定监护人签字：_____ 联系电话：_____

日期：_____

我们已经向研究对象及其监护人宣读和解释了这份知情同意书，并且回答了他/她所提出的所有问题。他/她本人及其监护人也已经理解并同意参加此项科学研究。

研究者签字：_____ 日期：_____

Informed Consent Form

Study on Improving the Mental Health Service Model for Children with ADHD in China

Hello, I am Dr. Li Ai from the Mental Health Center of Shantou University, and also a Ph.D. student at the University of Manitoba, Canada. I am currently conducting a study on improving the mental health service model for children with ADHD in China. If you and your child are interested in participating in this study, please read the following information carefully. Thank you for your attention to this study!

I. Introduction to the Research Project

Attention Deficit Hyperactivity Disorder (ADHD) is the most common neurodevelopmental disorder in childhood. It is mainly characterized by hyperactivity, impulsive behavior, and difficulties with sustained attention and concentration that are inconsistent with the child's developmental age, which increases the difficulty of parenting. This project aims to improve the mental health service model for children with ADHD in China by learning from the advanced and effective ADHD mental health service model in Manitoba, Canada, and adapting it to the local context of Shantou. Through this project, we hope to provide timely and effective help to these children, enabling them to better adapt to school, interact with peers and family, and improve their learning and daily living.

II. Participation Criteria

- 1) Children aged 6 – 12 years, regardless of gender;
- 2) Diagnosed with ADHD by a child psychiatrist;
- 3) The child has no major physical illness, serious mental illness, intellectual disability, or autism spectrum disorder; the parent has no untreated severe psychotic disorder or recent severe family stressors;
- 4) The parent/legal guardian of the child provides informed consent, agrees to follow the study protocol, and consents to receiving diagnosis and treatment.

III. Study Process

- 1) Enrolled children will receive ADHD treatment for a period of 6 months;
- 2) Enrolled children will undergo the following assessments at the beginning and end of treatment: Conners Parent Rating Scale, Attention Deficit Hyperactivity Disorder Diagnostic Scale-Parent Version (ADHDDS-P), Family Environment Scale-Chinese Version (FES-CV), and Integrated Visual and Auditory Continuous Performance Test (IVA-CPT). These will be used to evaluate the severity of the child's condition and assess the treatment outcomes.

IV. Voluntary Participation

You are participating in this study entirely voluntarily. You have the right to refuse participation, and you also have the right to withdraw at any time during the study without affecting your relationship with medical staff or future medical care. If you decide to withdraw from this study, please contact the researcher.

V. Termination of the Study

If you experience any adverse events during the study, or if some of your

circumstances change such that you no longer meet the inclusion criteria, the researcher may also terminate your participation at any time.

VI. Possible Risks of the Study

This study does not cause additional medical harm to patients. Through this study, children with ADHD can receive standardized professional treatment interventions, and parents can receive professional parenting guidance. Throughout the treatment, staff will follow ADHD diagnosis and treatment principles to ensure standardized care.

VII. Possible Benefits

You may obtain information about your child's and your own mental health status, as well as related information and services, from the free interviews, mental status examinations, and related psychological assessments provided by this study.

VIII. Confidentiality

Your participation in this study and your personal information will be kept confidential. The records will be properly stored and will only be accessible to researchers for scientific research purposes.

IX. Contact Information

If you have any questions about this study, you may directly contact Dr. Li Ai at the Mental Health Center of Shantou University. Contact number: 0754-88900598.

Informed Consent Signature Page

As the legal guardian and the participant, I have read the above information and

understand the purpose of this study and the potential benefits of participating. All my questions regarding the study procedures and content have been answered to my satisfaction. I voluntarily sign this informed consent form and voluntarily agree to participate in this study.

Participant signature: _____

Legal guardian of participant signature: _____

Contact number: _____

Date: _____

We have read and explained this informed consent form to the study subject and their legal guardian, and have answered all questions they raised. The subject and their legal guardian have understood and agreed to participate in this scientific research.

Researcher signature: _____ Date: _____