



Research article

Knowledge, attitude, and practice toward total neoadjuvant therapy for rectal cancer among oncologists in China: A survey study

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ABSTRACT

This cross-sectional survey study aimed to explore the knowledge, attitude, and practice (KAP) toward total neoadjuvant therapy (TNT) for rectal cancer (RC) among specialists in Hainan Province, China. RC specialists working in Hainan Province (China) were enrolled in this cross-sectional study between March and June 2023. A self-designed questionnaire was used to collect the participants' characteristics and KAP toward TNT for RC. A total of 279 valid questionnaires were collected. The KAP scores were 15.91 ± 6.02 (possible range: 0–24), 34.16 ± 5.11 (possible range: 10–50), and 12.42 ± 1.83 (possible range: 3–15), respectively. The KAP scores of specialists who had applied TNT in clinical practice or research and had evaluated RC patients treated with TNT were significantly higher than those who had not (all $P < 0.05$). The structural equation model showed that knowledge of TNT directly affected attitude ($\beta = 0.292$, $P = 0.007$) and practice ($\beta = 0.912$, $P = 0.007$), and attitude toward TNT also had a direct effect on practice ($\beta = 1.047$, $P = 0.008$). In conclusion, RC specialists in Hainan (China) had inadequate knowledge, negative attitudes, and sufficient practice toward TNT in Hainan Province, China. It is necessary to enhance education for RC specialists to improve their knowledge and attitude toward TNT.

1. Introduction

Colorectal cancer is the third most common cancer and the second cause of cancer-related death globally, with rectal cancer (RC) accounting for 732,210 new cases and 339,022 deaths annually [1]. Multimodality treatment strategy improved the outcomes of patients with locally advanced RC (LARC) [2,3], but the prognosis of RC remains relatively poor. Total neoadjuvant therapy (TNT) is a therapeutic strategy that combines chemotherapy with chemoradiotherapy (CRT) before surgery and can be effective in selected patients [4], including for LARC [5]. Still, the use of TNT for RC is not unanimous among physicians. TNT offers various advantages for patients with RC, such as enhancing patients' compliance with planned therapy, downstaging tumor stage, addressing possible micrometastases through timely introduction of optimal systemic chemotherapy, and facilitating in-vivo assessment of chemosensitivity [6]. On the other hand, there are certain controversies associated with TNT, including treatment resistance due to inflammatory fibroblasts [7–9], increased perioperative adverse effects, disputable strategies to assess treatment response, and unclear long-term effects on disease recurrence and overall survival [10,11].

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A practice survey on the treatment of LARC conducted among radiation oncologists, medical oncologists, and colorectal surgeons in the United States of America (USA) found that TNT is widely adopted for node-positive LARC [12]. In contrast, a survey from France revealed divergence among physicians in choosing the optimal neoadjuvant therapy regimen for RC [13]. The practice patterns of Chinese specialists regarding TNT for RC are still unknown.

The knowledge, attitude, and practice (KAP) theory is a widely used model to elucidate how individual knowledge and beliefs shape healthcare behavior. The KAP theory argues that changes in human behavior can be divided into three continuous processes, i.e., acquiring knowledge, producing beliefs, and forming behaviors [14]. Still, the data on specialists' knowledge or perceptions toward TNT for RC are limited, as previous attitude surveys mainly focused on investigating specialists' beliefs toward the "watch-and-wait" strategies after a complete clinical response to CRT in RC treatment [15,16].

Therefore, this study aimed to explore the KAP toward TNT for RC specialists in Hainan Province, China.

2. Methods

2.1. Study design and specialists

Specialists in Hainan Province, China, were enrolled in this cross-sectional study between March and June 2023. The inclusion criteria were 1) RC specialists working in healthcare facilities in Hainan Province, China, 2) clinical practice specialists, and 3) specialists directly involved in the diagnosis and treatment of patients with colorectal cancer. The exclusion criteria were 1) specialists unfamiliar with TNT for RC or 2) specialists working in a private hospital. The study was approved by the Medical Ethics Committee of Hainan General Hospital (# Yilunyan [2023]18). Written informed consent was obtained from the participants.

2.2. Questionnaire and data collection

Clinical guidelines and previous studies were consulted when designing the self-administered questionnaire [3,17]. A pre-test (n = 81) was conducted; Cronbach's α was 0.932, indicating good internal consistency.

The final questionnaire included 36 items across four dimensions. Ten items addressed the basic characteristics. The KAP dimensions consisted of 12, 10, and four items, respectively. For the knowledge dimension, 2 points, 1 point, and 0 points were assigned for "well known", "partly known", and "unknown", with a score ranging from 0 to 24 points. The attitude dimension involved 10 questions, scored on a 5-point Likert scale ranging from strongly agree (5 points) to strongly disagree (1 point) in items A1, A2, A7, and A10; the remaining items were reverse-scored. The score range was 6–30 points. The practice dimension included four questions, which were also scored on a 5-point Likert scale ranging from very positive attitude/practice (5 points) to very negative attitude/practice (1 point). Item P4 investigated the information sources of learning about TNT and was used for descriptive analysis only.

RC specialists were recruited using a convenient sampling method through WeChat groups and face-to-face department interaction. Questionnaire Star was used to distribute the online questionnaire to the participants (<https://www.wjx.cn/>). At the beginning of the questionnaire, the participants had to click the option "I agree to participate in this study" before they could answer the questions. All data were collected anonymously. In order to avoid repetition, IP restriction was applied, thus making sure that the survey could only be completed once from a single IP address. The main investigator was responsible for answering specialists' questions on time. All questionnaires were checked for completeness, internal coherence, and reasonableness. If the same option was selected for all items in the questionnaire, the questionnaire was considered invalid and excluded from the analysis. A total score of each dimension ≥ 70 % was defined as adequate knowledge, positive attitude, and proactive practice [18].

2.3. Sample size

The sample size should ideally be at least 10 times the number of predictors [19]. With 26 independent variables in this questionnaire, the minimum sample size required would be 260. Accounting for a 20 % non-response rate, the final required sample size was 325.

2.4. Statistical analysis

Stata 17.0 (Stata Corporation, College Station, TX, USA) was used for statistical analysis. Continuous variables were described as mean \pm standard deviation (SD) and compared using the student's t-test or one-way analysis of variance (ANOVA). Categorical variables were expressed as n (%). The Pearson correlation analysis was used to analyze the correlation between KAP dimensions. Structural equation modeling (SEM) was used to test the following hypotheses: 1) knowledge had an impact on attitude, 2) knowledge had an impact on practice, and 3) attitude had an impact on practice. SEM was performed using AMOS 24.0 (IBM, NY, USA). A two-sided $P < 0.05$ was considered statistically significant.

3. Results

Among 330 collected questionnaires, 40 were excluded as the participants had never heard of TNT, according to their answers to item K1. Eleven questionnaires were excluded because the same option was selected for all items in the questionnaires. Finally, 279 valid questionnaires were included, resulting in an effective questionnaire rate of 84.55 %. Among the 279 participants, 61.65 % were

male, 48.03 % were aged 30–39 years, 45.16 % worked in the Radiology Department, 51.97 % had >10 years of clinical work experience, 55.91 % had applied TNT in clinical practice or research, and 64.16 % specialists had evaluated RC patients treated with TNT (Table 1).

The KAP scores were 15.91 ± 6.02 , 34.16 ± 5.11 , and 12.42 ± 1.83 , respectively. The KAP scores of the participants who had applied TNT in clinical practice or research (knowledge: 19.45 ± 4.10 vs. 11.43 ± 4.99 ; attitude: 35.67 ± 5.32 vs. 32.24 ± 4.12 ; practice: 13.03 ± 1.53 vs. 11.64 ± 1.90 ; all $P < 0.001$) and who had evaluated RC patients treated with TNT (knowledge: 18.65 ± 4.62 vs. 11.02 ± 5.06 ; attitude: 35.36 ± 5.29 vs. 32.01 ± 3.98 ; practice: 12.94 ± 1.57 vs. 11.48 ± 1.90 ; all $P < 0.001$) were significantly higher compared to those who had not (Table 1).

In the knowledge dimension, the top three items the participants were well familiar with included: “adjuvant chemotherapy, radiotherapy, and chemoradiotherapy have been used before surgery for cancer treatment in some clinical studies, which is called TNT”, “TNT is recommended for stage II-III rectal cancer by the Clinical Practice Guidelines in Oncology, NCCN”, and “TNT may be used to address occult micro-metastases at an earlier stage than traditional therapy”. However, 29 (10.39 %) specialists had never heard of the following: “TNT modality: adding consolidation chemotherapy after CRT”, “TNT may result in a longer preoperative treatment period for patients and may increase the risk of perioperative adverse events”, and “for patients who achieve complete clinicopathological remission after TNT treatment, it is possible to adopt the Watch-and-Wait strategy and avoid surgery” (Table 2).

Considering the attitude, 239 (85.66 %) specialists believed that “TNT is a promising treatment modality for rectal cancer”. They agreed or strongly agreed with the use of TNT for the treatment of stage II-III rectal cancer, 233 (83.51 %) were willing to conduct research related to TNT for RC, and 227 (81.36 %) agreed or strongly agreed that “TNT is a beneficial therapeutic option for patients with stage II-III rectal cancer.” Nearly half of the specialists (149, 53.41 %) held a neutral attitude toward the overtreatment of TNT. In contrast, some specialists did not support the use of TNT as they believed that: “the long-term impact of TNT is still unclear” (91, 32.62

Table 1
Characteristics and KAP of RC specialists.

Variables	N (%)	Knowledge score		Attitude score		Practice score	
		Mean \pm SD	P	Mean \pm SD	P	Mean \pm SD	P
Total	279	15.91 \pm 6.02		34.16 \pm 5.11		12.42 \pm 1.83	
Gender			0.290		0.014		0.694
Male	172 (61.65)	16.22 \pm 5.91		33.56 \pm 5.23		12.45 \pm 1.85	
Female	107 (38.35)	15.43 \pm 6.18		35.11 \pm 4.79		12.36 \pm 1.81	
Age, years			<0.001		<0.001		0.017
[22, 30)	54 (19.35)	12.93 \pm 5.70		31.70 \pm 4.66		12.15 \pm 2.02	
[30, 40)	134 (48.03)	15.02 \pm 6.08		34.13 \pm 5.22		12.22 \pm 1.87	
[40, 65]	91 (32.62)	19.00 \pm 4.68		35.66 \pm 4.67		12.87 \pm 1.58	
Education			<0.001		<0.001		<0.001
Junior college/Undergraduate	147 (52.69)	14.03 \pm 6.06		32.41 \pm 4.82		12.12 \pm 1.98	
Master	99 (35.48)	17.29 \pm 5.77		35.39 \pm 5.09		12.53 \pm 1.69	
Doctor	33 (11.83)	20.15 \pm 2.21		38.24 \pm 2.35		13.45 \pm 1.00	
Type of institution			0.011		0.002		0.226
Public Primary	8 (2.87)	16.88 \pm 5.99		33.38 \pm 7.87		13.38 \pm 2.39	
Public Secondary	42 (15.05)	13.36 \pm 6.51		31.67 \pm 4.78		12.17 \pm 2.12	
Public Tertiary	229 (82.08)	16.35 \pm 5.83		34.64 \pm 4.94		12.43 \pm 1.75	
Department			<0.001		<0.001		<0.001
Gastrointestinal Surgery	79 (28.32)	19.65 \pm 3.53		35.51 \pm 5.00		13.15 \pm 1.40	
Medical Oncology	46 (16.49)	19.22 \pm 3.71		36.07 \pm 5.47		13.07 \pm 1.18	
Radiotherapy	17 (6.09)	17.71 \pm 6.04		34.12 \pm 5.27		12.47 \pm 2.18	
Radiology	126 (45.16)	12.60 \pm 5.95		32.70 \pm 4.64		11.86 \pm 1.07	
Endoscopy	7 (2.51)	10.86 \pm 2.61		34.43 \pm 4.54		10.25 \pm 1.71	
Pathology	4 (1.43)	9.75 \pm 4.03		31.25 \pm 5.56		10.25 \pm 1.70	
Professional title			<0.001		<0.001		0.061
Intermediate	117 (41.94)	15.78 \pm 5.60		34.49 \pm 5.28		12.39 \pm 1.81	
Junior and below	81 (29.03)	12.77 \pm 6.09		31.57 \pm 4.53		12.10 \pm 2.06	
Vice senior and above	81 (29.03)	19.26 \pm 4.68		36.27 \pm 4.30		12.78 \pm 1.57	
Years of clinical work experience			<0.001		<0.001		0.130
<1 year	12 (4.30)	10.50 \pm 4.54		31.92 \pm 3.50		11.50 \pm 1.57	
≥ 1 but <5 years	60 (21.51)	14.20 \pm 5.76		31.87 \pm 5.23		12.32 \pm 2.17	
≥ 5 but <10 years	62 (22.22)	14.26 \pm 6.57		33.98 \pm 4.98		12.23 \pm 1.80	
≥ 10 years	145 (51.97)	17.78 \pm 5.30		35.37 \pm 4.87		12.62 \pm 1.70	
Applying TNT in clinical practice or research			<0.001		<0.001		<0.001
No	123 (44.09)	11.43 \pm 4.99		32.24 \pm 4.12		11.64 \pm 1.90	
Yes	156 (55.91)	19.45 \pm 4.10		35.67 \pm 5.32		13.03 \pm 1.53	
Evaluating RC patients treated with TNT			<0.001		<0.001		<0.001
No	100 (35.84)	11.02 \pm 5.06		32.01 \pm 3.98		11.48 \pm 1.90	
Yes	179 (64.16)	18.65 \pm 4.62		35.36 \pm 5.29		12.94 \pm 1.57	
Attending academic conferences or training on TNT			<0.001		0.641		0.002
No	153 (54.84)	14.10 \pm 6.04		34.29 \pm 4.67		12.10 \pm 1.87	
Yes	126 (45.16)	18.11 \pm 5.23		34.00 \pm 5.62		12.80 \pm 1.72	

Abbreviations: TNT: total neoadjuvant therapy; RC: rectal cancer.

Table 2
Knowledge of physicians regarding TNT for rectal cancer.

Items	Know it well	Heard of it	Never heard of it
1. Have you heard of total neoadjuvant therapy (TNT) for rectal cancer?	144 (51.61)	135 (48.39)	0 (0)
2. In recent years, adjuvant chemotherapy, radiotherapy, and chemoradiotherapy have been used before surgery for cancer treatment in some clinical studies, which is called TNT. Do you know about it?	136 (48.75)	134 (48.03)	9 (3.23)
3. TNT is recommended for stage II-III rectal cancer by the Clinical Practice Guidelines in Oncology (2022 edition), NCCN (National Comprehensive Cancer Network).	124 (44.44)	132 (47.31)	23 (8.24)
4. Do you know about the following TNT modalities?			
4.1 Adding induction chemotherapy prior to preoperative chemoradiotherapy (CRT)	114 (40.86)	138 (49.46)	27 (9.68)
4.2 Adding consolidation chemotherapy after CRT	110 (39.43)	140 (50.18)	29 (10.39)
5. Current clinical studies on patients with locally progressive rectal cancer demonstrate that TNT can result in higher rates of complete remission and disease-free survival in patients; however, its long-term impact on disease recurrence and overall survival remains to be explored.	110 (39.43)	144 (51.61)	25 (8.96)
6. TNT may result in a longer preoperative treatment period for patients and increase the risk of perioperative adverse events.	114 (40.86)	136 (48.75)	29 (10.39)
7. TNT may address occult micrometastases at an earlier stage than traditional therapy.	116 (41.58)	140 (50.18)	23 (8.24)
8. For patients who achieve complete clinicopathological remission after TNT treatment, it is possible to take the Watch-and-Wait strategy and avoid surgery.	104 (37.28)	146 (52.33)	29 (10.39)
9. The identification of patients who are more likely to benefit from TNT and the efficacy assessment of TNT remains to be addressed.	98 (35.13)	153 (54.84)	28 (10.04)
10. The magnetic resonance tumor regression grading (mrTRG) established by pelvic magnetic resonance and its functional imaging has been widely used in clinical diagnosis of rectal cancer and the monitoring of treatment response, but some studies have found that mrTRG is poorly consistent with postoperative pathology and cannot be used as an efficacy assessment indicator.	110 (39.43)	142 (50.9)	27 (9.68)
11. Neoadjuvant rectal (NAR) score can be used as an independent predictor of disease-free survival, overall survival, distant metastasis-free survival, and local recurrence; however, some studies do not support the NAR score as a surrogate endpoint to assess the outcomes.	98 (35.13)	144 (51.61)	37 (13.26)

Abbreviations: TNT: total neoadjuvant therapy.

Table 3
Attitudes of physicians regarding TNT for rectal cancer.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. TNT is a promising treatment modality for rectal cancer.	141 (50.54)	98 (35.13)	38 (13.62)	2 (0.72)	0 (0)
2. You agree with the use of TNT for the treatment of stage II-III rectal cancer.	74 (26.52)	165 (59.14)	40 (14.34)	0 (0)	0 (0)
3. There is a risk of overtreatment in TNT for rectal cancer. Therefore, you do not support the use of TNT modality.	31 (11.11)	38 (13.62)	149 (53.41)	45 (16.13)	16 (5.73)
4. The decisions to recommend TNT for patients may be influenced by bed turnover, hospitalization rate, and surgery rate in the hospital.	35 (12.54)	153 (54.84)	74 (26.52)	14 (5.02)	3 (1.08)
5. Patients treated with TNT will have difficulty undergoing surgery. Therefore, you do not support the use of the TNT modality.	22 (7.89)	42 (15.05)	102 (36.56)	103 (36.92)	10 (3.58)
6. TNT can affect the immune status of the body and reduce the tolerance of patients to surgery. Therefore, you do not support the use of the TNT modality.	25 (8.96)	43 (15.41)	90 (32.26)	107 (38.35)	14 (5.02)
7. TNT is a beneficial therapeutic option for patients with stage II-III rectal cancer.	108 (38.71)	119 (42.65)	51 (18.28)	1 (0.36)	0 (0)
8. The long-term impact of TNT is still unclear. Therefore, TNT cannot be widely used in clinical practice at present.	28 (10.04)	63 (22.58)	88 (31.54)	92 (32.97)	8 (2.87)
9. The key to avoiding surgeries for patients with rectal cancer after TNT is how to evaluate the efficacy of TNT accurately. You believe TNT should not be implemented due to the lack of a standardized efficacy assessment protocol.	28 (10.04)	60 (21.51)	90 (32.26)	96 (34.41)	5 (1.79)
10. You are willing to conduct research related to TNT for rectal cancer.	71 (25.45)	162 (58.06)	45 (16.13)	1 (0.36)	0 (0)
Practice	Definitely	May be	Unsurely	May not/	Definitely not
1. If there are academic conferences or training programs on TNT, would you attend?	110 (39.43)	144 (51.61)	22 (7.89)	3 (1.08)	0 (0)
2. If you are involved in the management of a patient with stage II-III rectal cancer, would you recommend TNT for the patient?	74 (26.52)	150 (53.76)	53 (19)	2 (0.72)	0 (0)
3. You will proactively follow the research progress of TNT.	89 (31.9)	124 (44.44)	61 (21.86)	5 (1.79)	0 (0)

Abbreviations: TNT: total neoadjuvant therapy.

%), “TNT should not be implemented due to the lack of a standardized efficacy assessment protocol” (88, 31.54 %), “TNT can affect the immune status of the body and reduce the tolerance of patients to surgery” (68, 24.37 %), and “patients treated with TNT will have difficulty undergoing surgery” (64, 22.94 %) (Table 3).

Considering the practice toward TNT, 110 (39.43 %) participants claimed that they would definitely attend academic conferences or training programs on TNT, if possible. In comparison, 144 (51.61 %) reported that they might be interested in attending such events. A total of 74 (26.52 %) participants expressed that they would definitely recommend TNT for patients with stage II-III RC vs. 150 (53.76 %) who might recommend it. Eighty-nine (31.9 %) participants claimed that they would proactively follow the research progress of TNT (Table 3). Most participants learned about TNT through departmental studies/academic conferences/educational and training lectures (231, 82.80 %), scientific literature (195, 69.89 %), and multimedia (183, 65.59 %) (Supplementary Fig. 1).

Pearson’s correlation analysis revealed that the knowledge scores were positively correlated with the attitude ($r = 0.272$, $P < 0.001$) and practice ($r = 0.586$, $P < 0.001$) scores, and their attitude scores were positively correlated with the practice scores ($r = 0.273$, $P < 0.001$) (Supplementary Table 1). The SEM results showed that participants’ knowledge of TNT for RC directly and positively affected their attitudes ($\beta = 0.292$, $P = 0.007$) and practices towards TNT ($\beta = 0.912$, $P = 0.007$), while the attitudes towards TNT also directly and positively affected their practices ($\beta = 1.047$, $P = 0.008$). Besides, the specialists’ knowledge exerted an indirect effect on practice through attitudes ($\beta = 0.955$, $P = 0.006$) (Fig. 1).

4. Discussion

The present study revealed that RC specialists in Hainan Province, China, had inadequate knowledge, negative attitudes, and sufficient practice toward TNT for RC. These findings may provide data to inform future research.

Good knowledge of TNT can help RC specialists formulate and optimize TNT regimens for RC patients according to individual characteristics such as tumor stage and location [20–22]. However, although nearly half of the RC specialists in the present study claimed they were well familiar with the definition of TNT, the recommendations of TNT by the National Comprehensive Cancer Network (NCCN), and the advantages of TNT in addressing occult micro-metastases, a certain number of specialists have just heard of TNT and some specialists have never heard of the specific TNT regimen such as adding consolidation chemotherapy after CRT. As the first study that evaluated specialists’ knowledge of TNT for RC, the findings of the present study revealed the gap in the understanding of TNT as specialists were mainly uncertain of how to conduct a specific TNT regimen for RC, showing an urgent need to enhance the education and training of specialists towards TNT.

There have been some reported concerns about the risk of overtreatment with TNT for RC, as TNT should not be advocated for all RC patients [23,24]. The present study revealed a neutral attitude toward the problem of overtreatment held by most specialists. Although most specialists in this study believed that TNT is a promising option for RC, worries about the reduced tolerance of patients to surgery, the unclear long-term impact of TNT, and the lack of a standardized efficacy assessment protocol were present. These worries about the limitations of TNT might explain the fact that 53.76 % of specialists claimed they might not recommend TNT for LARC patients. The results also revealed sufficient practice toward TNT for RC among specialists in China. Similarly, in other practice surveys from Western countries, oncologists reported TNT to be widely adopted for LARC [25–27]. Although this survey does not represent all the specialists and oncologists, it can give some ideas about promoting TNT for patients with RC in China. In this study, specialists who had attended academic conferences or training had significantly higher knowledge and practice scores toward TNT, consistent with the results reported by Devon et al., arguing that surgeons and graduates with subspecialty training had better knowledge of RC care [28]. Therefore, specialists from different institutions should be given more opportunities to participate in academic conferences or training programs on TNT. Previous experience with related diseases and treatments is known to have a significantly positive effect on the specialists’ knowledge score [29].

In this study, about half of the specialists had experience in applying TNT or evaluating RC patients, and they showed significantly higher KAP toward TNT. Nonetheless, additional efforts are needed to improve the KAP of specialists without TNT experience.

4.1. Limitations

There were some limitations to the present study. First, the sample size was relatively small, and a multicenter, nationwide, large-sample study is needed. The study included a relatively small proportion of junior physicians, many of whom were residents and had limited cancer knowledge. Second, survey studies often suffer from a selection bias. The questionnaires were distributed to the physicians through a convenient sampling method, limiting the generalizability of the reported findings since only the physicians interested in participating completed the survey. Third, the questionnaire was designed by the investigators based on local practices, customs, and policies, limiting the exportability of the questionnaire and the generalizability of the results. Fourth, the questionnaire was self-reported, which might lead to social desirability bias in the participant responses, with some participants answering what they knew they should do instead of what they were doing. Fifthly, the study design was cross-sectional, preventing any analysis of causality. Sixthly, since all study variables were collected using the same questionnaire, a common method bias is possible. Finally, the present study was a survey performed using an unvalidated questionnaire, preventing the elaboration of a conceptual framework regarding TNT for RC. Future studies should examine the design of a formal validated questionnaire to address that issue.

In conclusion, specialists in Hainan Province, China, had inadequate knowledge and negative attitudes but sufficient practice toward TNT for RC. Consequently, it might be necessary to enhance specialists’ education to improve TNT knowledge and implementation. As TNT can benefit selected patients with RC, an appropriate KAP of TNT is necessary to propose TNT to adequate patients with RC, which could translate into better patient outcomes.

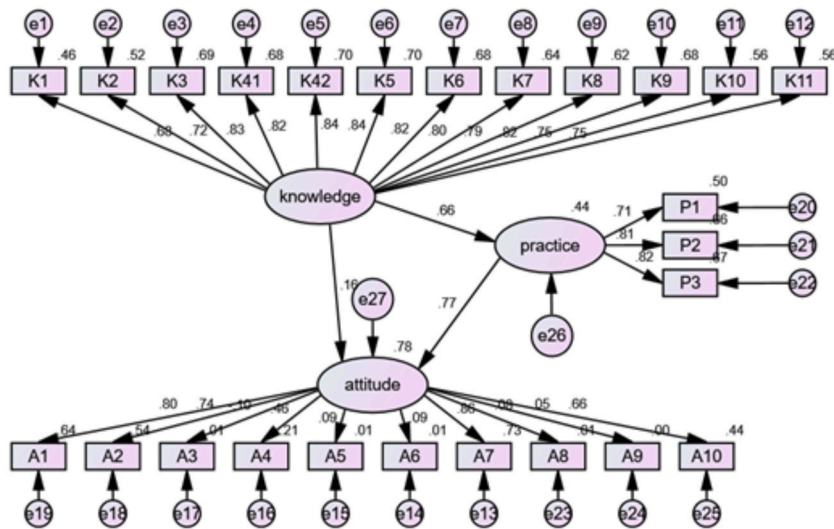


Fig. 1. The structural equation model of RC specialists' KAP.

Ethics approval and consent to participate

The study was approved by the Medical Ethics Committee of Hainan General Hospital (# Yilunyan [2023]18). Written informed consent was obtained from the participants.

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Data availability

The data underlying this article are available in the article and its online supplementary material. Data will be made available upon reasonable request to the corresponding author.

CRedit authorship contribution statement

Qinlei Cai: Writing – review & editing, Writing – original draft, Project administration, Methodology, Conceptualization. **Shanxi Guo:** Validation, Project administration, Data curation. **Fangxiang Fu:** Visualization, Software, Data curation. **Shishi Luo:** Validation, Resources, Data curation. **Wangsheng Chen:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Not applicable.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e32957>.

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